# *APPENDIX B*
# *FIELD SAMPLING AND ANALYSIS PLAN/QUALITY ASSURANCE QUALITY CONTROL PLAN*
*AECOM 2011*

AECOM

Environment

Submitted to:
PPG Industries
Allison Park, Pennsylvania

Submitted by:
AECOM
Piscataway, New Jersey
60149955.4013A
June 2010

# Field Sampling Plan / Quality Assurance Project Plan

## PPG Non-Residential and Residential Chromium Sites
## Hudson County, New Jersey

1 of 2

DRAFT

# FIELD SAMPLING PLAN / QUALITY ASSURANCE PROJECT PLAN
## Non-Residential and Residential Chromium Sites
## Hudson County, New Jersey

# FIELD SAMPLING PLAN / QUALITY ASSURANCE PROJECT PLAN
## Non-Residential and Residential Chromium Sites
## Hudson County, New Jersey

Prepared By: Mary O'Connell Kozik Date: ____________
Mary O'Connell Kozik

Reviewed By: ____________ Date: ____________
Scott H. Mikaelian

Approved By: Kathleen Whooley Date: ____________
QA Reviewer
Kathy Whooley

# Contents

# List of Tables

# List of Appendices

# 1.0 Introduction

## 1.1 Purpose

The Field Sampling Plan/Quality Assurance Project Plan (FSP/QAPP) for operations at the PPG Industries, Inc. (PPG) residential and non-residential chromium sites, including associated perimeter air monitoring, in Hudson County, New Jersey, was developed by AECOM Environment (AECOM) to comply with the New Jersey Department of Environmental Protection (NJDEP) quality assurance (QA) requirements for remedial investigations (RI). The purpose of the FSP/QAPP is to assure reliable monitoring data by serving as the instrument of control for field and analytical activities associated with the project. Stated or referenced within the FSP/QAPP are the analytical methods, sampling procedures, Quality Assurance policies, Quality Control (QC) criteria, and reporting requirements that must be followed by all prime and subcontractor personnel when carrying out their assigned responsibilities on the project.

This document is intended to be an organic document that is updated as required and will be modified as necessary during the performance of activities. This FSP/QAPP was prepared in accordance with the July 19, 1990 Administrative Consent Order (ACO) between the State of New Jersey and PPG Industries, Inc., and the NJDEP Technical Requirements for Site Remediation (New Jersey Administrative Code [N.J.A.C.] 7:26E-2.2 *et. seq*.). This FSP/QAPP will also be utilized during execution of the remedial activities related to the Judicial Consent Order (JCO) as filed on June 26, 2009.

The FSP/QAPP was prepared in accordance with the requirements and methods described in the NJDEP *Technical Requirements for Site Remediation* (N.J.A.C. 7:26E *et. seq.*, November 4, 2009, date last amended April 19, 2010), *Field Sampling Procedures Manual* (August, 2005, last updated April 30, 2009), *Alternative Ground Water Sampling Techniques* (July 1994), *Field Analysis Manual* (July 1994) and N.J.A.C. Chapter 9D *Well Construction, Maintenance, and Sealing of Abandoned Wells Drilling Regulations and Requirements* (April 2, 2007), as guidance. Remedial investigation results will be compared to New Jersey's *Remediation Standards* (N.J.A.C. 7:26D *et. seq*., November 2009) for soil delineation purposes for non-chromium compounds. The most stringent (non-residential) chromium soil cleanup criteria (CrSCC) of 20 mg/kg for hexavalent chromium, and the most stringent (residential) soil cleanup criteria of 120,000 mg/kg for trivalent chromium, will be utilized for soil delineation purposes pursuant to the *Chromium Soil Cleanup Criteria* (NJDEP, September 2008). Groundwater results will be compared to the *Ground Water Quality Standards* (N.J.A.C. 7:9C), last amended November 4, 2009.

The FSP/QAPP is the standard by which field and laboratory procedures must be performed and the standard against which activities will be audited. In the event that the FSP/QAPP must be changed to include a new procedure or modify an existing procedure, the procedure discussed in **Section 3.0** of the FSP/QAPP will be used to document the change.

## 1.2 Project Background

PPG Industries, Inc., owned and operated a chromate chemical production facility encompassing approximately 16.6 acres located on Garfield Avenue in the City of Jersey City, County of Hudson, New Jersey.

On or about September 1, 1963, PPG ceased operations at the chromate chemical production facility. These operations had resulted in the generation of chromate ore processing residue (COPR) that was distributed by third parties as fill material for use in certain construction and development projects in Hudson County, New Jersey.

The chromate ore processing residue was used for the backfilling of demolition sites, preparation for building foundations, construction of tank berms, roadway construction, the filling of wetlands and other construction and development-related purposes.

The JCO requires the investigation and if necessary, the remediation of chromate chemical production waste (CCPW) at residential properties within the vicinity of the PPG sites. Perimeter air monitoring will be conducted during various ground intrusive remedial phases at the Garfield Avenue site (PPG Site 114) for protection of residents and the community. The remaining PPG residential and non-residential chromium sites are designated by the ACO. This FSP/QAPP will augment the individual work plans and report submittals developed for on and off-site work.

## 1.3 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data needed to accomplish the project objectives. The design for each sampling program will be based on USEPA's DQO guidance (USEPA, 2000), a multi-step, iterative process that ensures that the type, quantity, and quality of environmental data used in decision-making is appropriate for its intended application. This process is summarized below:

- State the problem;
- Identify the decision;
- Identify inputs to the decision;
- Define the study boundaries;
- Develop a decision rule;
- Specify decision error limits; and
- Optimize the study design.

The field collection efforts at the non-residential sites will generate data to be used for a variety of purposes, including but not limited to site characterization, evaluation of alternatives, engineering design, risk assessment, and potential responsible party (PRP) determination. Therefore, the sampling and analysis programs incorporate the following QA elements:

- A sampling program designed to obtain sufficient data to determine levels of constituents in media of interest;

- The use of sample collection and handling procedures that will ensure the representativeness and integrity of the samples;
- An analytical program designed to generate definitive data of sufficient quality and sensitivity to meet the project objectives; and
- Data deliverables that will allow verification and validation of the data and reproducibility of the reported results.

## 1.4 Project Schedule

Project schedules for each site are site-specific and will be presented in the site-specific work plans or other individual report submittals for each site.

# 2.0 Project Organization

A Project Management Team has been established that consists of three primary classifications: the Principal-in-Charge, Project Managers, and the Field Operations Leader. Responsibilities of the management team, and supporting staff, are described in **Section 2.1**.

## 2.1 Management Responsibilities

The roles and responsibilities each for program position that will participate in projects associated with this FSP/QAPP are summarized below. Personnel assigned to these positions are provided in **Table 2-1**.

AECOM:

**Principal-In-Charge (PIC):** The Principal-in-Charge (PIC) works closely with PPG Industries, Inc. and is responsible for managing contractual agreements between AECOM and PPG. The PIC will also have the responsibility for reviewing major deliverables to ensure compliance with the FSP/QAPP requirements.

**Project Managers:** Project Managers (PMs) will be designated on a site-by-site basis and will be responsible for daily coordination of the project, management of the project team, and the overall success of the project. The Project Manager will review reports and all correspondence prior to submission, and will act as overall technical coordinator. The Project Manager will maintain budget and schedule; track invoices, purchase orders, subcontracts; and set project goals and objectives according to proposal and client-authorized changes as they arise.

**Field Operations Leader:** The Field Operations Leader (FOL) is directly responsible for sampling quality control. It is the FOL's responsibility to mobilize the proper equipment, ensure that sampling procedures are implemented properly, that field control samples are collected as required, maintain chain of custody, and complete the required documentation. The FOL has full authority over logistical aspects of sampling in the field and the authority to implement minor changes to sampling plans to accommodate field conditions.

**Site Supervisor:** The site supervisor has the overall responsibility and authority to direct work operations at the job site according to the work plans. The Site Supervisor may also serve as a Task Leader or other role.

**Task Leader:** Task Leaders have the responsibility for supervising subcontractors, and for overseeing the collection of soil and groundwater sampled. A geologist or hydrogeologist will be the Task Leader for drilling and well construction operations, and has the responsibility for supervising the drilling subcontractor during the collection of soil samples and grab-groundwater samples, and installation of monitoring wells, and for classifying soil samples in the field. The Task Leader will ensure that field engineering and geological data is in accordance with currently accepted professional standards and that wells are installed in accordance with the FSP/QAPP, work plans and other report submittals.

The Task Leader will have the direct responsibility to ensure that soil and groundwater sampling activities are performed in accordance with the FSP/QAPP, work plans and other report submittals. The task leader reports directly to and is supervised by the FOL. The task leader will communicate with the FOL and report any conditions that may require changes in field activities or procedures.

The Task Leader or another AECOM representative may be designated by the Site Safety Officer (SSO) to perform as the SSO's field representative, and will report directly to the SSO to ensure that procedures outlined in the Health and Safety Plan (HASP) are followed.

**Sampling and Health and Safety Technicians:** Sampling Technicians are responsible for implementing sampling procedures as described in the FSP/QAPP, work plans and other report submittals. Sampling Technicians do not have the authority to change the sampling plan. Sampling Technicians may also serve as Health and Safety (H&S) Technician, and will report directly to the SSO's representative to ensure that the proper H&S precautions are taken. There will be an H&S Technician on-site for all activities. The H&S technicians' responsibilities are further outlined in the site-specific HASP and work plans.

**Regional Safety, Health & Environment Manager (RSHEM):** The AECOM RSHEM is the individual responsible for the preparation, interpretation and modification of the Health and Safety Plans (HASPs) as needed and will serve as the primary Health and Safety resource for the program.

**Database Manager:** The Database Manager will be responsible for the development and management of the groundwater, soil, and geologic databases. Additional support by trained administrative staff will be available as needed.

**GIS Manager:** The GIS Manager will be responsible for maintaining the geographic information systems for the program, and directing the production of GIS drawings and data presentation.

**Data Validation Manager:** The Data Validation Manager will act as the data review supervisor.

**Project Quality Assurance Officer (QAO):** The QAO will be responsible for maintaining compliance with AECOM's internal and project specific standards and practices for Quality Assurance. The project QAO will maintain and implement the FSP/QAPP.

**Engineering Manager:** The Engineering Manager will manage and delegate tasks related to evaluation of remedial options and implementation of remedial actions.

**On-Site Health & Safety Coordinators:** Each of the Task Leaders identified in **Table 2-1** will be in charge of coordinating health and safety issues on site and maintaining health and safety documentation for the duration of time each is on-site. They will apprise the Field Operations Leader of matters regarding health and safety. However, decisions pertaining to health and safety will be the responsibility of the RSHEM, with input from the Site Safety Officer, Site Supervisor and Task Leaders, as appropriate. These personnel will be responsible for coordinating field staff, maintaining budget and schedule, as well as the development of detailed internal work plans and schedules. Each will be in charge of coordinating health and safety issues on-site and maintaining health and safety documentation during their time on-site.

PPG Industries, Inc.:

**Director, Environmental Affairs:** The PPG Director, Environmental Affair is responsible for overall contract execution and PPG program management.

**Project Manager, Environmental Remediation:** The PPG Project Managers are responsible for monitoring field activities, assisting in contract execution, management of individual site projects, and coordinating with various contractors on technical work execution.

NJDEP:

**Manager, Site Remediation:** The primary NJDEP representative is responsible for review and approval of submittals. JCO Team:

**JCO Site Administrator:** The Site Administrator is appointed by the Courts under the terms of the JCO and is responsible for establishing the Master Schedule, coordination of JCO activities, holding meetings with stakeholders, and hiring experts and consultants to assist him in JCO oversight, financial management of the JCO Fund, and other related tasks as dictated by the JCO.

**JCO Site Administrator Project Manager:** The Site Administrator Project Manager is responsible to assist the Site Administrator in his duties.

**Technical Consultant:** The Technical Consultant is hired by the Site Administrator under the terms of the JCO and provides technical support to the Site Administrator and NJDEP, and other tasks as dictated by the JCO.

**Table 2-1 Program Personnel**

| Title, Affiliation, Name | Address | Phone | Email |
|---|---|---|---|
| ***Principal-In-Charge (AECOM)*** | | | |
| Robert Falotico | 2 Technology Park Drive, Westford, MA 01886 | (978) 589-3183 | Robert.Falotico@aecom.com |
| ***Program Manager (AECOM)*** | | | |
| Scott Mikaelian | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3624 | Scott.Mikaelian@aecom.com |
| ***Project Managers (AECOM)*** | | | |
| Richard Feinberg | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3610 | Richard.Feinberg@aecom.com |

| Title, Affiliation, Name | Address | Phone | Email |
|---|---|---|---|
| Alfred LoPilato (non-Garfield Avenue sites) | Rusten Corporate Park, 100 Red Schoolhouse Rd, Suite B-1<br>Chestnut Ridge, NY 10977 | (845) 425-4980 | Alfred.LoPilato@aecom.com |
| Robert Cataldo (Garfield Avenue Group) | 2 Technology Park Drive<br>Westford, MA | (978) 589-3141 | Robert.Cataldo@aecom.com |
| Leo Gendron (Air Monitoring) | 2 Technology Park Drive<br>Westford, MA 01886 | (978) 589-3146 | Leo.Gendron@aecom.com |
| William Spronz | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3917 | Bill.Spronz@aecom.com |
| Hue Quan | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3631 | Hue.Quan@aecom.com |
| Richard Simun | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3636 | Richard.Simun@aecom.com |
| ***Field Operations Leader (AECOM)*** | | | |
| Richard Feinberg | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3610 | Richard.Feinberg@aecom.com |
| Richard Simun (Alternate) | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3636 | Richard.Simun@aecom.com |
| ***Task Leaders and Health and Safety Technicians (AECOM)*** | | | |
| Christine Basinski | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3603 | Christine.Basiniski@aecom.com |
| Megan Merdinger | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3622 | Megan.Merdinger@aecom.com |
| Julia Shackford | Rusten Corporate Park, 100 Red Schoolhouse Rd, Suite B-1<br>Chestnut Ridge, NY 10977 | (845) 425-4980 | Julia.Shackford@aecom.com |
| Steven Wright | Rusten Corporate Park, 100 Red Schoolhouse Rd, Suite B-1<br>Chestnut Ridge, NY 10977 | (978) 852-7620 | Stephen.E.Wright@aecom.com |

| Title, Affiliation, Name | Address | Phone | Email |
|---|---|---|---|
| Eric Acs<br>(Site Supervisor) | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3901 | Eric.Acs@aecom.com |
| Mark Hayden<br>(Alternate Site Supervisor) | 2 Technology Park Drive<br>Westford, MA 01886 | (978) 589-3447 | Mark.Hayden@aecom.com |
| Anne Salazar | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3635 | Anne.Salazar@aecom.com |
| Jeff Holzer | 30 Knightsbridge Avenue, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3616 | Jeffrey.Holzer@aecom.com |
| ***Regional Health, Safety and Environment Manager (AECOM)*** | | | |
| Phillip Platcow | 66 Long Wharf<br>Westford, MA 02110 | 617-899-5403 | Phillip.Platcow@aecom.com |
| ***District Health, Safety and Environment Manager (AECOM)*** | | | |
| Mike Grasso | 1001 West Seneca St.<br>Ithaca, NY 14850 | 607-277-5716 | Michael.Grasso@aecom.com |
| ***Air Database Manager (AECOM)*** | | | |
| Melissa Wellman | 2 Technology Park Drive<br>Westford, MA 01886 | (978) 589-3386 | Melissa.Wellman@aecom.com |
| ***Overall Database Manager (AECOM)*** | | | |
| James Herberich | 2 Technology Park Drive, Westford, MA 01886 | (978) 589-3193 | Jim.Herberich@aecom.com |
| ***GIS Manager (AECOM)*** | | | |
| Erik Anderson | 2 Technology Park Drive, Westford, MA 01886 | (978) 589-3710 | Erik.Anderson@aecom.com |
| ***Data Validation Manager (AECOM)*** | | | |
| Lisa Krowitz | 2 Technology Park Drive, Westford, MA 01886 | (978) 589-3343 | Lisa.Krowitz@aecom.com |
| ***Quality Assurance Officers (AECOM)*** | | | |
| Mary Kozik<br>(Analytical Procedures) | 2 Technology Park Drive, Westford, MA 01886 | (978) 589-3338 | Mary.OConnellKozik@aecom.com |

| Title, Affiliation, Name | Address | Phone | Email |
|---|---|---|---|
| Kathy Whooley (Field Procedures) | 30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | (732) 564-3644 | Kathy.Whooley@aecom.com |
| ***Engineering Manager (AECOM)*** | | | |
| Craig MacPhee | 2 Technology Park Drive, Westford, MA 01886 | (978) 589-3064 | Craig.MacPhee@aecom.com |
| ***Director, Environmental Affairs (PPG)*** | | | |
| Mark Terril | 4325 Rosanna Drive<br>Allison Park, PA 15101 | (412) 492-5466 | terril@ppg.com |
| ***Project Manager, Environmental Remediation (PPG)*** | | | |
| Brian G. McGuire | 4325 Rosanna Drive,<br>Allison Park, PA, 15101 | (412) 492-5512 | bmcguire@ppg.com |
| Dave Claassen | 4325 Rosanna Drive,<br>Allison Park, PA, 15101 | (412) 492-5629 | dclaassen@ppg.com |
| ***JCO Site Administrator*** | | | |
| Michael McCabe | 4 Normandy Drive<br>Chadds Ford, PA 19317 | (610) 388-9625 | jcsiteadministrator@earthlink.net |
| ***Project Manager for JCO Site Administrator*** | | | |
| Brian McPeak | 208 Winding Way South<br>Little Silver, NJ 07739 | (732) 216-6364 | bmcpeak@planningprogress.com |
| ***Manager, Site Remediation (NJDEP)*** | | | |
| Thomas Cozzi | 401 E State St.<br>5th floor<br>Trenton, NJ 08625 | (609) 984-2905 | tom.cozzi@dep.state.nj.us |
| ***Technical Consultant (Weston Solutions)*** | | | |
| Prabal Amin | 205 Campus Drive<br>Edison, NJ 08837 | (732) 417-5857 | prabal.amin@westonsolutions.com |

## 2.2 Laboratory

The analytical laboratory contractors supporting the standard analytical work for the non-residential and residential chromium site remedial activities are Accutest Laboratories, Inc. (Accutest), and Test America (formerly Severn Trent Laboratories, Inc. (STL)). The geotechnical laboratory supporting the geotechnical analyses will be GeoTesting Express, Inc. Analysis of hexavalent chromium on air filters will be performed by Galson Laboratories. Analyses of air filters for particulates ($PM_{10}$) will be performed by the AECOM laboratory in Harvard, MA. Measurements for Dissolved Oxygen, pH, temperature, turbidity, specific conductance, and oxidation/reduction potential (ORP) in the field will be performed by AECOM personnel.

All laboratories utilized for this program will be NJDEP-certified laboratories and hold current certifications for parameters of interest listed in **Appendix D** (where appropriate). **Table 2-2** provides contact and certification information for the participating laboratories.

**Table 2-2 Laboratory Information**

| Laboratory | Laboratory Contact | NJDEP Certification No. | Analytical Role |
|---|---|---|---|
| Accutest Laboratories<br>Fresh Ponds Corporate Village, Building B<br>2235 Route 130<br>Dayton, NJ 08810 | Matt Cordova,<br>Director of Client Services<br>Phone: 732.329.0200<br>e-mail: matt@accutest.com | 12129 | Laboratory support for chemical analysis of soil and water samples |
| AECOM<br>30 Knightsbridge Road, Suite 520<br>Piscataway, NJ 08854 | Erin Murphy<br>Phone: 732.564.3628<br>e-mail: erin.murphy@aecom.com | 12995 | Field measurements of dissolved oxygen, pH, temperature, turbidity, ORP, and specific conductance. |
| AECOM<br>325 Ayer Road<br>Harvard, MA 01451 | Henry Chow<br>Phone: 978.772.3345<br>e-mail: henry.chow@aecom.com | MA010 | Field GC measurements<br>Particulates |
| Galson Laboratories<br>6601 Kirkville Road<br>East Syracuse, NY 13057 | Ed Stuber, CIH<br>Phone: 315.432.5227<br>e-mail:estuber@galsonlabs.com | NY024 | Hexavalent Chromium in air |
| GeoTesting Express Inc.<br>1145 Massachusetts Ave.<br>Boxborough, MA 01719 | Mark Dobday<br>978-635-0012 Tel<br>978-844-2074 Cell<br>e-mail: mdobday@geotesting.com | Not Applicable | Laboratory support for geotechnical analysis of solid samples |
| TestAmerica<br>777 New Durham Road<br>Edison, NJ 08817 | Thomas Tanico<br>Customer Service Manager<br>Phone: 732.549.3900<br>e-mail: Thomas.Tanico@testamericainc.com | 12028 | Laboratory support for chemical analysis of soil and water samples |

## 2.3 Field Responsibilities

Task Leaders for continuing investigation and remedial activities, will be responsible for locating sample points (e.g., wells), ensuring adequate sample containers are available for sampling personnel, making sure that the required samples are collected and proper sampling techniques are used, ensuring that the appropriate documentation is completed, and the samples are properly preserved, packaged, and shipped to the appropriate laboratories. Task Leaders will receive copies of field notes and documentation from Field Team members and will review these notes. Deficiencies in the field notes will be reported by the Task Leaders to the project QAO and Field Team authors. Field notebook authors will revise the field notes as appropriate. Task Leaders and on-site representatives will also be responsible for subcontractor management while AECOM subcontractor personnel are onsite and ensuring that tailgate health and safety briefings are conducted for compliance with the HASP.

The Field Team members' responsibilities will include collecting field samples, collecting personnel and perimeter air monitoring samples, conducting field measurements, and documentation of all activities pursuant to this FSP/QAPP, work plans, AECOM Standard Operating Procedures (SOPs), and applicable NJDEP regulation and guidance. Field Team members will submit a copy of field documentation to the appropriate Task Leader, and will revise notes as necessary based on the Task Leader’s quality assurance review.

### 2.3.1 Personnel Training

AECOM and subcontractor personnel working on this program will be properly trained and qualified individuals. Prior to the commencement of work on the site, personnel will be given instructions specific to this project, covering the following areas:

- Organization and lines of communication and authority;
- Overview of the field investigation activities;
- QA/QC considerations;
- Documentation requirements;
- Decontamination requirements; and
- Health and safety considerations.

Training of field personnel will be provided by the AECOM Project Manager, AECOM Task Leaders, Project QAO, and/or any other qualified designee. Federal regulations found in Title 49 of the Code of Federal Regulations (49 CFR) Part 172.702 require that each employer whose employees work with hazardous materials (as defined in sections 49 CFR 171 and 172) must train each of its hazmat employees. "Hazmat employees" include those who prepare the packages for shipping, prepare, sign or review the paperwork, load trucks, drive the vehicles or unload or receive the hazardous materials.

A hazmat employee who performs any of these functions may not perform the function unless he or she has been trained in the requirements of hazardous materials (generally: identification, classification, labeling, marking, placarding, packaging, etc.) that apply to that function. It is the duty of each hazmat employer to comply with the applicable requirements of this subchapter and to ensure that each hazmat employee has received the appropriate training. AECOM employee(s) will have the New Jersey Department of Transportation (NJDOT) Hazardous Materials Transportation Certification pursuant to 49 CFR 172.704. Only personnel knowledgeable and trained in the shipment of hazardous or dangerous goods will be responsible for the shipment of hazardous materials.

# 3.0 Changes to Project Plans

The following procedure provides a means for controlling and documenting changes to the approved FSP/QAPP or site-specific work plans and changes during field activities or related to changes in accepted methods. The objective of the process is to maintain the level of QA/QC provided in the original review and approval process.

## 3.1 Changes or Additions

If non time-critical changes to a FSP/QAPP or site-specific work plan are required, the requesting party will initiate a request for change by editing the existing procedure and indicating the proposed changes by underlining the altered portions of the FSP/QAPP, work plans or other report submittals. The revision will be submitted with a cover letter (which includes the timeline for implementation of the change) to PPG and subsequently NJDEP for review, comment, and/or approval. Changes or additions required by NJDEP will be addressed by PPG based on written comments by NJDEP. Upon acceptance or approval of the revision by PPG and NJDEP, the change will be added to the appropriate section of the project planning document. Depending upon the complexity and extent of modifications, changes may be incorporated by marking the revised pages of the document with the word "revised" with the revision number and date placed in the lower right-hand corner. Extensive changes which result in resubmission of the entire document will be noted as a revision number for the document.

If time critical changes which could impact the overall project schedule (Master Schedule) are indentified, AECOM will implement a procedure for rapid notification of key parties (AECOM Project Manager and Principal-In-Charge, NJDEP’s Technical Consultant [Weston] and PPG via direct contact (phone or electronic mail). This will be followed by written documentation of the issue identified, proposed solution, and proposed schedule revisions to the Site Administrator. Following agreement on actions and approval of changes, the existing FSP/QAPP or work plan will be modified as needed. Revised pages or, if necessary, a complete, revised version of these documents will be prepared and distributed to all parties who received the original documents. Any schedule changes or revisions would also be documented in the Progress Report in accordance with 74.e and 74.f. of the ACO.

## 3.2 Changes or Additions to Laboratory Services

In the event that an additional laboratory subcontractor is required to handle the project load or there is a need to add additional analyses to the SOPs for the laboratory, a request will be made in writing to the other party. The letter will document the reason for the change, indicate any new analytical procedures to be used, present all pertinent laboratory SOPs, present the laboratory organization along with resumes and include a schedule for implementation as applicable. The requesting party will forward the letter to the other party for review, comment, and/or approval. Upon approval by both parties, the change or addition will be implemented. Appropriate correspondence documenting the acceptance of the change or addition of the analysis, along with supporting documentation, will be added as an appendix to the FSP/QAPP.

Requests for revisions or additions will be transmitted through the NJDEP Case Manager (if originating from NJDEP) or Mr. Brian McGuire or Mr. Mark Terril. (if originating from PPG) to the AECOM PIC, Mr. Robert Falotico or AECOM Program Manager, Scott Mikaelian

## 3.3 Field Changes or Additions

Because time critical changes or additions to the FSP/QAPP or site-specific work plan may be needed in order to accommodate field conditions or respond to findings obtained in the field, a mechanism to accommodate such changes has been established. These changes or additions may be initiated by either NJDEP or AECOM and PPG through the use of the following procedure:

1. Notification: The requesting party makes contact with the other party to request and discuss the change and a schedule for implementation. Persons to be contacted in addressing field changes are the AECOM PM and PIC, Technical Consultant (Weston), and PPG representative(s).

2. Field Sign-off: Following internal discussion, if both parties orally agree to the change or addition, it will be implemented according to the agreed upon schedule. Oral requests for field changes and agreement on field changes will be documented in the site log book and will require sign-off by both parties in the field log prior to implementation.

3. Project Manager Sign-off: The requesting party must complete a field change request form (**Appendix A**) and submit it to the other party within 72 hours to document written approval of the change.

4. Revision to the FSP/QAPP: All approved field changes will be followed up by formal written changes to the FSP/QAPP, unless the changes are site-specific. Site-specific changes will be documented in the appropriate site-specific report.

# 4.0 Quality Assurance Objectives

The overall QA objective is to develop and implement procedures for field sampling, chain of custody, laboratory analysis, and reporting that will provide results that are legally defensible in a court of law. Specific procedures for sampling, chain of custody, instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of field equipment, and corrective action are described in other sections of this FSP/QAPP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability. These terms are described below.

## 4.1 Precision

### 4.1.1 Definition

Precision is a measure of the degree to which two or more measurements are in agreement.

### 4.1.2 Field Precision Objectives

Field precision is assessed through the collection and measurement of field duplicates at a rate of one duplicate per twenty field samples. Precision will be measured through the calculation of relative percent difference (RPD). The equation for this calculation is presented in **Section 5.2.1** of this FSP/QAPP. The objectives for field precision RPDs are 30% RPD for aqueous samples and $\leq$50% RPD for soil, chip, masonry, and air particulate samples. Co-located samples will be collected to assess the precision of air particulate measurements. Field duplicates will not be collected for wipe samples or hexavalent chromium in air.

### 4.1.3 Laboratory Precision Objectives

Precision in the laboratory is assessed by calculating the RPD for duplicates. The equation for this calculation is presented in **Section 5.2.1** of this FSP/QAPP. Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples will be used to evaluate the precision of organic analyses. Laboratory duplicates as well as MS and/or MSD samples will be used for inorganic analyses; blank spike and/or blank spike duplicate samples will be used to assess laboratory precision for the determination of hexavalent chromium collected on air filters. Precision objectives will be the statistical control limits, or those specified in the method, whichever are more stringent.

## 4.2 Accuracy

### 4.2.1 Definition

Accuracy is the degree of agreement between the observed value and an accepted reference value.

### 4.2.2 Field Accuracy Objectives

The achievement of accurate data in the field will be addressed through the use of sampling procedures that minimize bias, the calibration of field instruments, and adherence to sample holding times and preservation requirements. Accuracy in the field will be evaluated through the use of trip blanks and/or field blanks. These blanks should contain no target analytes above the reporting limit.

### 4.2.3 Laboratory Accuracy Objectives

Laboratory accuracy will be expressed as percent recovery and will be determined through the analysis of matrix spikes, surrogates, and laboratory control samples. The equation that will be used to calculate percent recovery is included in **Section 5.2.2** of this FSP/QAPP. Laboratory accuracy objectives limits will be the statistical control limits, or those specified in the method, whichever are more stringent.

## 4.3 Completeness

### 4.3.1 Definition

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. “Normal conditions” are defined as the conditions expected if the sampling plan were implemented as planned.

### 4.3.2 Field Completeness Objective

Field completeness will be measured on the basis of (1) the number of valid field measurements and (2) the number of valid samples collected. The equation for completeness is presented in **Section 5.2.3** of this FSP/QAPP. The objective for field completeness for this project is greater than 90%.

### 4.3.3 Laboratory Completeness Objectives

Laboratory completeness will be measured by the number of valid measurements obtained compared to the number of valid samples submitted. The equation for calculating completeness is presented in **Section 5.2.3** of this FSP/QAPP. The completeness objective for the laboratory is greater than 90%.

## 4.4 Representativeness

### 4.4.1 Definition

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

### 4.4.2 Measures to Ensure Representativeness of Field and Laboratory Data

Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The rationale of the sampling program is discussed in the site-specific work plan. Representativeness will be satisfied by ensuring that the work plan is followed, proper sampling techniques are used, samples are appropriately preserved, proper analytical procedures are followed, and holding times of the samples are not exceeded. Representativeness will be included as a QA measure during the yearly Project QA audits.

Sampling protocols (discussed in **Section 6**) have been developed to assure that samples collected are representative of the media. Field handling protocols (e.g., storage, handling in the field, and shipping) have also been designed to protect the representativeness of the collected samples. Proper field documentation will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

## 4.5 Comparability

### 4.5.1 Definition

Comparability expresses the confidence with which one data set can be compared to another.

### 4.5.2 Measures to Ensure Comparability of Field and Laboratory Data

The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data, as documented in this FSP/QAPP, are expected to provide comparable data. Any changes in procedure or QA objectives, however, may affect data comparability.

When comparing data, it is important to compare data collected under the same set of conditions. Seasonal trends, depth of sample collection, analytical protocol, stream flow during sample collection, and any other sampling/analytical variables must be taken into account when comparing data sets.

Comparability will be maximized by: (1) the use of Project Operating Procedures (POPs) and SOPs throughout the project; (2) the recording of data in a standardized format; (3) the use of standard methods; (4) conducting confirmatory sampling and analysis when using alternative sampling and analysis methodologies; and (5) reporting of data in appropriate, consistent units.

## 4.6 Level of Quality Control Effort

### 4.6.1 Field Measurement

The field measurement equipment will be calibrated required under the methodologies specified in **Section 11** of this FSP/QAPP and the individual work plan(s). SOPs and POPs for the use of field instrumentation also contain detailed calibration requirements.

### 4.6.2 Laboratory Analysis

The level of QC effort provided by the laboratory will be equivalent to the level of QC effort required under the methodologies specified in **Section 12** of this FSP/QAPP. Each sample set processed as a batch by the laboratory will include a method blank, a measure of analytical accuracy such as a blank spike or matrix spike, and a measure of analytical precision such as a laboratory or matrix spike duplicate. Laboratories will adhere to all quality control procedures required in the analytical SOPs specified in **Appendix D**.

In accordance with the quality assurance requirements of the recently amended N.J.A.C. 7:26E-2.1(a)7, “The person responsible for conducting the remediation shall ensure that hexavalent chromium analysis of aqueous and nonaqueous samples is conducted as follows: i. Measure the pH and Eh of each sample, not just the quality control sample, with the pH and Eh data included and plotted in the full data deliverables using the graph in USEPA SW-846 Method 3060A incorporated herein by reference, as amended and supplemented; and ii. Use a site sample for the quality control analyses so the reduction/oxidation effects of the site matrix can be properly evaluated using USEPA SW-846 Method 3060A." The NJDEP certified laboratories that will perform the hexavalent chromium analysis are aware of these requirements. These requirements will also be included in the technical terms and conditions which are part of the laboratory purchase order in order to ensure compliance.

# 5.0 Data Assessment Procedures

## 5.1 Field Measurements

Field data will be reviewed by the AECOM Field Operations Leader and Task Leader for compliance with the Work plan, FSP/QAPP, and SOPs/POPs as applicable. Precision, accuracy, and completeness will be evaluated based on the methods and equations described in **Sections 4.1, 4.2, and 4.3**.

## 5.2 Laboratory Data

Laboratory analytical results will be assessed for compliance with precision, accuracy, completeness, and sensitivity requirements as described in the following sections.

### 5.2.1 Precision

AECOM will review the nonconformance summaries reported by the laboratories, which include RPD measurements outside laboratory QC limits by analyte group.

AECOM expects that the precision of laboratory analysis will be assessed by comparing the analytical results between MS/MSD samples for organic analysis, and laboratory duplicate analyses and MS/MSD samples for inorganic analysis. The RPD will be calculated for each pair of duplicate analysis using the following equation:

$$\% RPD = \frac{(S - D)}{(S + D)/2} \times 100$$

where S = original sample data
D = duplicate sample data

### 5.2.2 Accuracy

AECOM will review the nonconformance summaries reported by the laboratories which include monitoring of recovery measurements based on laboratory QC limits by analyte group. The accuracy of laboratory results will be assessed for compliance with the criteria established in **Section 4.2** of this FSP/QAPP using the analytical results of method blanks, trip blanks, field blanks, and MS/MSD samples. The percent recovery (%R) of matrix spike samples will be calculated using the following equation:

$$\% R = \frac{(A - B)}{C} \times 100$$

where A = the analyte concentration determined experimentally from the spiked sample,
B = the background level determined by a separate analysis of the unspiked sample, and
C = the amount of the spike added.

### 5.2.3 Completeness

The completeness of laboratory analytical results will be assessed by the laboratory for the amount of data required in **Section 4.3** of this FSP/QAPP. The completeness will be calculated using the following equation.

$$Completeness = \frac{ValidDataObtained}{TotalPlannedData} \times 100$$

### 5.2.4 Sensitivity

The laboratory will monitor the data quality through constant instrument performance and that instrument sensitivity will be monitored through the use of method blanks, calibration check samples, etc., in accordance with the methods listed in **Appendix D** of this FSP/QAPP. Method detection limits will be calculated according to 40 CFR Part 136 Appendix B.

As required in the *Technical Requirements for Site Remediation* at N.J.A.C. 7:26E-2.1(a)8, samples that will be used for determining compliance will be analyzed using a method with adequate sensitivity to accurately measure to the applicable remedial standard. Detection limits will be at or below applicable *Remediation Standards (*N.J.A.C 7:26D*),* last revised November 4, 2009*, or* *Soil Cleanup Criteria,* last revised May 12, 1999 (for trivalent and hexavalent chromium), Table 1 from the NJDEP guidance document *Development of Site-Specific Impact to Ground Water Soil Remediation Standards using the Soil-Water Partition Equation*, December 2008 (revised), *and* the *Ground Water Quality Standards (*N.J.A.C. 7:9C Appendix Table 1) adopted by reference as Ground Water Remediation Standards*.* **Tables 5-1 and 5-2** provide a comparison of the laboratory reporting limits with the applicable NJDEP practical quantitation levels (PQL) and remediation standards for the soil and aqueous analytes of interest. The detection limits and action limits for the air monitoring program will be specified in the specific air monitoring work plan.

# 6.0 Field Operations

The standard sampling procedures to be used for the PPG residential and non-residential chromium sites, and perimeter air monitoring are described in this section. All sample collection and field screening will be conducted in accordance with the current versions of the NJDEP *Field Sampling Procedures Manual* (August 2005), the NJDEP *Technical Requirements for Site Remediation* (November 2009), applicable AECOM SOPs/POPs), and accepted practices. SOPs and POPs for all significant field activities are presented in **Appendix B**. All samples will be handled in a manner consistent with the sample container, preservation, and holding time requirements specific to the analytical and data quality requirements of the investigation.

All samples collected during the field investigation will be analyzed by NJDEP-certified laboratories. The laboratories will adhere to the United States Environmental Protection Agency (USEPA) protocols for sample preparation and analysis dictated by the requested analytical method.

Full laboratory data deliverables, as detailed in Appendix A of the NJDEP *Technical Requirements for Site Remediation* (November 2009) will be submitted for all hexavalent chromium and hexavalent chromium associated analytical data (pH, Eh, sulfides, etc.). The full laboratory data deliverables will consist of the following:

- three electronic copies of the laboratory data package on CD in Adobe portable document format (pdf),
- one paper copy of the laboratory data package,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*,
- and one electronic copy of the analytical data in the EQuIS four-file format, as modified by AECOM.

Reduced laboratory data deliverables, as detailed in Appendix A of the NJDEP *Technical Requirements for Site Remediation* (November 2009), will be submitted for all other analytical data (ex. metals, volatile organic compounds [VOCs], etc…). The reduced laboratory data deliverables will consist of the following:

- one electronic copy of the full, validatable laboratory data package on CD in Adobe pdf will be submitted,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*, and
- one electronic copy of the analytical data in the EQuIS four-file format, as modified by AECOM.

Details are provided in this section for both field measurement activities and sample acquisition. Details are also provided for:

- Equipment cleaning and decontamination;
- Drilling and monitoring well installation;
- Sample storage and handling; and
- Documentation.

In addition to the requirements described in the above protocols, the following general requirements apply to all sampling activities:

- Whenever possible, samples will be collected in order of least to most contaminated, so that risks of systematic contamination are minimized.

  Samples designated for laboratory analysis will be collected from the liner and placed in appropriate laboratory pre-cleaned containers (after homogenization, if appropriate). Per Section 6.9.2, Means of Sample Collection, of the *NJDEP Field Sampling Procedures Manual* (August 2005) the order in which analytical samples should be collected is as follows:

  1. VOC (prior to soil sample homogenization);
  2. Total organic halogens (TOX)
  3. Total organic carbon (TOC)
  4. Semivolatile organic compounds (SVOCs)
  5. Extractable petroleum hydrocarbons (EPH)
  6. Polychlorinated biphenyls (PCBs)
  7. Total metals
  8. Dissolved metals (groundwater only)
  9. Phenols
  10. Cyanide
  11. Chloride
  12. Preserved inorganics
  13. Non-preserved inorganics

  When several wells with known or suspected contamination will be sampled, the least contaminated well should be sampled first, and the wells then sampled in order of increasing contamination.

- Additional sample locations will be co-located when necessary to obtain additional sample volume for the required analyses from each depth interval or sample location. The samples will be thoroughly homogenized prior to filling the sample bottles, except for samples collected for volatile organics analysis.
- Wherever possible, sampling equipment will arrive at the Site pre-cleaned and will be dedicated to one sample location on-site. Where not practical, field decontamination will be conducted in accordance with **Section 9**.
- Water and soil samples requiring chemical preservation will be placed in pre-preserved containers supplied by the laboratory.
- Sample containers and blank water will be obtained from the analytical laboratories which will provide properly cleaned and preserved (where required) sample containers. The vendor-prepared bottles will be prepared according to USEPA protocol as described in Specification and Guidance for Contaminant-Free Sample Containers, EPA 540/R-93/051. The laboratories will also prepare analyte-free blank water to be used for field blanks. Care will be taken to ensure that blanks are prepared using only water supplied by the laboratory that will perform the analysis. In general, a single laboratory will be responsible for the analysis of samples collected at a single location. For air samples, a blank filter will be submitted with field samples; the filter will be from the same manufacturing lot as that used for sample collection.
- Field changes to site-specific work plan(s), either by AECOM field personnel or NJDEP field personnel, are permissible only when made in strict accordance with field change policies described in **Section 3**.
- Outer gloves will be changed between sampling locations.
- Air monitoring will be conducted in accordance with the HASP. Field instruments for air monitoring will include a photoionization detector (PID), hydrogen sulfide ($H_2S$) portable, hand-held analyzer, and an aerosol/dust monitor.

## 6.1 Soil and Building Materials Investigation

Drilling and soil sample collection will be supervised by the Task Leader who will be an AECOM geologist/hydrogeologist. Drilling, sample collection, well construction and well/boring abandonment will be conducted in accordance with N.J.A.C 7.9D. A driller licensed by the State of New Jersey will be in charge of all drilling operations. Drillers shall be required to comply with OSHA 1910.120. Drilling and soil sampling procedures in the applicable POP(s) are attached in **Appendix B (POP Nos. PPG 005 and PPG 006).**

Soil samples will be screened for VOC in the field shortly after collection using an instrument equipped with a PID. The equipment will be issued through a formal equipment tracking system and operated by trained personnel in accordance with manufacturers' recommendations. All field measurement equipment will be maintained to ensure that measurements obtained are accurate and defensible.

All samples will be placed in pre-cleaned containers for transport to the laboratory. Soil samples for VOC will be transferred directly from the sample collection tool to containers prepared by the laboratory in accordance with the NJDEP *Field Sampling Procedures Manual* (August 2005) (refer to applicable POP(s) in **Appendix B (POP No. PPG 005**). VOC sample collection utilizing EnCore® or similar sampling devices will reduce the potential for VOC loss during sample collection and will result in lower reporting limits comparable to the impact to groundwater soil remediation standard. VOC samples will be collected using an EnCore® or similar sampling device and promptly shipped to the laboratory to permit freezing or analysis within 48 hours of collection.

Soil samples for all other parameters will be homogenized prior to placing in the containers. Homogenization will be performed in a stainless-steel bowl per the applicable POP(s) in **Appendix B (POP No. PPG 005)**. Building materials samples will be placed in containers without homogenization. Prior to homogenization, soils will be field screened with a PID using the applicable POP(s) in **Appendix B (POP Nos. PPG 004 and PPG 005)**.

In accordance with N.J.A.C. 7:26E-3.6(a)4, all soil samples to be analyzed for volatile organics shall be collected as follows:

i. A bulk sampling device that will collect an intact core (for example, splitspoon) shall be used to minimize contaminant loss during sampling; and

ii. Each core shall be screened with a properly calibrated direct reading instrument equipped with a photoionization detector (PID), flame ionization detector (FID), or other suitable instrument capable of detecting the contaminants pursuant to N.J.A.C. 7:26E-2.1(b) to select samples of volatile organics analysis using the following criteria:

(1) If field measurement readings are detected above background:

(A) The coring shall be extended until either background readings are achieved, groundwater is encountered, or bedrock is encountered; and

(B) An undisturbed sample from the six-inch interval registering the highest field measurement reading shall be collected, at a minimum, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4; or

(2) If all intervals register the same field measurement reading or all field measurement readings do not exceed backgrounds:

(A) The coring shall be extended to groundwater, bedrock, or 10 feet, whichever is encountered first; and

(B) One undisturbed sample at a minimum, from the six-inch interval at the bottom of the soil boring shall be collected, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4; and

iii. Contaminants that cannot be detected with field-screening instruments shall be sampled in accordance with the requirements at N.J.A.C. 7:26E-3.4(a).

### 6.1.1 Utility Protection

Prior to conducting any intrusive operations, existing drawings and other available documentation will be reviewed to evaluate whether potential conflicts with underground utilities exist. New Jersey One Call will be notified by the drilling contractor at least three and not more than ten business days prior to the start of drilling in each off-site area.

If any doubt exists regarding the potential presence of subsurface utilities, a professional utility locating service will be retained to conduct surveys to clear proposed drilling locations. A variety of techniques are available to locate utilities, including ground penetrating radar, electromagnetic conductivity, radio frequency, audio frequency, and passive electric. The efficacy of each technique is dependent on the material used to construct the utility, type of utility, number and type of nearby utilities, and many other factors. As such, it is common practice to use more than one utility locating technique. The requirements for utility location and appropriate techniques will be determined once available information is gathered and evaluated.

Soil boring, sampling, and monitoring well locations will be adjusted to avoid underground and overhead utilities. As an added precaution, vacuum boring to a depth of four feet or to the expected invert depth of the deepest utility at any given soil boring or well location may be conducted. However, if vacuum boring is required at certain locations, collection of shallow soil samples for laboratory analysis in the vacuumed zone will still be undertaken from the sidewall area of the vacuumed zone to ensure that shallow surface soil samples will be collected at all proposed off-site investigation locations.

### 6.1.2 Direct-Push Drilling and Soil Sampling

Direct-push methods (Geoprobe® and similar systems) of soil sampling utilize a hydraulically-powered percussion drilling machine to drive hollow soil samplers into the subsurface to obtain soil samples. The equipment and hydraulics used in the drilling machine are generally mounted on a vehicle to provide both mobility around the jobsite and a stable drilling platform. A POP for direct-push drilling is included in **Appendix B (POP No. PPG 005)**.

Geoprobe® sampling systems typically utilize the Macro-Core sampler, which is a 45-inch long, 1.5-inch diameter hollow steel sampling barrel, lined with a disposable factory-clean acetate liner. It is the Macro-Core which is driven into the ground for collection of soil samples. This method works best in stable subsurface environments where borehole collapse is not a significant issue.

Where borehole instability is anticipated (e.g., “running sands”), sampling can also be conducted using a dual tube sampling system. This system is similar to the Macro-Core except that the liner (in this case PVC) is withdrawn but the steel outer casing remains in place until the last sample is collected and the borehole grouted to prevent borehole collapse.

Once a sample is collected, the liner is cut with a knife by the driller (per the project HASP). Following liner cutting, the soil sample will be field screened with a calibrated PID, if required. Sample recovery will be determined by the geologist/hydrogeologist using a folding rule or tape measure. Any portion of the split-spoon contents which are not considered part of the true sample (heaved soils, borehole scrapings, etc.) will not be included in the measurement.

Due to anticipated variations in sample recovery, thickness of various strata identified in the recovered sample, and the number of analyses proposed, sample collection precedence as described below will be used to collect soil samples. Samples will be collected using this precedence until no additional material is available for the sampling interval. If additional sample volume is needed to complete the analyte suite required, sample volume will be collected from the six-inch interval directly above or below the target interval, whichever is most similar in terms of geology and field observations.

Samples designated for laboratory analysis will be collected from the liner and placed in appropriate laboratory pre-cleaned containers (after homogenization, if appropriate). Sample order precedence is discussed above in **Section 6.0**. Sample handling is discussed in **Section 10.0**.

### 6.1.3 Split-Spoon Sampling

Soil samples obtained during hollow-stem auger or mud-rotary drilling will be collected using a split-spoon sampler (refer to POP No. PPG 005 in **Appendix B**). Split-spoon sampling devices are constructed of steel and are most commonly available in lengths of 18 and 24 inches and inside diameters of 1.5 to 3 inches. Typically, the 1.5-inch diameter sampler is used; however, larger diameter samplers may be used if large volumes of soil are required for analytical testing.

The split-spoon consists of a tubular body with two halves that split apart lengthwise, a drive head on the upper end with a ball-check valve for venting, and a hardened steel cutting shoe at the bottom. The soil sample enters the split-spoon through the cutting shoe as the device is driven into the ground. A replaceable plastic or metal basket is often inserted into the shoe to assist with retaining samples. Once the sampler is retrieved, the drive head and cutting shoes are removed and the split-spoon halves are then separated, revealing the sample.

The drilling subcontractor will lower the split-spoon into the borehole. The sampler is generally driven into the ground using a 140-pound hammer with a vertical free drop of 30 inches, although a down-hole hammer or hydraulic drivers may be utilized as an alternative.

The number of blows required for every 6 inches of penetration will be recorded on the boring. Blow count information is used as an indicator of soil density for stratigraphic logging purposes. Once the split-spoon has been driven to its fullest extent, or to refusal, it will be removed from the borehole. Refusal is defined as 50 blows for six inches or less of penetration.

The split-spoon will be immediately opened upon removal from the casing/auger/borehole. The open sampler shall then be field screened with a calibrated PID, if required. Sample recovery will be determined by the geologist/hydrogeologist using a folding rule or tape measure. Any portion of the split-spoon contents which are not considered part of the true sample (heaved soils, borehole scrapings, etc.) will not be included in the measurement.

Samples designated for laboratory analysis will be collected from the liner and placed in appropriate laboratory pre-cleaned containers (after homogenization, if appropriate). Sample order precedence is discussed in **Section 6.0**. Sample handling is discussed in **Section 10.0**.

### 6.1.4 Soil Sampling Beneath Residential Slabs

During completion of field activities, it may become necessary to collect soil samples from beneath concrete slabs in residential buildings. Soil sampling beneath residential slabs will be conducted following the applicable POP(s) in **Appendix B** (POP No. PPG 005). Prior to collection of the samples, utility protection measures consistent with **Section 6.1.1** will be implemented to ensure the concrete at the proposed sampling location is free of utilities. After the sampling location has been cleared for utilities, the drilling contractor will utilize a concrete core drill to create an opening in the slab of sufficient size to allow for collection of the soil samples. Upon completion of sampling activities, the drilling contractor will repair the opening with concrete.

### 6.1.5 Air Sampling

The AIRMETRICS MiniVol™ portable air sampler will be used for the integrated sampling of airborne particulates ($PM_{10}$) and hexavalent chromium on 47 mm filters. Two separate MiniVol™ samplers will be used; for the collection of $PM_{10}$ the sampler will be configured to draw air at 5 liters/minute through a 10 micron particle size separator (impactor) then though a 47 mm pre-weighed filter. A similar configuration will be used for the collection of hexavalent chromium with the exception that no particle size impactor is required and the flow rate will be set at 3.5 liters/minute. Filters for $PM_{10}$ and hexavalent chromium will be recovered and shipped under chain-of-custody to off-site laboratories for analysis.

Additional on-site air measurements will include the use of a direct reading real-time MIE DataRAM Analyzer or TSI DustTrak Aerosol Monitor or equivalent for the determination of $PM_{10}$ which will be used as a surrogate for continuous monitoring of hexavalent chromium, metals, and polyaromatic hydrocarbons (PAHs). Total VOC (TVOC) concentrations associated with ground intrusive activities will be monitored through the use of RAE portable PID. If an elevated TVOC level is detected at one of the fixed air monitoring sites, a gas chromatograph fitted with an automatic injection feature will monitor for benzene, toluene, ethylbenzene and xylenes (BTEX). As needed, handheld measurements for hydrogen sulfide will be made using the Arizona Instrument Jerome Model 631X Hydrogen Sulfide portable analyzer or equivalent.

Specific procedures for these field instruments are contained in SOP Nos. PPG-017 and PPG 020 in Appendix B.

### 6.1.6 Feasibility Study

Material which is tentatively identified as Green-Gray Mud or Chromite Ore Processing Residue (COPR) but cannot be confirmed to be one of these materials through other techniques such as visual, magnetic or similar tests will be subjected to hydrochloric acid testing using the procedure described in POP PPG 015. Green-Gray Mud is expected to contain percent levels of calcium; COPR may contain significant levels of calcium as well. The field test described in POP PPG 015 will involve dropwise addition of 1:1 Hydrochloric Acid to a sample of the suspected material, if calcium or other carbonate salts/minerals are present foaming or effervescence should occur. However, as noted in the POP, this test is not specific to calcium and should be used in conjunction with other observations to assist in the identification of materials containing Green/Gray Mud and COPR.

In order to document that representative samples are obtained for testing of proposed remediation procedures, samples taken from a predetermined grid will be field screened for grain size using a series of sieves. In addition, soil color and the presence/absence of COPR nodules or paste-like material will be documented; photographs will be used as appropriate to further document the nature of the sample. POP PPG 016 describes the specific procedures which will be used to document the condition of field samples collected for assessment of remediation options.

## 6.2 Quality Control Samples

QC samples collected during field activities will consist of trip blanks, field blanks, field duplicates, matrix spike, and matrix spike duplicate samples. The procedures for collection of specific sample matrices are discussed in the applicable POPs in **Appendix B** (POP Nos. PPG 005, PPG 008, PPG 010, PPG 011, PPG 012, PPG 013, PPG 018, and PPG019) and below. A description of the QC samples is provided below:

- **Field Blanks:** Field blanks are analyzed to check for procedural contamination at the site that may cause sample contamination. Field blanks will be prepared by routing analyte free deionized/distilled water (provided by each laboratory performing the sample analysis) through sampling equipment after equipment decontamination and before field sample collection. The blank water quality supplied by each laboratory will meet the requirements stated in Section 2.5.4 of the NJDEP *Field Sampling Procedures Manual* (August 2005). The appropriate laboratory water will be used to collect the field blanks depending on the analysis and the laboratory performing the analysis. Thus, field blanks associated with analyses to be performed by a designated laboratory will only be collected using the deionized/distilled water supplied by the designated laboratory. In addition, if specific water is provided by the laboratory for a specific analysis then only that water will be used to collect the associated field blank.

  Field blanks will be preserved in the same manner as samples (**Appendix C**). For air and wipe sampling, field blanks will be collected using filters and wipes from same lot number as those used for sampling. For this FSP/QAPP, field blanks will be collected at the frequency specified in Table 6-1 and analyzed for all applicable target parameters as specified in **Table 6-1**.

  **For the non-aqueous matrix,** for sampling events lasting more than one day, field blanks associated should be performed at a rate of 10% of the total number of samples collected throughout the event for all parameters sampled that day. If collection of 10% of total number of samples will result in the collection of more than 1 Field Blank per day, this is not necessary per the NJDEP FSPM (2005).

  **For the aqueous matrix**, field blanks must be performed at a rate of one per day for all parameters sampled that day.

- **Trip Blanks:** Trip blanks are used to assess the potential for contamination of samples due to VOC contaminant migration during sample shipment and storage. Each laboratory performing volatile organic analysis will prepare trip blanks by filling sets of 40-milliliter (ml) vials with analyte free deionized water, sealing the vials with septum-lined caps (allowing no headspace or entrapped air bubbles). The vials will then be kept with the sample cooler from the time the sampling kit leaves the laboratory until it is returned from the field. The blank water quality supplied by each laboratory will meet the requirements stated in Section 2.5.4 of the NJDEP *Field Sampling Procedures Manual* (August 2005). The trip blanks prepared by a designated laboratory will only accompany samples being delivered to that designated laboratory. In general, a single laboratory will be responsible for all analyses associated with a specific location. According to the *NJDEP Field Sampling Procedures Manual* (August 2005), trip blanks are not required for the non-aqueous matrix. Trip blanks will be required at a frequency of one set per cooler in which aqueous VOC samples are shipped (**Table 6-1**). Trip blanks will be analyzed for VOC only.

- **Field Duplicates:** Field duplicates are analyzed to check for sampling and analytical reproducibility. Duplicate samples will be collected by alternately filling sample bottles from the source being sampled. Field duplicates will not be collected for wipe samples. Co-located samplers will be used for the collection of field duplicates for the $PM_{10}$ analysis. Field duplicates for air, soil, aqueous, chip, and masonry samples will be collected at the frequencies specified in **Table 6-1**.
- **Matrix Spike Samples:** Matrix spikes provide information about the effect of the sample matrix on the preparation and measurement methodology. Matrix spikes for organic and inorganic analyses are performed in duplicate and (referred to as MS/MSD samples). MS/MSD samples will be prepared by the laboratory according to their SOPs, as applicable to the method. A matrix spike/laboratory duplicate analysis may be substituted for an MS/MSD for inorganic parameters (if allowed by the method) at the same frequency as the MS/MSD. MS/MSDs will not be collected for wipe and air samples; blank spikes and blank spike duplicates will be used for these analyses. MS/MSD soil, aqueous, chip, and masonry samples will be collected at the frequencies specified in **Table 6-1**.

## 6.3 Borehole Abandonment

Unless a well is to be installed, boreholes will be abandoned by grouting in accordance with N.J.A.C 7.9D.

## 6.4 Location Measurements

The locations of all new borings and other sample collection points will be measured using standard surveying techniques or using GPS. The locations and elevations of all new monitoring wells will be measured by a New Jersey State licensed surveyor in accordance with NJDEP requirements. Latitude and Longitude will be measured to the nearest 1/10 of second (NAD 83) and to the New Jersey State Plane Coordinates (NAD 83) to the nearest 1 foot. A permanent reference mark will be made on the top of the riser (cap off), and the elevation (NAVD 88) will be surveyed to the nearest 1/10 foot. Surveyors shall be required to comply with OSHA 1910.120. All surveying and reporting of location information will be in compliance with the requirements of N.J.A.C. 7:26E-3.13(c)3v.

# TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY

| Matrix [1] | Analyses [1] | Quality Assurance Samples | Sampling Frequency | Criteria |
|---|---|---|---|---|
| AIR | Chromium (Total and Hexavalent) | Field Blank | 1/day from same lot number as sample filters | <MDL [8] |
| | Particulates ($PM_{10}$) | Field (Blind) Duplicate (co-located) | 1/20 samples (5% of total) or minimum of 1/week | RPD < 50% |
| WIPES | Chromium [4] (Total and Hexavalent) | Field Blank | 1/day from same lot number as the sample wipes | <RL [2] |
| SOIL, CHIP, CONCRETE, SWEEP, MASONRY<br>(including TCLP and/or SPLP, as applicable) | TCL VOCs<br>TCL SVOCs<br>TCL PCBs<br>TAL Metals<br>Hexavalent Chromium [4]<br>EPH<br>Phenols<br>Cyanide | Field Blank | Either 1/day or 10% of the total number of samples collected, but not more than 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 50% |
| | | MS/MSD | 1/20 samples (5% of total) | See method [3] |
| | Wet Chemistry [5] | Field Blank | Either 1/day or 10% of the total number of samples collected, but not more than 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 50% |
| | Geotechnical [6] | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 50% |
| | Waste Characteristics [7] | | | |

## TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY (continued)

| Matrix [1] | Analyses [1] | Quality Assurance Samples | Sampling Frequency | Criteria |
|---|---|---|---|---|
| AQUEOUS | TCL VOCs | Trip Blank | 1/cooler | < RL [2] |
| | | Field Blank | 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |
| | | MS/MSD | 1/20 samples (5% of total) | See method [3] |
| | TCL SVOCs<br>TCL PCBs<br>TAL Metals<br>Hexavalent Chromium [4]<br>EPH<br>Phenols<br>Cyanide | Field Blank | 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |
| | | MS/MSD | 1/20 samples (5% of total) | See method [3] |
| | Wet Chemistry [5] | Field Blank | 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |
| | Waste Characteristics [7] | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |

Notes:

[1] - These are proposed matrices and analytes, refer to the RIWP for the specific matrices and analytes.

[2] - Refer to Tables 5-1 and 5-2 for the analyte specific RL.

[3] – Refer to the specific analytical methods for the MS/MSD QC Criteria.

[4] – Hexavalent chromium analysis includes Eh and pH analysis on every sample.

[5] – Wet Chemistry analyses may include BOD, CEC, COD, TDS, TSS, TOC, TOX, Alkalinity, Chloride, Ferrous iron, Nitrate, Nitrite, Phosphate, and Sulfide.

[6] – Geotechnical analyses may include moisture content, permeability, specific gravity, grain size, bulk density, Atterberg limits, and unconfined compressive strength.

[7] – Waste Characteristic analyses may include ignitability, reactivity, moisture content, and corrosivity.

[8] - Refer to the specific air monitoring work plan.

Acronyms:

| | | | |
|---|---|---|---|
| EPH | Extractable Petroleum Hydrocarbons | TAL | Target Analyte List |
| MDL | Method Detection Limit | TCL | Target Compound List |
| PCB | Polychlorinated Biphenyl | TDS | Total Dissolved Solids |
| $PM_{10}$ | Particulates | TOC | Total Organic Carbon |
| RL | Reporting Limit | TOX | Total Organic Halides |
| RPD | Relative Percent Difference | TSS | Total Suspended Solids |
| SOP | Standard Operating Procedure | VOC | Volatile Organic Compound |
| SVOC | Semivolatile Organic Compound | | |

# 7.0 Groundwater Investigation

Soil boring investigation methodologies are described previously in **Section 6.0**. The following section details the well construction, development, and groundwater sampling methodologies.

## 7.1 Well Construction

Wells will be constructed by the drilling contractor at the direction of the Site geologist/hydrogeologist. Wells will be constructed in accordance with N.J.A.C 7.9D typically using two-inch (nominal) Schedule-40 PVC riser and screen. Wells installed below the meadow mat (or equivalent elevation, where there is no meadow mat) will be double cased using a six-inch (minimum) nominal diameter steel pipe as the outer casing. The outer diameter of the borehole will be a minimum of four inches larger than the well riser or outer casing. Double cased (or telescoping) wells will be advanced into the meadow mat (intermediate wells) or deeper confining layer (deep wells). The outer casing will be installed into the confining or semi-confining geological unit and grouted in place. Drilling to the target depth will proceed following a minimum period of 24 hours so that the grout has had sufficient time to set.

In boreholes where a shallow water-bearing zone is encountered above a deeper water bearing zone, casing will be installed to prevent downward migration between the water-bearing zones in accordance with N.J.A.C. 7.9D. The casing will be installed into the confining or semi-confining unit; or where absent to a sufficient depth to prevent migration between the water-bearing zones. The annular space between the casing and borehole, as well as the annular space between water-bearing zones, will be grouted. The grout will be allowed to set for a minimum of 24 hours prior to further advancement of the borehole. In accordance with the NJDEP *Field Sampling Procedure Manual* (August 2005), installation of well couplets (e.g., shallow and deep) and well triplets (e.g., shallow, intermediate and deep) will be installed in separate boreholes since grout is less likely to invade well intakes (screens) if the wells are installed in separate boreholes. Care will be taken to assure that any confining unit between aquifer zones is not breached without providing adequate protection of underlying/overlying aquifers.

Well screens will be machine-slotted (0.010- to 0.020-inch slots), and will be of a length suitable for the particular use. Sand pack will be installed to an approximate height of two feet or greater above the top of the screen. An approximate one-foot thick bentonite seal will then be placed above the sand pack and the remainder of the well annulus will be grouted with a Portland cement and bentonite mixture. Specific well construction procedures are presented in POP PPG 006 in **Appendix B**.

## 7.2 Well Development

Not sooner than 24 hours after completion, all wells will be developed to remove fines and minimize the effects of drilling on the water quality. Pumping will be the preferred method for developing the monitoring wells. When recharge is adequate, the monitoring well will be surged (by surge block or by raising and lowering the pump along the screened interval) and pumped using one of the following: a submersible pump or a surface centrifugal pump. Bailing may be used to surge the well and remove sediment if recharge is inadequate to use a submersible pump to develop the monitoring well.

Well development water will be contained in 55-gallon drums or tanks for waste classification and disposal. The determination of groundwater disposal for off-site wells will be made on a case-by-case basis by the Site hydrogeologist, with PPG approval. Well development procedures are presented in POP PPG 007 in **Appendix B**.

## 7.3 Groundwater Sampling Procedures and Equipment

To ensure that each groundwater sample collected is representative of the conditions at that location, and that the sample is neither altered nor contaminated by the sampling and handling procedures, AECOM will conduct all sampling as per the NJDEP *Field Sampling Procedure Manual* (August 2005), and applicable AECOM SOPs and POPs. All groundwater samples will be handled in a manner consistent with the sample container, preservation, and holding time requirements specific to the analysis requirements of this investigation (refer to Appendix C of the *Field Sampling Procedures Manual*, August 2005). Groundwater sampling procedures are presented in POP PPG 008 in **Appendix B**.

Field instruments that will be utilized in the groundwater remedial investigation will include water level indicators (Solinst® or equivalent), oil/water interface probes, water quality meters (Horiba U-22 or equivalent), and/or PIDs (as required). All field measurement equipment will be maintained to ensure that measurements obtained are accurate and defensible. The equipment will be issued through a formal equipment tracking system and operated by trained personnel in accordance with manufacturers' recommendations.

### 7.3.1 Groundwater Sampling Program

All groundwater samples will be collected in accordance with the NJDEP *Low Flow Purging and Sampling Guidance* (December 2003). Prior to initiating the groundwater sampling program, synoptic groundwater elevation measurements will be collected. A PID and/or a gas monitor (if required by the HASP) will be used to screen the well headspace immediately after the cap is removed. Then, from the survey mark at the top of the well casing, the depth to water and the total depth of the well will be measured using an appropriate water level gauging meter.

Permanent monitoring wells installed with a screened interval of 10 feet will be sampled at two locations within the well. The locations will be at five-foot intervals within the screen, in accordance with the NJDEP *Low Flow Purging and Sampling Guidance* (December 2003). Groundwater sampling logs will be completed in the field as per New Jersey Technical Requirements and will include measurements of field parameters ( i.e., temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential). Groundwater quality parameters will be measured and recorded at timed intervals prior to and during purging to evaluate the stabilization of water quality parameters prior to sampling as directed in applicable guidance documents.

#### 7.3.1.1 Low-Flow Purging and Sampling

Low-flow purging and sampling will be accomplished using a peristaltic pump (submersible or bladder pumps will be utilized for samples for VOC analysis) as described in POP PPG 008 in **Appendix B**.

Groundwater will then be purged from the well at rates between 0.1 liters per minutes (L/min) and 0.5 L/min) through dedicated polyethylene tubing (Teflon© or Teflon©-lined tubing will be utilized for samples for VOC analysis) attached to a flow-through cell and in-line water quality meter.

Water quality indicator parameters (WQIPs) will be collected once water fills the in-line cell at a minimum of 5-minute intervals. Water quality parameters will be monitored for stabilization. Stabilization will be defined when three consecutive water quality readings are within:

| Field Measurement | Stabilization Requirement |
|---|---|
| Temperature | ±3% |
| pH | ±0.1 Standard Units |
| Specific Conductivity | ±3% |
| Turbidity | ±1 Nephelometric Turbidity Units (NTU)* |
| Dissolved Oxygen (DO) | ±10% |
| Oxidation-Reduction Potential (ORP)/Eh | ±10 mV |
| * Turbidity readings must stabilize to ± 10% for turbidity (if greater than 1 NTU). Because metals are a primary concern at this site and metals analyses are strongly influenced by the presence of suspended solids in the sample, special attention will be paid to turbidity measurements. Typically, turbidity stabilization needs to occur first. The target value shall be < 10 NTUs. After turbidity stabilization is attained the remainder of parameters will be evaluated for stabilization. After four hours of purging, samples will be collected regardless of whether WQIPs have stabilized. | |

Water levels will also be monitored during purging and the purge rate will be adjusted (where possible) to minimize drawdown (not greater than 0.3 feet). Upon stabilization of water quality parameters, the water line will be severed prior to the in-line water quality meter and samples will be collected directly from the pump/tubing. AECOM is certified (NJ Lab Certification # 12995) to collect Dissolved Oxygen, pH and temperature measurements in the field. AECOM's Lab Certification for field measurement of conductivity, turbidity and ORP is pending upon NDJEP approval of certification. Laboratory-supplied sample bottleware will be filled directly from the tube starting with VOC vials. The order of sample collection will be:

1. VOC
2. TOX
3. TOC
4. SVOC
5. EPH

6. PCBs
7. Total Metals
8. Dissolved Metals (groundwater only)
9. Phenols
10. Cyanide
11. Chloride
12. Preserved inorganics
13. Non-preserved inorganics

Non-VOC samples may <u>not</u> be collected before VOC samples. When several wells will be sampled of known or suspected contamination, the least contaminated well should be sampled first, and the wells then sampled in order of increasing contaminant concentration for that parameter, as long as VOCs are collected prior to non-VOC parameters.

## 7.4 Hydraulic Conductivity Testing

In-situ permeability (rising and falling head or "slug") tests will be conducted in selected wells to estimate in-situ lateral variability thereof. Permeability data will be used to estimate the average linear velocity of the groundwater, and to evaluate whether separate flow regimes may exist as a result of lithologic differences.

Time-drawdown data will be collected by instantaneously displacing a volume of water and recording the change in water level as the well recovers. Water will be displaced using a solid slug. Slug size will be selected to displace enough water to ensure a valid test. Where the static water level is found above the screened interval, a falling-head test and a rising-head test will be performed. Where the static water level is in the screen, two rising head tests will be performed, as displacement of water into the unsaturated screened zone introduces error into testing results. Water levels will be recorded automatically with pressure transducers and an electronic data logger. The time-drawdown data will be analyzed in the office utilizing the appropriate analytical method. Duplicate test results will be compared to determine the precision of the method and then, if appropriate, averaged to give a more accurate value. Field procedures for performing slug tests are presented in POP PPG 009 in **Appendix B**.

## 7.5 Quality Control Samples

QC samples collected during field activities will consist of trip blanks, field blanks, field duplicates, and/or MS/MSDs (described in **Section 6.2**) as appropriate to the matrix and analytical method. The procedures for collection of these samples are discussed in **Section 6.0**. Frequencies of collection for QC samples are specified in **Table 6-1**.

# 8.0 Building Component Sampling

Building component sampling provides information on monitoring surficial contamination and is intended for non-volatile species. Four types of sampling methods for collecting building components are presented as follows:

1. **Chip Sampling:** Applicable for obtaining samples of porous material (e.g., concrete and brick) on flat surfaces (e.g., floors). The procedure is presented in POP PPG 010 in **Appendix B**.
2. **Wipe Sampling:** Applicable mostly for collecting samples from the surface of non-porous materials (e.g., painted walls, glass, or metal). The procedure is presented in POP PPG 011 in **Appendix B**.
3. **Concrete Core Sampling:** Applicable for collecting samples of concrete floor slabs and foundations. The procedure is presented in POP PPG 012 in **Appendix B**.
4. **Scrape/Sweep:** Applicable for collecting scrape and sweep samples from all types of surfaces. The procedure is presented in POP PPG 013 in **Appendix B**.

# 9.0 Decontamination and Waste Management Procedures

All equipment, vehicles, and personal protective equipment (PPE) potentially exposed to hazardous materials will be decontaminated prior to removal from the Site.

Equipment in contact with samples will be decontaminated prior to use to ensure sample integrity. Wherever possible, pre-cleaned, disposable or dedicated equipment will be utilized. All other sampling equipment used in the field investigations will be cleaned before and after sample collection using a three-part decontamination procedure. Cleaning of equipment is performed to prevent cross-contamination between samples and to maintain a clean working environment for all personnel. Detailed decontamination procedures are presented in POP PPG 014 in **Appendix B**.

Although it is preferred that all non-aqueous field sampling equipment is either laboratory cleaned, wrapped, and dedicated, it may be necessary to decontaminate in the field using more than one method. Decontamination of equipment in the field that is not dedicated or disposable will be conducted in general accordance with POP PPG 014 found in **Appendix B** of this FSP/QAPP. The following modifications to the decontamination POP PPG 014 in **Appendix B** will be made:

Eight-Step Decontamination Process:

A solvent rinse and acid rinse steps of the full 8-step decontamination process will not be performed during field decontamination. Under typical field conditions, the 3-step decontamination process consisting of a laboratory grade glassware detergent (i.e., Alconox®) and tap water scrub to remove visible contamination followed by a generous tap water rinse and a final rinse using distilled and deionized (ASTM Type II) water. If visual contamination persists, or gross contamination is suspected, additional decontamination procedures will be required (steps 4 through 8 below dependent upon the analysis required.

The field sampling equipment cleaning and decontamination procedures are as follows:

1. Laboratory grade glassware detergent plus tap water wash to remove all visible particulate matter and residual oils and grease;
2. Generous tap water rinse;
3. Distilled and deionized (ASTM Type II) water rinse;
4. 10% nitric acid rinse (trace metal or higher grade $HNO_3$ diluted with distilled and deionized (ASTM Type II) $H_2O$)*
5. Distilled and deionized (ASTM Type II) water rinse*
6. Acetone (pesticide grade) rinse**
7. Total air dry or pure nitrogen blow out**

8. Distilled and deionized (ASTM Type II) water rinse**

*Only if sample is to be analyzed for metals.
**Only if sample is to be analyzed for organics.

All sampling equipment decontaminated via this procedure must be wrapped and/or sealed during storage and prior to use. If visual contamination persists, or gross contamination is suspected, additional decontamination procedures will be required.

In the field, decontamination should be carried out over a container and the residual liquid material must be properly disposed. Decontamination wastes must be disposed in accordance with current NJDEP policy (see Chapter 2 of the _Field Sampling Procedure Manual_ (August 2005), Section 2.4.5.7, *Disposal of Development, Purge, Pump Test and Decontamination Water*). Where possible, only dedicated and disposable materials will be used for sample collection to minimize the need for on-site full decontamination.

Decontamination of drilling equipment will be performed by the drilling subcontractor. AECOM will provide the drilling subcontractors with a copy of all the applicable POP(s) . Subcontractors will be overseen to ensure that decontamination is completed in accordance with POP PPG 014 and NJDEP _Field Sampling Procedures Manual_ (August 2005).

## 9.1 Management of Waste Liquids

Waste liquids are managed directly by PPG in accordance with the Resource Conservation and Recovery Act (RCRA), Department of Transportation (DOT) requirements, NJDEP requirements for the disposal of installation, development, purge, pumping test and decontamination waters (Section 2.4.5.7 of the _Field Sampling Procedures Manual_ (August 2005)) and all applicable laws and regulations. All purge water and waste decontamination fluids will be containerized. Waste liquids are periodically (less than 90 days after generation) transported off-site for proper management as a hazardous waste.

Waste liquids generated at off-site parcels will be placed in 55-gallon drums. The 55-gallon drums will either be transported to the Site 114 Drum Storage Area by the drilling contractor utilizing a rack truck, or will be secured at the off-site parcel for subsequent disposal.

## 9.2 Management of Drill Cuttings

Drill cuttings and other hazardous solids are managed directly by PPG in accordance with RCRA and DOT requirements, NJDEP requirements for the disposal of drill cuttings (Section 2.4.5.6 of the _Field Sampling Procedures Manual_ (August 2005)) and all applicable laws and regulations. All drill cuttings will be containerized in DOT-approved 55-gallon drums and transported on a daily basis (minimum) to the on-site drum storage area. Drummed waste is periodically (less than 90 days after generation) transported off-site for proper management as a hazardous waste. Drill cuttings generated at off-site parcels will be placed in 55-gallon drums. The 55-gallon drums will either be transported to the Site 114 Drum Storage Area by the drilling contractor utilizing a rack truck, or will be secured at the off-site parcel for subsequent disposal.

# 10.0 Documentation and Chain-of-Custody

Documentation of custody is one of several factors that are necessary to document the proper handling of samples A sample is considered to be in a person's custody if:

- It is in the actual possession of an authorized person;
- It is in the view of an authorized person, after being in his/her actual possession;
- It was in the actual physical possession of an authorized person and then was locked up to prevent tampering; or
- It is in a designated and identified secure area.

## 10.1 Field Custody Procedures

### 10.1.1 Field Procedures

The field sampling personnel along with the Task Leader will be personally responsible for the care and custody of the samples until they are transferred or dispatched properly.

All sample containers will be labeled with a unique sample identifier that will consist of an alphanumeric sequence. Any other pertinent information regarding sample identification will be recorded in the field logbooks and/or on sample log sheets. Soil samples will be identified by the boring number followed by the depth of the sample below ground surface. Groundwater samples will be identified by the well number.

Labels will be completed prior to or during the sampling event for each sample. Labels will be completed with the site name, sample ID, sample collection date and time, analysis requested, and preservative (if any) and will be initialed by the sample collector. Labels will be water resistant, and will be completed using waterproof ink.

All relevant information will be transferred to a laboratory-supplied chain of custody (COC) form and signed by the individual responsible for the sampling.

Copies of the COC and field documentation will be supplied to the FOL or his/her designee on the same day as the sampling event. The FOL will review field activities to determine whether proper custody procedures were followed during the fieldwork and will decide if additional samples are required. The FOL will notify the project QAO of any deficiencies encountered during the review of documentation and will provide a copy of the reviewed/corrected COC to the Database Manager.

### 10.1.2 Field Notebook/Documentation

Field notebooks will provide the means of recording the data collecting activities performed. As such, entries will be described in as much detail as possible so that persons going to the Site could reconstruct a particular situation without reliance on memory.

Field notebooks will be bound, numbered, field survey books or notebooks. Field notebooks will be maintained by the Task Manager until they are archived. Each notebook will contain the notebook number, project identification, “return to” information, and project start and end dates. Entries into the notebook will include the Project name and number, date, start-time, weather, summary and purpose of planned field activities, and the names of all sampling team members present. The names of visitors to the Site (including subcontractors), the times and dates of their arrival and departure, and the purpose of their visit will also be recorded in the field notebook.

Content of the field notebook will include, but not be limited to, measurements made and samples collected, descriptions of sampling locations, sample collection times and depths, calibration information for field equipment, etc. Information recorded in the field notebook may be transferred to AECOM standard logs used to record and present field data. These logs may include:

- Geologic/Soil boring logs;
- Well construction logs;
- Well development logs;
- Groundwater purge and sample logs;
- Water level and product thickness records;
- COC forms; and
- Environmental sample logs.

Logs will include entries in every blank, with appropriate use of the abbreviations NA (not applicable) and NR (not recorded). All "NR" entries should be accompanied by an explanation. All entries will be recorded in waterproof ink or marker, and signed and dated by the person making the entry. No erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark, the correct entry recorded, and the change initialed and dated by the person making the correction.

Special visual observations and detection of odors shall be indicated in the field book. However, careful attention shall be given when attributing the source or substance of the observations.

A photographic log will also be maintained (when applicable) by AECOM field personnel. Field documentation of each photograph will be recorded in the field notebook and will contain a description of the object and field of view being photographed, type and lens size (if applicable) of camera, direction faced, frame number, time and date the photograph was taken, identity of photographer, and indication of scale or scale reference. The reference number assigned to the photograph and described in the log will be written on the back of the photograph and/or the file name of the electronic version will be saved with the reference number. Copies of the photographic logs will be filed in a central location in the AECOM Piscataway, New Jersey office. Detailed field documentation procedures for the Recording of Field Data are presented in POP PPG 001 in **Appendix B**.

### 10.1.3 Transfer of Custody and Shipment Procedures

Samples will be packaged and shipped according to POPs PPG 002 and PPG 003 in Appendix B. Samples will be accompanied by a properly completed COC form. At the time the sample possession is transferred, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler, to another person, to a mobile laboratory, to the permanent laboratory, or to/from secure storage locations.

Minimum information recorded on the COC record in addition to the signatures and dates of all custodians will include the following information in the appropriate spaces on the COCs:

| | |
|---|---|
| **Name (for Reporting):** | Designated AECOM Project Manager |
| **Company:** | AECOM |
| **Address:** | (INSERT Task Manager address) |
| **City, State, Zip Code:** | (INSERT Task Manager address) |
| **Phone:** | (INSERT Task Manager phone) |
| **Fax:** | (INSERT Task Manager fax) |
| **Email:** | njlabdata@aecom.com |
| **Name (for Invoicing):**<br>**Company:** | Erin Farrell<br>AECOM |
| **Address:** | 30 Knightsbridge Road, Suite 520 |
| **City, State, Zip Code:** | Piscataway, NJ 08854 |
| **Phone:** | (732) 564-3609 |
| **Fax:** | (732) 369-0122 |
| **Email:** | Erin.Farrell@aecom.com |
| **Samplers Name:** | This person must be the same person that relinquishes initial custody. |
| **Sample Delivery Group (SDG) No.** | The SDG Number will be recorded when assigned by the laboratory. The PPG Site Number will be included in the Sample ID. |
| **Purchase Order (PO) Number:** | AECOM's PO number (provided to the sampler by the Task Manager) |
| **AECOM Project Number** | **INSERT Task Specific Project Number (Mandatory Information to be Required on all COCs)** |
| **Site/Project Identification:** | PPG Site Number |
| **Case Type:** | NJ –Administrative Consent Order |

Any special instructions are to be filled in on every page of the COCs and page numbers must be written at the top right corner of the COC.

Aqueous and non-aqueous (soil, chip, wipe, sweep, waste, core) samples will be packed in coolers and transported, as needed, from the field to the laboratory by courier, laboratory representative, or AECOM personnel. For air samples, sample cassette /plastic mailer assemblies should be placed in a clean Ziploc® bag and the bag should be packed with small bubble wrap snugly in a clean shipping container or cooler to prevent movement of the samples during shipment. To preserve the samples during transit, blue ice packs will be placed inside the shipping cooler as standard practice. Refer to POP PPG 019. Samples are generally shipped daily to arrive at the laboratory within 24 hours of collection. Sample containers will be placed in a cooler packed with an absorbent material such as vermiculite and packed with ice to maintain a temperature of 4°C.

All sample containers will be labeled as described above. All sample documentation will then be affixed to the underside of each transport container lid. If samples are shipped to the laboratory via overnight air transportation (e.g., Federal Express) or by commercial courier, the COC record identifying the contents will be enclosed in each sample cooler and the cooler will be taped closed with fiberglass tape covering the custody seals. If a laboratory courier is used, the courier will sign the COC before departing the site. The transport container lid will then be closed and affixed with a custody seal. The coolers will be locked or secured with strapping or packing tape and sealed with custody seals. The preferred procedure is to attach a custody seal to the front right and back left of the cooler. The back copy of the COC will be detached and kept as part of the field records. The original record and remaining copies will accompany the coolers.

Regulations for packaging, marking/labeling, and shipping hazardous materials and wastes are issued by the USDOT. Air carriers which transport hazardous materials, such as Federal Express, may also require compliance with the current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations. The IATA protocol details the procedures for the shipment and transportation of hazardous materials by a common air carrier. It is important to note that following all current IATA regulations will ensure compliance with USDOT protocol.

## 10.2 Laboratory Custody Procedures

The laboratory will be responsible for receiving the samples and logging them in. On arrival at the laboratory, all samples will be inspected thoroughly to confirm that the integrity of the samples and containers has not been compromised. The cooler custody seals will be inspected to verify that they are still intact and were properly signed and dated by the field sampling team. The individual sample containers will be inspected to verify that each has a sample label. The condition of the samples may be noted on the COC form under "Remarks".

The sample containers will be checked against the accompanying chain-of-custody to verify that the cooler contents are identical to the samples described on the COC documents. If discrepancies exist, they will be reported to the designated Project Manager by the Laboratory’s Project Manager. The problem will be resolved, in writing (e.g., email, fax, memo, etc.), before the samples are logged in.

After it has been determined that the samples are in satisfactory condition and the documents are in order, each sample will be assigned a unique laboratory identification number. A sample log-in sheet will be initiated and will serve as documentation as to the condition of the samples upon receipt and cross-referenced between field identification numbers and assigned laboratory numbers.

After the samples have been entered into the laboratory tracking system, copies of the log-in forms and chain-of-custody records will be sent to the Project Manager, who will verify that the specified samples and parameters correspond to the samples and parameters identified in the FSP/QAPP. The samples will be placed in a secured storage area, under the conditions called for by the analytical method, until taken for analysis. Samples removed from the secure area for preparation or analysis will be tracked using internal custody forms.

Typically, samples will not be delivered on Saturday or Sunday. If Saturday delivery is required, the laboratory will be notified in advance.

# 11.0 Calibration Procedures

This section describes procedures for maintaining the accuracy of all the instruments that are used for conducting field tests and laboratory analyses. These instruments will be calibrated at the frequencies recommended by the manufacturer and the information will be recorded in the appropriate field book.

## 11.1 Field Instrument Calibration

Instruments used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Field instruments will be issued through a formal tracking system and operated by trained personnel, in accordance with the appropriate POPs or manufacturer's specifications. Each instrument used in the field will be examined daily by the AECOM FOL or his designee to verify that it is operating properly.

Field instruments will include a PID; hydrogen sulfide portable, hand-held monitor; air monitoring units containing continuous gas chromatographs (GC) fitted with a PID; the MiniVol™ portable (tactical) air sampler; water level meter; multi-parameter water quality meter; turbidity meter; and an aerosol/dust monitor. Calibration procedures will be performed according to the applicable SOP(s) and/or POP(s) in **Appendix B** work plans, and/or applicable manufacturer's instructions. In general, each instrument will be calibrated daily before its initial use. The calibration will be checked periodically according to the manufacturer's recommendations and/or the requirements in the applicable SOP(s), POP(s) and work plans. Calibration and calibration check results will be recorded in calibration log forms or in the field logbook. Preventative maintenance will be performed by the equipment rental agency supplying the instruments.

Calibration procedures will be documented in the field records. Documentation will include the date and time of calibration, the identity of the person performing the calibration, the reference standard used, the readings taken, and any corrective action. This information will be incorporated into the appropriate reports to be submitted to NJDEP for review. In addition to the manufacturer's recommended calibration procedures and frequencies, the contractor's preventive maintenance and internal calibration schedule will be provided and kept at the site for review by the NJDEP auditor. Field instruments will be calibration checked at a minimum of twice daily, before and after use. A calibration curve will be run every six (6) to eight (8) weeks. Documentation will also include the calibration curve, as well as a log of field calibration dates and standards.

### 11.1.1 Laboratory Instrument Calibration

Calibration is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet the detection limits established for the method (refer to the applicable SOPs in **Appendix D**). These methodologies include specific instrument calibration procedures and frequencies that will be followed by the laboratory. If an instrument has not been properly calibrated and the quality of the data has been adversely affected, the corrective actions outlined in the methodologies will be implemented.

The laboratory maintains documentation for each instrument which includes the following information: instrument identification, serial number, date of calibration, analyst, calibration solutions, and the samples associated with these calibrations.

# 12.0 Laboratory Operations

## 12.1 Analytical Procedures

The analytical methods shown in **Appendix D, Laboratory SOP Lists**, will be used for all site specific analyses, such as, hexavalent chromium and total chromium. Additional analyses may be required including those for volatile and semi-volatile organics, PCBs, and additional metals. The site-specific work plans for each site will provide a specific list of analytes. SW-846 Methods are used for determination of volatile and semivolatile organics, metals, and hexavalent chromium; these methods are consistent with the regulatory requirements of this program but permit flexibility to maximize data usability with regard to sample preparation and clean up, and analytical sensitivity. Contract Laboratory Program (CLP)-type quality control requirements will, however, be implemented for all analyses as noted in **Section 12.3** of this document.

The laboratories identified in **Section 2.2** will be responsible for conducting all chemical analyses specified in **Appendix D**. Sample handling protocols, analytical procedures, and reporting procedures employed by the laboratories are described in the laboratory SOPs (**Appendix D**) and in the Quality Assurance Plan for each laboratory (which can be provided upon request).

## 12.2 Bottle Preparation

The laboratories will provide properly prepared containers for sampling in a convenient insulated shipping container/cooler. COC seals and forms are provided to ensure complete documentation during sample transport, sampling and analysis. The laboratories provide both chemical preservatives and ice packs in the coolers to ensure that proper preservation techniques are performed and preservation requirements are met. The laboratories provide new, properly cleaned sample containers in the cooler for sample collection. The laboratories do not prepare solvent rinsed sample containers. Solvent rinsed bottles are purchased as projects necessitate. The vendor-prepared bottles are prepared by USEPA protocol. The bottle and preservation requirements for the non-residential sites are summarized in **Appendix C**.

Bottle preparation procedures are described in Specifications and Guidance for Contaminant-Free Sample Containers, EPA-540/R-93/051. The selected laboratories provide containers from suppliers who meet or exceed the requirements outlined in this document; each lot of bottles is delivered with documentation certifying that the containers meet USEPA specifications. The laboratory sample management staff documents the receipt of each bottle shipment upon delivery. The bottle size, vendor lot number, date received, date submitted for quality control checking and date approved for use are recorded in a Bottle Receipt Logbook.. The lot certificate of analysis supplied by the bottle manufacturer is archived by the laboratory Quality Assurance Manager; this information is available on request.

## 12.3 Quality Control

Each laboratory has a QC program in place to ensure the reliability and validity of the analysis performed at the laboratories. All analytical procedures are documented in writing as SOPs and each SOP includes a QC section which addresses the minimum QC requirements for the procedure to meet CLP requirements. The internal QC checks differ slightly for each individual procedure but the following general QC requirements are incorporated as appropriate to the analytical procedure:

- Method blanks;
- Reagent/preparation blanks (inorganic parameters);
- Instrument blanks;
- MS/MSDs;
- Surrogate spikes;
- Laboratory duplicates
- Laboratory control sample (LCS);
- Post-digestion spike
- Internal standard areas;
- Mass tuning;
- Inductively Coupled Plasma (ICP) serial dilutions; and
- ICP interference check samples.

## 12.4 Data Reduction and Reporting

Data reduction, QC review, and reporting will be the responsibility of the analytical laboratory and is discussed in this section. Data assessment, including a formal data validation procedure, will be conducted by AECOM. AECOM will also conduct data reduction to facilitate the use of raw data in site evaluations. This process is discussed in the next section.

### 12.4.1 Data Reduction

Data reduction includes all automated and manual processes for reducing or organizing raw data generated by the laboratory. For all published and referenced methods, the laboratories adhere strictly to the requirements of the method for calculation of results. Further details are supplied in the laboratories’ Standard Operating Procedures.

### 12.4.2 Data QC Review

Prior to being released as final, laboratory data will proceed through a tiered review process. Data verification starts with the analyst who performs a review of the data to ensure the work was done correctly the first time. Following the completion of the initial verification by the analyst performing the data reduction, a systematic check of the data will be performed by an experienced peer or supervisor. This check will be performed to ensure that initial review has been completed correctly and thoroughly. A third-level review will be performed by the Laboratory Project Manager before results are submitted to clients. This review serves to verify the completeness of the data report and to ensure that project requirements are met for the analyses performed.

### 12.4.3 Data Reporting

The full analytical, quality control, and deliverables requirements (3 electronic copies, and one paper copy for chromium results; full data packages for all analytes) will be provided with the final Remedial Investigation Report, including New Jersey Electronic Data Deliverable (EDD), to be submitted to NJDEP. At a minimum, the data included in the laboratory report will meet the requirements of the Reduced Laboratory Data Deliverables for non-USEPA CLP Methods. A fully validatable CLP-type data package containing all raw data will be requested for those data sets being subjected to full data validation.

Full laboratory data deliverables, as detailed in Appendix A of the NJDEP *Technical Requirements for Site Remediation* (November 2009) will be submitted for all hexavalent chromium and hexavalent chromium associated (pH, Eh, sulfides, etc.) analyses. The full laboratory data deliverables will consist of the following:

- three electronic copies of the laboratory data package on CD in Adobe portable document format (pdf),
- one paper copy of the laboratory data package,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*,
- and one electronic copy of the analytical data in the EQuIS four-file format, as modified by AECOM.

Reduced laboratory data deliverables, as detailed in Appendix A of the NJDEP *Technical Requirements for Site Remediation* (November 2009), will be submitted for all other analytical data (ex, metals, VOCs, etc.). The reduced laboratory data deliverables will consist of the following:

- one electronic copy of the laboratory data package on CD in Adobe pdf will be submitted,
- three electronic copies of the analytical data using the format NJDEP's 1999 *Electronic Data Interchange Manual*,
- and one electronic copy of the analytical data in the EQuIS four-file format, as modified by AECOM.

# 13.0 Data Validation

Each data package will undergo a formal review procedure. The validation will be performed by the AECOM data validation staff under direction of the AECOM Data Validation Manager.

## 13.1 Data Validation

Validation of the laboratory deliverables will be performed by AECOM. One hundred percent of the analytical data will be reviewed, either as full or limited validation or for completeness. The percentage of the data for each level of validation will be identified in the site-specific work plan for each program.

For full validation, the data will be reviewed for the following, where applicable to the method:

- Completeness of deliverable;
- Technical holding times and sample preservation;
- Laboratory and field blank contamination;
- Surrogate spike recoveries,
- Field and laboratory duplicates;
- MS/MSD recoveries and RPDs;
- Post-digestion spike recoveries;
- LCS recoveries;
- Initial and continuing calibrations;
- Instrument tuning,
- Internal standard performance,
- ICP serial dilution results;
- ICP interference check sample results; and
- Calculation and transcription verifications (i.e., verifying summary data against raw data).

Limited validation will be based on information presented on summary forms and will include the following:

- Completeness of deliverable;
- Technical holding times and sample preservation;
- Laboratory and field blank contamination;
- Surrogate spike recoveries,

- Field and laboratory duplicates;
- MS/MSD recoveries and RPDs; and
- LCS recoveries.

The discovery of significant anomalies or discrepancies during validation using the summary forms may result in an in-depth review of the raw data and the incorporation of additional review elements into the validation of all data.

AECOM will perform validation of soil and aqueous samples according to the following validation protocols:

- Target Compound List (TCL) Organics, USEPA Region 2 Data Validation Guidance, which will be modified as required to reflect the actual laboratory SOPs used for this program.):
    - *Validating Volatile Organic Compounds by SW-846 Method 8260B, SOP-HW-24*, Rev.2, October 2006;
    - *Validating Semivolatile Organic Compounds by SW-846, Method 8270; SOP HW-22*, Rev 3, October 2006
- Target Analyte List (TAL) Inorganics, NJDEP Office of Data Quality Data Validation (DV) SOP:
    - SOP 5.A.16 , Rev. 1, Quality Assurance Data Validation of *Analytical Deliverables for Inorganics (based on USEPA SW-846 methods);* May 2002.
- Hexavalent Chromium, NJDEP Office of Data Quality DV SOPs:
    - SOP 5.A.9, Rev.1, *Standard Operating Procedure for the Completion of the Hexavalent Chromium Data Validation Report Forms and the Preparation of the Final Data Validation, October 2001.*
    - SOP 5.A.10, Rev.3, *Standard Operating Procedure for Analytical Data Validation of Hexavalent Chromium,* September 2009.

Data for $PM_{10}$ and hexavalent chromium in air will be reviewed for adherence to the respective SOP, and the laboratory precision and accuracy control limits contained in the method.

Once the validation for a data package is completed, a validation report will be prepared. This report will summarize the samples reviewed, elements reviewed, any nonconformances with the established criteria, and validation actions (including application of data qualifiers). Data qualifiers will be consistent with the NJDEP SOPs. Data validation results will be presented in accordance with the NJDEP "hit list" format using the template provided in **Appendix E**. A copy of each validation report as well as the analytical data package will be forwarded to the NJDEP for review with each report submittal.

## 13.2 Data Assessment

Following data validation, the AECOM project technical staff will assess the data for usability. Data assessment activities will examine site-specific factors which interfere with chemical analyses or utility of the results. Some of the factors which will be assessed include:

- Adverse matrix effects on the analytical recoveries.
- Nature and cause of extraneous contamination not attributable to laboratory contamination.
- Reproducibility of results for site-specific media in relation to stated precision goals.
- Adequacy of the data base in terms of numbers of samples, critical data points, and representativeness for meeting stated objectives.

Validated data and related assessments will be reported in appropriate charts and tables in the RI report.

## 13.3 Data Reliability

The overall reliability of the data will be assessed primarily using the results of the data validation process and will include a discussion of the effect of any nonconformances with regard to holding times, sample preservation, blank contamination, instrument calibration, and QC analyses. The usability of hexavalent chromium data will be evaluated based on the pre-digestion and post-digestion spike recoveries and the parameters indicative of oxidizing/reducing conditions.

# 14.0 Performance and System Audits

A system audit is defined as a qualitative evaluation of the components of a measurement system to determine their proper selection and use. A performance audit is a quantitative evaluation of the measurement system that requires testing of the system with samples of known composition or behavior to evaluate precision and accuracy.

## 14.1 Field Procedures

### 14.1.1 Field Performance Audits

It will be the responsibility of the AECOM FOL to continually monitor the performance of the field team, including subcontractors, for conformance to the site-specific work plan(s) and the FSP/QAPP. Any problems or deficiencies will be communicated to the Project Manager and project QAO. A record of any problems encountered, and their resolution, will be maintained in the field notebook.

Field performance will also be evaluated based on the analytical results of the field blanks and field duplicates. Field blanks assess the effectiveness of measures taken in the field to minimize cross contamination. The results of field duplicates reflect the ability of the field team to collect representative sample portions of each matrix type.

### 14.1.2 Field System Audits

Internal audits of field activities will be conducted periodically by the project QAO (or designate) during the field sampling program. Follow-up audits will be conducted if significant problems are encountered.

The audits will cover the execution of sample identification, sample control, COC procedures, field sampling and documentation, agreement with QA/QC objectives, FSP/QAPP and site-specific work plan(s). The audits will involve a review of field logbooks and standard forms, COC records, and instrument calibration records. The project QAO will review field performance with the FOL.

During the field performance audit, the auditor will maintain a record of the audit with written field notes. Preliminary results of the audit will be reviewed with the FOL. Corrective action for deficiencies that adversely affect the quality of the data will be implemented immediately.

Upon completion of the audit, the project QAO will develop an audit report in the form of a memorandum that summarizes the audit findings and identifies those areas still requiring corrective measures. This report will be submitted in memorandum form to the AECOM Project Manager, Task Manager, FOL, to NJDEP as well as to the project file. The resolution of final action as described in **Section 17.0** of the FSP/QAPP will be subsequently implemented.

## 14.2 Laboratory Audits

AECOM has contracted NJDEP-certified laboratories to perform all laboratory analysis of soil and groundwater sampling performed by AECOM.

### 14.2.1 Laboratory Performance Audits

Continuous performance auditing is accomplished through the regular use of LCS, matrix spike samples, duplicate samples, QC samples, proficiency testing, and through continuing calibration verification samples. Federal and State agencies may administer the proficiency testing.

### 14.2.2 Laboratory System Audits

The laboratory will conduct regular audits of facilities, processes, and procedures according to written protocols established by the laboratory QA Program. These audits will be conducted by the laboratory's QA Officer and the results documented in the laboratory analytical reports.

Laboratory audits are conducted periodically by AECOM or another qualified party as part of their analytical subcontractor monitoring program. The laboratory audit includes a review of the following areas:

- QA organization and procedures;
- Personnel training and qualifications;
- Sample log-in procedures;
- Sample storage facilities;
- Analyst technique;
- Adherence to laboratory SOPs;
- Compliance with QA/QC objectives;
- Instrument calibration and maintenance;
- Facility security;
- Bottleware preparation;
- Waste management;
- Data archival;
- Data recording, reduction, review, and reporting; and
- Cleanliness and housekeeping.

Preliminary results of the systems audit are discussed with laboratory personnel in an on-site debriefing. A written report that summarizes audit findings and recommends corrective actions is prepared and submitted to the laboratory for response, to the AECOM Project Manager and will be submitted to NJDEP as well. The results of the audit, including resolution of any deficiencies, are included in the QA reports to management as described in **Section 17**.

# 15.0 Preventative Maintenance

## 15.1 Field Instruments

Field instruments will be rented through an equipment rental company. Preventive maintenance for all field instruments is conducted according to applicable manufacturer's instructions by the rental company. A representative log for maintenance or calibration of field instruments is included with the rental unit. Instrument instruction manuals will be maintained with the rental unit.

AECOM field personnel will be responsible for ensuring that the instruments are properly functioning. At a minimum, this will entail checking the instrument prior to shipment to the field and performing daily operational checks and calibration as described in **Section 11**. Routine maintenance and trouble-shooting procedures will be performed as described in the manufacturer’s instructions. All calibration and maintenance procedures will be documented in field records. Spare parts will be readily available on site or from the vendor. Preventive maintenance for all field instruments will be conducted according to applicable manufacturer's instructions, NJDEP guidance, and rental company SOPs.

Instrument instruction manuals will be available on site. Critical spare parts such as lamps, probes, and battery chargers will be kept on site to minimize downtime.

## 15.2 Laboratory Instruments

The laboratories will conduct preventative maintenance routinely on each analytical instrument and analytical instruments will be maintained and serviced in accordance with the manufacturer's specifications, laboratory SOPs, and analytical methods.

# 16.0 Corrective Action

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-limit QC performance that can affect data quality. Corrective action can occur during data compilation, data import, data validation, and data assessment. Any nonconformance with the established QC procedures in the FSP/QAPP will be identified and corrected in accordance with the FSP/QAPP. Corrective actions proposed and implemented in response to potential data quality issues will be documented in the QA sections of project deliverables. The following procedures should be followed when problems are identified and corrective actions are taken:

The person who identifies the problem is responsible for notifying the AECOM Project Manager, relevant Task Manager, and project QAO.

- Corrective action should only be implemented after approval by the AECOM Project Manager, or his designee (generally the FOL).
- If immediate corrective action is required, approvals may be secured by telephone from the AECOM Project Manager.
- All corrective actions should be documented in writing.

Corrective actions are defined as those measures taken to rectify a laboratory or field measurement system that exceeds its control limits. These actions may be initiated by any person performing work in support of investigation or remediation activity. The need for corrective action may be identified by system or performance audits or by standard QC checks. The essential steps in the corrective action process are:

- Identifying and defining the problem;
- Assigning responsibility for investigating the problem;
- Investigating and determining the cause of the problem;
- Determining a corrective action to eliminate the problem;
- Assigning and accepting responsibility for implementing the corrective action;
- Implementing the corrective action and evaluating its effectiveness; and
- Verifying that the corrective action has eliminated the problem.

## 16.1 Sample Collection/Field Measurements

Corrective action in the field can be needed when:

- The sample network is changed (i.e., more or fewer samples, sampling locations other than those specified in the site-specific work plan(s) and/or FSP/QAPP, etc.);

- Sampling procedures and/or field analytical procedures require modification because of unexpected conditions; or
- The integrity of field measurements or samples is in question.

The field team members will be responsible for identifying any suspected technical or QA deficiencies and reporting them to the AECOM FOL. The AECOM FOL will be responsible for assessing the suspected deficiency, for determining the impact on the quality of the data (in consultation with the project QAO, Task Manager, and Project Manager), developing the appropriate corrective action, and ensuring it is implemented. If the corrective action augments the original scope of the sampling plan (i.e., increases the numbers or types of samples/analyses) and uses existing and approved procedures in this FSP/QAPP, approval by the AECOM FOL and AECOM Project Manager will be sufficient. If the corrective action results in a reduced scope of the work, significant alterations in sample location, major modifications to analytical methods, or causes the project data quality objectives not to be achieved, it will be necessary for all levels of project management to concur with the proposed action.

If problems with field measurements occur, corrective action may include:

- Repeating the measurement to check the error;
- Checking for all proper adjustments for ambient conditions such as temperature;
- Checking the batteries;
- Recalibrating equipment;
- Checking the calibration;
- Replacing the instrument or piece of equipment; or
- Stopping work.

If, during his/her review of sampling operations, the AECOM FOL determines that the integrity or quality of the sample(s) has been adversely affected, the following corrective measures may be implemented:

- Reviewing sampling and/or COC procedures and modifying as necessary;
- Replacing or repairing sampling equipment;
- Collecting replacement sample(s); or
- Stopping work.

Deficiencies may also be noted during internal field audits. The project QAO will identify the deficiencies and recommend the appropriate corrective action to the AECOM Project Manager. Upon approval by the AECOM Project Manager, the AECOM FOL, Task Manager, and field team members will be responsible for implementing the corrective action. If the use of unapproved methods, or the improper use of approved methods, is adversely affecting the data, corrective action may be implemented immediately.

Corrective actions will be documented in the field records. Documentation will include:

- A description of the circumstance that initiated the corrective action;
- The action taken in response;
- The final resolution; and
- Any necessary approvals.

Corrective action resulting from internal field audits will be documented in the QA reports to management per **Section 17**. No staff member will initiate corrective action without prior communication of findings through the proper channels.

## 16.2 Laboratory Analyses

Laboratory personnel will be alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy;
- Blanks contain target analytes above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected by the QA department during internal or external auditors or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received.

Corrective action procedures may be handled at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors, check the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. Corrective action will be in accordance with method protocol (when applicable). If the problem persists or cannot be identified, the matter will be referred to the laboratory supervisor, manager and/or QA department for further investigation. If the nonconformance causes the project objectives not be achieved, the AECOM Project QAO will be notified, who in turn will communicate the issue to the AECOM Project Manager and Task Manager.

Corrective actions will be performed prior to the release of data from the laboratory. The corrective action will be documented in both the laboratory's corrective action files, and in the narrative data report generated by the laboratory.

## 16.3 Data Validation/Data Assessment

The need for corrective action may be identified during either data validation or data assessment. Potential types of corrective action may include re-sampling by the field team or re-injection and reanalysis of samples by the laboratory. These actions are dependent upon the ability to mobilize the field team, whether the data to be collected are necessary to meet the required QA objectives, and physical limitations on the ability to recollect or reanalyze the sample.

The need for corrective action may be identified by the data validator or by a member of the project team assessing the data. The person responsible for identifying the corrective action situation will notify the AECOM Project Manager, who will be responsible for approving implementation of the corrective action. All corrective actions of this type will be documented by the project QAO in the QA reports (**Section 17**).

# 17.0 Quality Assurance Reports

As part of the requirements of each member of the project team, notification will be submitted to the project QAO to ensure that any problems identified during the sampling and analysis programs are investigated and the proper corrective measures taken in response. The FOL and Task Managers will assist the project QAO in preparing the QA reports. These reports will be prepared on an as-needed basis and will include:

- Summary of the status of field activities, including compiled field data sets and the results of field audits;
- Periodic assessment of measurement data accuracy, precision, and completeness;
- Data validation results;
- Summary of the status of laboratory activities, including timely submittal of analytical results, and compilation of QC data; and
- Any other QA issues relevant to the project, including corrective action situations, resolutions of previously stated problems, summaries of training programs, results of any performance evaluation audits, and any minor changes to this FSP/QAPP.

These QA reports will be prepared in writing by the project QAO who will provide compilation report(s), as necessary to the AECOM Principal-in-Charge, Project Manager, and to NJDEP. If serious QA deficiencies are noted, supplemental reports may be submitted.

# 18.0 References

New Jersey Administrative Code (N.J.A.C.), 2007. Title 7.

Chapter 9C. *Ground Water Quality Standards*, date last amended November 4, 2009 and *Specific Ground Water Quality Criteria*. Appendix Table 1.

Chapter 9D. *Well Construction and Maintenance; Sealing of Abandoned Wells* (Drilling Regulations and Requirements Effective April 2, 2007).

Chapter 26C. *Administrative Requirements for the Remediation of Contaminated Sites* (ARRCS), date adopted November 4, 2009, last amended April 19, 2010.

Chapter 26D. *Remediation Standards*, date last amended November 4, 2009.

Chapter 26E. T*echnical Requirements for Site Remediation,* date adopted November 4, 2009, date last amended April 19, 2010.

NJDEP, July, 1994. *Alternative Ground Water Sampling Techniques Guide*.

NJDEP, July 1994. *Field Analysis Manual*.

NJDEP, June 1997. *Guidance for the Submission and Use of Data In GIS Compatible Formats Pursuant to "Technical Requirements for Site Remediation,"* last revised January 30, 2009.

NJDEP, May 1999. *Soil Cleanup Criteria,* last revised May 12, 1999.

NJDEP, April 1999. *Site Remediation Program Electronic Data Interchange Manual*.

NJDEP, October 2001. SOP 5.A.9, Rev.1, *Standard Operating Procedure for the Completion of the Hexavalent Chromium Data Validation Report Forms and the Preparation of the Final Data Validation.*

NJDEP, May 2002. SOP 5.A.16 Rev. 1, Quality Assurance Data Validation of *Analytical Deliverables for Inorganics (based on USEPA SW-846 methods)*.

NJDEP, December 2003. *Low Flow Purging and Sampling Guidance*.

NJDEP, August 2005. *Field Sampling Procedures Manual,* last updated April 30, 2009.

NJDEP, February 2007. NJDEP *Commissioner Jackson's February 8, 2007 Memorandum Regarding Chromium Moratorium*.

NJDEP, September 2008. *Chromium Soil Cleanup Criteria,* last revised April 2010.

NJDEP, December 2008. *Guidance Document Development of Site-Specific Impact to Ground Water Soil Remediation Standards using the Soil-Water Partition Equation.*

NJDEP, September 2009. SOP 5.A.10, Rev.3, *Standard Operating Procedure for Analytical Data Validation of Hexavalent Chromium*.

NJDEP, USEPA Region II, October 2006. *Validating Volatile Organic Compounds by SW-846 Method 8260B*, SOP-HW-24, Rev.2.

USEPA Region II, October 2006; *Validating Semivolatile Organic Compounds by SW-846*, Method 8270; SOP HW-22, Rev 3.

# Tables

## TABLE 5-1 ANALYTES, ANALYTICAL METHODS, NJDEP SITE REMEDIATION STANDARDS, NJDEP PRACTICAL QUANTITATION LIMITS, AND LABORATORY REPORTING LIMITS FOR SOIL/SOLID SAMPLES

| Analyte [1] | Accutest Method | Test America Method | CAS No. | NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg) | NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Soil PQL (mg/kg) | Accutest RL (mg/kg) | Test America RL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| **TAL Metals** | | | | | | | | | |
| Aluminum | SW846 6010B | SW846 6010B | 7429-90-5 | 3,900 | 78,000 | NA | 20 | 20 | 10 |
| Antimony | SW846 6010B | SW846 6010B | 7440-36-0 | 4 | 31 | 450 | 6 | 2 | 0.5 |
| Arsenic | SW846 6020 | SW846 6010B | 7440-38-2 | 19 [9] | 19* | 19* | 1 | 0.04 | 0.25 |
| Barium | SW846 6010B | SW846 6010B | 7440-39-3 | 1,300 | 16,000 | 59,000 | 20 | 20 | 10 |
| Beryllium | SW846 6010B | SW846 6010B | 7440-41-7 | 0.5 | 16 | 140 | 0.5 | 0.2 | 0.1 |
| Cadmium | SW846 6010B | SW846 6010B | 7440-43-9 | 1 | 78 | 78 | 0.5 | 0.5 | 0.25 |
| Calcium | SW846 6010B | SW846 6010B | 8047-59-4 | NA | NA | NA | NA | 500 | 250 |
| Chromium - Hexavalent | SW846 3060A/7196A | SW846 7196A | 18540-29-9 | See note [17] | 120 | 20 | 2 | 2 | 2 |
| Chromium (total) | SW846 6020 | SW846 6010B | 16065-83-1 | See note [17] | 120,000 | NA | 2 | 1 | 0.5 |
| Cobalt | SW846 6010B | SW846 6010B | 7440-48-4 | 59 | 1,600 | 590 | 5 | 5 | 2.5 |
| Copper | SW846 6010B | SW846 6010B | 7440-50-8 | 7,300 | 3,100 | 45,000 | 3 | 3 | 1.25 |
| Iron | SW846 6010B | SW846 6010B | 8053-60-9 | NA | NA | NA | NA | 10 | 7.5 |
| Lead | SW846 6020 | SW846 6010B | 7439-92-1 | 59 | 400 | 800 | 1 | 0.10 | 0.25 |
| Magnesium | SW846 6010B | SW846 6010B | 7439-95-4 | NA | NA | NA | NA | 500 | 250 |
| Manganese | SW846 6010B | SW846 6010B | 7439-96-5 | 42 | 11,000 | 5,900 | 2 | 2 | 0.75 |
| Mercury | SW846 7471A | SW846 7471A | 7439-97-6 | 0.1 [10] | 23 | 65 | 0.1 | 0.03 | 0.033 |
| Nickel | SW846 6010B | SW846 6010B | 7440-02-0 | 31 | 1,600 | 23,000 | 4 | 4 | 2 |
| Potassium | SW846 6010B | SW846 6010B | 7440-09-7 | NA | NA | NA | NA | 1000 | 250 |
| Selenium | SW846 6010B | SW846 6010B | 7782-49-2 | 7 | 390 | 5,700 | 4 | 2 | 0.5 |
| Silver | SW846 6010B | SW846 6010B | 7440-22-4 | 1 [10] | 390 | 5,700 | 1 | 0.5 | 0.5 |
| Sodium | SW846 6010B | SW846 6010B | 7646-69-7 | NA | NA | NA | NA | 1000 | 250 |
| Thallium | SW846 6010B | SW846 6010B | 7440-28-0 | 3 [10] | 5 | 79 | 3 | 1 | 0.5 |
| Vanadium | SW846 6010B | SW846 6010B | 7440-62-2 | NA | NA | NA | NA | 5 | 2.5 |
| Zinc | SW846 6010B | SW846 6010B | 7440-66-6 | 600 | 23,000 | 110,000 | 6 | 2 | 1.5 |

| Analyte [1] | Accutest Method | Test America Method | CAS No. | NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg) | NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Soil PQL (mg/kg) | Accutest RL (mg/kg) | Test America RL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| **TCL VOC** | | | | | | | | | |
| 1,1,1-Trichloroethane | SW846 8260B | SW846 8260B | 71-55-6 | 0.2 | 290 | 4,200 | 0.005 | 0.005 | 0.001 |
| 1,1,2,2-Tetrachloroethane | SW846 8260B | SW846 8260B | 79-34-5 | 0.005 [10] | 1 | 3 | 0.005 | 0.005 | 0.001 |
| 1,1,2-trichloro-1,2,2-trifluoroethane | SW846 8260B | SW846 8260B | 76-13-1 | NA | NA | NA | NA | 0.005 | 0.001 |
| 1,1,2-Trichloroethane | SW846 8260B | SW846 8260B | 79-00-5 | 0.01 | 2 | 6 | 0.005 | 0.005 | 0.001 |
| 1,1-Dichloroethane | SW846 8260B | SW846 8260B | 75-34-3 | 0.2 | 8 | 24 | 0.005 | 0.005 | 0.001 |
| 1,1-Dichloroethene | SW846 8260B | SW846 8260B | 75-35-4 | 0.005 | 11 | 150 | 0.005 | 0.005 | 0.001 |
| 1,2,3-Trichlorobenzene | SW846 8260B | SW846 8260B | 87-61-6 | NA | NA | NA | NA | 0.005 | 0.001 |
| 1,2,4-Trichlorobenzene | SW846 8260B | SW846 8260B | 120-82-1 | 0.4 | 73 | 820 | 0.005 | 0.005 | 0.001 |
| 1,2-Dibromo-3-chloropropane | SW846 8260B | SW846 8260B | 96-12-8 | 0.005 [10] | 0.08 | 0.2 | 0.005 | 0.01 (0.0005)[12] | 0.001 |
| 1,2-Dibromoethane | SW846 8260B | SW846 8260B | 106-93-4 | 0.005 [10] | 0.008 | 0.04 | 0.005 | 0.001 | 0.001 |
| 1,2-Dichlorobenzene | SW846 8260B | SW846 8260B | 95-50-1 | 11 | 5,300 | 59,000 | 0.005 | 0.005 | 0.001 |
| 1,2-Dichloroethane | SW846 8260B | SW846 8260B | 107-06-2 | 0.005 [10] | 0.9 | 3 | 0.005 | 0.001 | 0.001 |
| 1,2-Dichloropropane | SW846 8260B | SW846 8260B | 78-87-5 | 0.005 [10] | 2 | 5 | 0.005 | 0.005 | 0.001 |
| 1,3-Dichlorobenzene | SW846 8260B | SW846 8260B | 541-73-1 | 12 | 5,300 | 59,000 | 0.005 | 0.005 | 0.001 |
| 1,4-Dichlorobenzene | SW846 8260B | SW846 8260B | 106-46-7 | 1 | 5 | 13 | 0.005 | 0.005 | 0.001 |
| 1,4-Dioxane | SW846 8260B | SW846 8260B | 123-91-1 | NA | NA | NA | NA | 0.13 | 0.5 |
| 2-Butanone (MEK) | SW846 8260B | SW846 8260B | 78-93-3 | 0.6 | 3,100 | 44,000 | 0.01 | 0.01 | 0.01 |
| 2-Hexanone | SW846 8260B | SW846 8260B | 591-78-6 | NA | NA | NA | NA | 0.005 | 0.01 |
| 4-Methyl-2-pentanone(MIBK) | SW846 8260B | SW846 8260B | 108-10-1 | NA | NA | NA | NA | 0.005 | 0.01 |
| Acetone | SW846 8260B | SW846 8260B | 67-64-1 | 12 | 70,000 | NA | 0.01 | 0.01 | 0.01 |
| Benzene | SW846 8260B | SW846 8260B | 71-43-2 | 0.005 [10] | 2 | 5 | 0.005 | 0.001 | 0.001 |
| Bromochloromethane | SW846 8260B | SW846 8260B | 74-97-5 | NA | NA | NA | NA | 0.005 | 0.001 |
| Bromodichloromethane | SW846 8260B | SW846 8260B | 75-27-4 | 0.005 [10] | 1 | 3 | 0.005 | 0.005 | 0.001 |
| Bromoform | SW846 8260B | SW846 8260B | 75-25-2 | 0.02 | 81 | 280 | 0.005 | 0.005 | 0.001 |
| Bromomethane | SW846 8260B | SW846 8260B | 74-83-9 | 0.03 | 25 | 59 | 0.005 | 0.005 | 0.001 |
| Carbon disulfide | SW846 8260B | SW846 8260B | 75-15-0 | 4 | 7,800 | 110,000 | 0.5 | 0.005 | 0.001 |

| Analyte [1] | Accutest Method | Test America Method | CAS No. | NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg) | NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Soil PQL (mg/kg) | Accutest RL (mg/kg) | Test America RL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| Carbon tetrachloride | SW846 8260B | SW846 8260B | 56-23-5 | 0.005 [10] | 0.6 | 2 | 0.005 | 0.005 | 0.001 |
| Chlorobenzene | SW846 8260B | SW846 8260B | 108-90-7 | 0.4 | 510 | 7,400 | 0.005 | 0.005 | 0.001 |
| Chloroethane | SW846 8260B | SW846 8260B | 75-00-3 | NA | 220 | 1,100 | 0.005 | 0.005 | 0.001 |
| Chloroform | SW846 8260B | SW846 8260B | 67-66-3 | 0.2 | 0.6 | 2 | 0.005 | 0.005 | 0.001 |
| Chloromethane | SW846 8260B | SW846 8260B | 74-87-3 | NA | 4 | 12 | 0.005 | 0.005 | 0.001 |
| cis-1,2-Dichloroethene | SW846 8260B | SW846 8260B | 156-59-2 | 0.2 | 230 | 560 | 0.005 | 0.005 | 0.001 |
| cis-1,3-Dichloropropene | SW846 8260B | SW846 8260B | 10061-01-5 | 0.005 [10] | 2 | 7 | 0.005 | 0.005 | 0.001 |
| Cyclohexane | SW846 8260B | SW846 8260B | 110-82-7 | NA | NA | NA | NA | 0.005 | 0.001 |
| Dibromochloromethane | SW846 8260B | SW846 8260B | 124-48-1 | 0.005 [10] | 3 | 8 | 0.005 | 0.005 | 0.001 |
| Dichlorodifluoromethane | SW846 8260B | SW846 8260B | 75-71-8 | 25 | 490 | 230,000 | 0.005 | 0.005 | 0.001 |
| Ethylbenzene | SW846 8260B | SW846 8260B | 100-41-4 | 8 | 7,800 | 110,000 | 0.005 | 0.001 | 0.001 |
| Isopropylbenzene | SW846 8260B | SW846 8260B | 98-82-8 | NA | 12NA | NA | NA | 0.005 | 0.001 |
| m,p-Xylene | SW846 8260B | SW846 8260B | 108-38-3 & 106-42-3 | 12 | NA | NA | NA | 0.002 | 0.002 |
| Methyl Acetate | SW846 8260B | SW846 8260B | 79-20-9 | 14 | 78,000 | NA | 0.005 | 0.005 | 0.001 |
| Methyl Tert Butyl Ether | SW846 8260B | SW846 8260B | 1634-04-4 | 0.2 | 110 | 320 | 0.005 | 0.001 | 0.001 |
| Methylcyclohexane | SW846 8260B | SW846 8260B | 108-87-2 | NA | NA | NA | NA | 0.005 | 0.001 |
| Methylene chloride | SW846 8260B | SW846 8260B | 75-09-2 | 0.007 | 34 | 97 | 0.005 | 0.005 | 0.001 |
| o-Xylene | SW846 8260B | SW846 8260B | 95-47-6 | 12 | NA | NA | NA | 0.001 | 0.001 |
| Styrene | SW846 8260B | SW846 8260B | 100-42-5 | 2 | 90 | 260 | 0.005 | 0.005 | 0.001 |
| Tetrachloroethene | SW846 8260B | SW846 8260B | 127-18-4 | 0.005 [10] | 2 | 5 | 0.005 | 0.005 | 0.001 |
| Toluene | SW846 8260B | SW846 8260B | 108-88-3 | 4 | 6,300 | 91,000 | 0.005 | 0.001 | 0.001 |
| trans-1,2-Dichloroethene | SW846 8260B | SW846 8260B | 156-60-5 | 0.4 | 300 | 720 | 0.005 | 0.005 | 0.001 |
| trans-1,3-Dichloropropene | SW846 8260B | SW846 8260B | 10061-02-6 | 0.005 [10] | NA | NA | NA | 0.005 | 0.001 |
| Trichloroethene | SW846 8260B | SW846 8260B | 79-01-6 | 0.007 | 7 | 20 | 0.005 | 0.005 | 0.001 |
| Trichlorofluoromethane | SW846 8260B | SW846 8260B | 75-69-4 | 22 | 23,000 | 340,000 | 0.005 | 0.005 | 0.001 |
| Vinyl chloride | SW846 8260B | SW846 8260B | 75-01-4 | 0.005 [10] | 0.7 | 2 | 0.005 | 0.005 | 0.001 |
| Xylene (total) | SW846 8260B | SW846 8260B | 1330-20-7 | 12 | 12,000 | 170,000 | 0.005 | 0.002 | 0.003 |

| Analyte [1] | Accutest Method | Test America Method | CAS No. | NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg) | NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Soil PQL (mg/kg) | Accutest RL (mg/kg) | Test America RL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| **TCL SVOC** | | | | | | | | | |
| 1,1'-Biphenyl | SW846 8270C | SW846 8270C | 92-52-4 | 90 | 3,100 | 34,000 | 0.2 | 0.067 | 0.33 [8] |
| 1,2,4,5-Tetrachlorobenzene | SW846 8270C | Need to subcontract [5] | 95-94-3 | NA | NA | NA | NA | 0.17 | Use Accutest [5] |
| 2,3,4,6-Tetrachlorophenol | SW846 8270C | Need to subcontract [5] | 58-90-2 | NA | NA | NA | NA | 0.17 | Use Accutest [5] |
| 2,4,5-Trichlorophenol | SW846 8270C | SW846 8270C | 95-95-4 | 44 | 6,100 | 68,000 | 0.2 | 0.17 | 0.33 [8] |
| 2,4,6-Trichlorophenol | SW846 8270C | SW846 8270C | 88-06-2 | 0.2 [10] | 19 | 74 | 0.2 | 0.17 | 0.33 (0.06) [12] |
| 2,4-Dichlorophenol | SW846 8270C | SW846 8270C | 120-83-2 | 0.2 [10] | 180 | 2,100 | 0.2 | 0.17 | 0.33 (0.05) [12] |
| 2,4-Dimethylphenol | SW846 8270C | SW846 8270C | 105-67-9 | 0.7 | 1,200 | 14,000 | 0.2 | 0.17 | 0.33 [8] |
| 2,4-Dinitrophenol | SW846 8270C | SW846 8270C | 51-28-5 | 0.3 [10] | 120 | 1,400 | 0.3 | 0.67 (0.04) [12] | 1 (0.07) [12] |
| 2,4-Dinitrotoluene | SW846 8270C | SW846 8270C | 121-14-2 | NA | 0.7 | 3 | 0.2 | 0.067 | 0.067 |
| 2,6-Dinitrotoluene | SW846 8270C | SW846 8270C | 606-20-2 | NA | 0.7 | 3 | 0.2 | 0.067 | 0.067 |
| 2-Chloronaphthalene | SW846 8270C | SW846 8270C | 91-58-7 | NA | NA | NA | NA | 0.067 | 0.33 |
| 2-Chlorophenol | SW846 8270C | SW846 8270C | 95-57-8 | 0.5 | 310 | 2,200 | 0.2 | 0.17 | 0.33 [8] |
| 2-Methylnaphthalene | SW846 8270C | SW846 8270C | 91-57-6 | 5 | 230 | 2400 | 0.2 | 0.067 | 0.33 [8] |
| 2-Methylphenol | SW846 8270C | SW846 8270C | 95-48-7 | NA | 310 | 3,400 | 0.2 | 0.067 | 0.33 [8] |
| 2-Nitroaniline | SW846 8270C | SW846 8270C | 88-74-4 | NA | 39 | 23,000 | 0.3 | 0.17 | 0.067 |
| 2-Nitrophenol | SW846 8270C | SW846 8270C | 88-75-5 | NA | NA | NA | NA | 0.17 | 0.33 |
| 3&4-Methylphenol | SW846 8270C | SW846 8270C | 108-39-4 & 106-44-5 | NA | 31 | 340 | 31 | 0.067 | 0.33 |
| 3,3'-Dichlorobenzidine | SW846 8270C | SW846 8270C | 91-94-1 | 0.2 [10] | 1 | 4 | 0.2 | 0.17 | 0.067 |
| 3-Nitroaniline | SW846 8270C | SW846 8270C | 99-09-2 | NA | NA | NA | NA | 0.17 | 0.067 |
| 4,6-Dinitro-o-cresol | SW846 8270C | SW846 8270C | 534-52-1 | 0.3 [10] | 6 | 68 | 0.3 | 0.67 (0.04) [12] | 1 (0.16)[12] |
| 4-Bromophenyl phenyl ether | SW846 8270C | SW846 8270C | 101-55-3 | NA | NA | NA | NA | 0.067 | 0.33 |
| 4-Chloro-3-methyl phenol | SW846 8270C | SW846 8270C | 59-50-7 | NA | NA | NA | NA | 0.17 | 0.33 |
| 4-Chloroaniline | SW846 8270C | SW846 8270C | 106-47-8 | NA | NA | NA | NA | 0.17 | 0.33 |
| 4-Chlorophenyl phenyl ether | SW846 8270C | SW846 8270C | 7005-72-3 | NA | NA | NA | NA | 0.067 | 0.33 |
| 4-Nitroaniline | SW846 8270C | SW846 8270C | 100-01-6 | NA | NA | NA | NA | 0.17 | 0.067 |

| Analyte [1] | Accutest Method | Test America Method | CAS No. | NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg) | NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Soil PQL (mg/kg) | Accutest RL (mg/kg) | Test America RL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| 4-Nitrophenol | SW846 8270C | SW846 8270C | 100-02-7 | NA | NA | NA | NA | 0.33 | 1 |
| Acenaphthene | SW846 8270C | SW846 8270C | 83-32-9 | 74 | 3,400 | 37,000 | 0.2 | 0.033 | 0.33 [8] |
| Acenaphthylene | SW846 8270C | SW846 8270C | 208-96-8 | NA | NA | 300,000 | 0.2 | 0.033 | 0.33 [8] |
| Acetophenone | SW846 8270C | SW846 8270C | 98-86-2 | 2 | 2 | 5 | 0.2 | 0.17 | 0.33 [8] |
| Anthracene | SW846 8270C | SW846 8270C | 120-12-7 | 1,500 | 17,000 | 30,000 | 0.2 | 0.033 | 0.33 [8] |
| Atrazine | SW846 8270C | SW846 8270C | 1912-24-9 | 0.2 [10] | 210 | 2,400 | 0.2 | 0.17 | 0.33 (0.06) [12] |
| Benzaldehyde | SW846 8270C | SW846 8270C | 100-52-7 | NA | 6100 | 68,000 | 0.2 | 0.17 | 0.33 [8] |
| Benzo(a)anthracene | SW846 8270C | SW846 8270C | 56-55-3 | 0.5 | 0.6 | 2 | 0.2 | 0.033 | 0.033 |
| Benzo(a)pyrene | SW846 8270C | SW846 8270C | 50-32-8 | 0.2 [10] | 0.2 | 0.2 | 0.2 | 0.033 | 0.033 |
| Benzo(b)fluoranthene | SW846 8270C | SW846 8270C | 205-99-2 | 2 | 0.6 | 2 | 0.2 | 0.033 | 0.033 |
| Benzo(g,h,i)perylene | SW846 8270C | SW846 8270C | 191-24-2 | NA | 380,000 | 30,000 | 0.2 | 0.033 | 0.33 [8] |
| Benzo(k)fluoranthene | SW846 8270C | SW846 8270C | 207-08-9 | 16 | 6 | 23 | 0.2 | 0.033 | 0.033 |
| bis(2-Chloroethoxy)methane | SW846 8270C | SW846 8270C | 111-91-1 | NA | NA | NA | NA | 0.067 | 0.33 |
| bis(2-Chloroethyl)ether | SW846 8270C | SW846 8270C | 111-44-4 | 0.2 [10] | 0.4 | 2 | 0.2 | 0.067 | 0.033 |
| bis(2-Chloroisopropyl)ether | SW846 8270C | SW846 8270C | 108-60-1 | 3 | 23 | 67 | 0.2 | 0.067 | 0.33 [8] |
| bis(2-Ethylhexyl)phthalate | SW846 8270C | SW846 8270C | 117-81-7 | 790 | 35 | 140 | 0.2 | 0.067 | 0.33 [8] |
| Butyl benzyl phthalate | SW846 8270C | SW846 8270C | 85-68-7 | 150 | 1,200 | 14,000 | 0.2 | 0.067 | 0.33 [8] |
| Caprolactam | SW846 8270C | SW846 8270C | 105-60-2 | 8 | 31,000 | 340,000 | 0.2 | 0.067 | 0.33 [8] |
| Carbazole | SW846 8270C | SW846 8270C | 86-74-8 | NA | 24 | 96 | 0.2 | 0.067 | 0.33 [8] |
| Chrysene | SW846 8270C | SW846 8270C | 218-01-9 | 52 | 62 | 230 | 0.2 | 0.033 | 0.33 [8] |
| Dibenzo(a,h)anthracene | SW846 8270C | SW846 8270C | 53-70-3 | 0.5 | 0.2 | 0.2 | 0.2 | 0.033 | 0.033 |
| Dibenzofuran | SW846 8270C | SW846 8270C | 132-64-9 | NA | NA | NA | NA | 0.067 | 0.33 |
| Diethyl phthalate | SW846 8270C | SW846 8270C | 84-66-2 | 57 | 49,000 | 550,000 | 0.2 | 0.067 | 0.33 [8] |
| Dimethyl phthalate | SW846 8270C | SW846 8270C | 131-11-3 | NA | NA | NA | NA | 0.067 | 0.33 |
| Di-n-butyl phthalate | SW846 8270C | SW846 8270C | 84-74-2 | 620 | 6,100 | 68,000 | 0.2 | 0.067 | 0.33 [8] |
| Di-n-octyl phthalate | SW846 8270C | SW846 8270C | 117-84-0 | 3300 [11] | 2,400 | 27,000 | 0.2 | 0.067 | 0.33 [8] |

| Analyte [1] | Accutest Method | Test America Method | CAS No. | NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg) | NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Soil PQL (mg/kg) | Accutest RL (mg/kg) | Test America RL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| Fluoranthene | SW846 8270C | SW846 8270C | 206-44-0 | 840 | 2,300 | 24,000 | 0.2 | 0.033 | 0.33 [8] |
| Fluorene | SW846 8270C | SW846 8270C | 86-73-7 | 110 | 2,300 | 24,000 | 0.2 | 0.033 | 0.33 [8] |
| Hexachlorobenzene | SW846 8270C | SW846 8270C | 118-74-1 | 0.2 [10] | 0.3 | 1 | 0.2 | 0.067 | 0.033 |
| Hexachlorobutadiene | SW846 8270C | SW846 8270C | 87-68-3 | 0.6 | NA | NA | NA | 0.033 | 0.067 |
| Hexachlorocyclopentadiene | SW846 8270C | SW846 8270C | 77-47-4 | 210 | 45 | 110 | 0.2 | 0.67 [8] | 0.33 [8] |
| Hexachloroethane | SW846 8270C | SW846 8270C | 67-72-1 | 0.2 [10] | 35 | 140 | 0.2 | 0.17 | 0.033 |
| Indeno(1,2,3-cd)pyrene | SW846 8270C | SW846 8270C | 193-39-5 | 5 | 0.6 | 2 | 0.2 | 0.033 | 0.033 |
| Isophorone | SW846 8270C | SW846 8270C | 78-59-1 | 0.2 [10] | 510 | 2,000 | 0.2 | 0.067 | 0.33 (0.04) [12] |
| Naphthalene | SW846 8270C | SW846 8270C | 91-20-3 | 16 | 6 | 17 | 0.2 | 0.033 | 0.33 [8] |
| Nitrobenzene | SW846 8270C | SW846 8270C | 98-95-3 | 0.2 [10] | 31 | 340 | 0.2 | 0.067 | 0.033 |
| N-Nitroso-di-n-propylamine | SW846 8270C | SW846 8270C | 621-64-7 | 0.2 [10] | 0.2 | 0.3 | 0.2 | 0.067 | 0.033 |
| N-Nitrosodiphenylamine | SW846 8270C | SW846 8270C | 86-30-6 | 0.2 | 99 | 390 | 0.2 | 0.17 | 0.33 (0.05) [12] |
| Pentachlorophenol | SW846 8270C | SW846 8270C | 87-86-5 | 0.3 [10] | 3 | 10 | 0.3 | 0.33 (0.06) [12] | 1 (0.16) [12] |
| Phenanthrene | SW846 8270C | SW846 8270C | 85-01-8 | NA | NA | 300,000 | 0.2 | 0.033 | 0.33 [8] |
| Phenol | SW846 8270C | SW846 8270C | 108-95-2 | 5 | 18,000 | 210,000 | 0.2 | 0.067 | 0.33 [8] |
| Pyrene | SW846 8270C | SW846 8270C | 129-00-0 | 550 | 1,700 | 18,000 | 0.2 | 0.033 | 0.33 [8] |
| **TCL PCBs** | | | | | | | | | |
| Aroclor 1016 | SW846 8082 | SW846 8082A | 12674-11-2 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1221 | SW846 8082 | SW846 8082A | 11104-28-2 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1232 | SW846 8082 | SW846 8082A | 11141-16-5 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1242 | SW846 8082 | SW846 8082A | 53469-21-9 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1248 | SW846 8082 | SW846 8082A | 12672-29-6 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1254 | SW846 8082 | SW846 8082A | 11097-69-1 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1260 | SW846 8082 | SW846 8082A | 11096-82-5 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1262 | SW846 8082 | SW846 8082A | 37324-23-5 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |
| Aroclor 1268 | SW846 8082 | SW846 8082A | 11100-14-4 | 0.2 | 0.2 | 1 | 0.03 | 0.034 [8] | 0.067 [8] |

| Analyte [1] | Accutest Method | Test America Method | CAS No. | NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg) | NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg) | NJDEP Soil PQL (mg/kg) | Accutest RL (mg/kg) | Test America RL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|
| **Miscellaneous** | | | | | | | | | |
| Cyanide | 9012B | SW846 9012A | 57-12-5 | 13 | 1,600 | 23,000 | 3 | 0.24 | 0.5 |
| Extractable Petroleum Hydrocarbons (EPH) | NJDEP EPH Ver.1.1 10/09 Rev. 2 | See note[6] | NA | NA | NA | NA | NA | 80 | Use Accutest[6] |
| Phenols | SW846 9065 | SW846 9065 | 64743-03-9 | 5 | NA | NA | NA | 2.4 | 5 |
| Total Organic Carbon (TOC) | EPA Lloyd Kahn | EPA Lloyd Kahn | 7440-44-0 | NA | NA | NA | NA | 1000 | 100 |
| Total Organic Halides (TOX) | SW846 9020 B | See note[5] | NA | NA | NA | NA | NA | 20 | Use Accutest[5] |
| Cation Exchange Capacity (CEC) | SW846 9081 | See note[5] | NA | NA | NA | NA | NA | NA | Use Accutest[5] |
| pH [7] | SW846 9045C | SW846 9045C | STL00204 | NA | NA | NA | NA | NA | NA |
| Eh [7] | ASTM D1498-76M | SM2580 | NA | NA | NA | NA | NA | NA | NA |
| COD [3, 15] | HACH 8000M | 5220D | STL00070 | NA | NA | NA | NA | 20 mg/l and 150 mg/l | 200 |
| Sulfide [3] | EPA 376.1M | SW846 9034 | 18496-25-8 | NA | NA | NA | NA | 4 | 10 |
| Ferrous Iron [3, 15] | ASTM D3872 | ASTM D3872 | NA | NA | NA | NA | NA | 2 | 2 |
| TCLP [4] | SW846 1311 | SW846 1311 | NA | See individual limits above | NA | NA | NA | see RLs above | see RLs above |
| SPLP [4] | SW846 1312 | SW846 1312 | NA | See individual limits above | NA | NA | NA | see RLs above | see RLs above |
| Nitrite [16] | SM19 4500NO2 B Modified | EPA 353.2 modified | NA | NA | NA | NA | NA | 0.2 | 2 |
| Nitrate/Nitrite [16] | EPA 353.2 modified | EPA 353.2 modified | NA | NA | NA | NA | NA | 20 | 2 |
| Alkalinity [16] | EPA 310.1 modified | EPA 310.1 modified | NA | NA | NA | NA | NA | 50 | 20 |
| Phosphate [16] | EPA 365.3 modified | EPA 365.3 modified | NA | NA | NA | NA | NA | 2.5 | 0.6 |
| Ignitability | SW846 1010A | 1030 | STL00250 | NA | NA | NA | NA | NA | NA |
| Reactivity | SW846 9034, Ch.7 | SW846 9034, Ch.7 | NA | NA | NA | NA | NA | 100 | 100 |

| **Analyte**[1] | **Accutest Method** | **Test America Method** | **CAS No.** | **NJDEP Default Impact to Ground Water Soil Screening Levels (mg/kg)** | **NJDEP Residential Direct Contact Soil Remediation Standard (mg/kg)** | **NJDEP Non-Residential Direct Contact Soil Remediation Standard (mg/kg)** | **NJDEP Soil PQL (mg/kg)** | **Accutest RL (mg/kg)** | **Test America RL (mg/kg)** |
|---|---|---|---|---|---|---|---|---|---|
| Corrosivity | SW846 9045C | SW846 9045C | STL00179 | NA | NA | NA | NA | NA | NA |
| Moisture Content | ASTM D1744-92 | EPA CLP SOW SOM01.1 | NA | NA | NA | NA | NA | NA | NA |
| Bulk Density | ASTM D2937-94M | See note[5] | NA | NA | NA | NA | NA | NA | Use Geotesting or Accutest[5] |
| **Analyte**[1] | **GeoTesting Method** | | | | | | | | |
| Compressive Strength | ASTM D1633 | | NA | NA | NA | NA | NA | NA | |
| Moisture Content | ASTM D2216 | | NA | NA | NA | NA | NA | NA | |
| Strength and stress-strain relationships of cohesive soil | ASTM 2850 | | NA | NA | NA | NA | NA | NA | |
| Grain Size Analysis | ASTM D422 | | NA | NA | NA | NA | NA | NA | |
| Plasticity of soils | ASTM D 4318 | | NA | NA | NA | NA | NA | NA | |
| Strength/stress-strain relationships of saturated cohesive soil | ASTM D4767 | | NA | NA | NA | NA | NA | NA | |
| Resistance of Solid Wastes to Freezing and Thawing[14] | ASTM D4842 | | NA | NA | NA | NA | NA | NA | |
| Wet/Dry Test of Solid Wastes | ASTM D4843 | | NA | NA | NA | NA | NA | NA | |
| Hydraulic Conductivity (Permeability) | ASTM D5084 | | NA | NA | NA | NA | NA | NA | |
| Specific Gravity | ASTM D854 | | NA | NA | NA | NA | NA | NA | |

**NOTES**

CAS No. - Chemical Abstracts System Registration Number
MDL – Method Detection Limit
Mg/kg – milligram per killigram
NA – Not available for this constituent.
NJDEP – New Jersey Department of Environmental Protection
PQL - Practical Quantitation Level as defined in N.J.A.C. 7:9C-1.4
RL – Reporting Limit
TAL – Target Analyte List
TCL – Target Compound List

[1] – The individual RIWPs will indicate the parameters/analytes that will be analyzed.

[2] – Or Allergic Contact Dermatitis (ACD) whichever is lower. ACD for hexavalent chromium is a site-specific determination.

[3] – This analysis may be required if the MS/MSD does not meet QC requirements for hexavalent chromium analysis. The analysis is used to assist in the evaluation of the tendency of Cr+6 to exist or not exist in the unspiked sample. This analysis is only necessary if the unspiked sample contains detectable Cr 6+. .

[4] – TCLP and/or SPLP may be needed for waste characterization

[5] – Test America does not perform this analysis, thus the analysis will be performed by Accutest or GeoTesting Express.

[6] – Test America is pending approval of their NJDEP EPH method; however, Accutest will be the only laboratory used for this analysis until Test America receives NJDEP certification.

[7] – Eh and pH are required to be determined under the hexavalent chromium analysis.

[8] – The laboratory reporting limit(s) (RLs) exceed the NJDEP Soil PQLs; however, since the laboratory RLs are less than both the NJDEP residential direct contact soil remediation standard and NJDEP non-residential direct contact soil remediation standard, these RLs are acceptable for these analytes.

[9] – Health based criterion defaults to background according to Table 1 in the NJDEP Guidance Document *Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation,* December 2008.

[10] – Standard set a Practical Quantitation Limit (PQL) according to Table 1 in the NJDEP Guidance Document *Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation,* December 2008.

[11] – Health based criterion defaults to soil saturation limit according to Table 1 in the NJDEP Guidance Document *Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation,* December 2008.

[12] – The laboratory reporting limit(s) (RLs) exceed one of the NJDEP standards (i.e., Impact to GW, NJDEP Soil PQL, NJDEP residential direct contact soil remediation standard, and/or NJDEP non-residential direct contact soil remediation standard. However, the laboratory MDL in parenthesis is below the NJDEP standards and thus is acceptable. Note, that a laboratory fortified blank (LFB) at a concentration equivalent to the lowest applicable NJDEP standard for those analytes with standards between the RL and MDL will be performed to ensure that the instrument accuracy is acceptable.

[13] - Standard represents a maximum value

[14] – Method has been removed from ASTM, but will only be used for informational purposes during the Feasibility Pilot Studies.

[15] – These parameters do not have applicable NJ certified methods for soil/solid samples. However, the aqueous methods are NJ certified. These parameters in soil are for informational purposes only to support the hexavalent chromium analysis (SW846 3060/7196) if the MS/MSD fails.

[16] – These parameters do not have applicable NJ certified methods for soil/solid samples. However, the aqueous methods are NJ certified. These parameters in soil are for informational purposes only to support the feasibility pilot studies to monitor the treatment.

[17] – Impact to GW soil remediation standards must be developed on a site-specific basis for chromium. For Class II GW, the GW quality standard is 70 ug/l (measured as total chromium), but assuming it is all in the form of hexavalent chromium. In addition to the cleanup criteria listed above, all remedial actions at sites that have hexavalent chromium must comply with Commissioner Jackson's memorandum dated February 8, 2007. A copy of this memorandum can be found on the Department web site at http://www.state.nj.us/dep/dsr/chromium/crmorlift200702.pdf

# TABLE 5-2 – ANALYTES, ANALYTICAL METHODS, NJDEP SPECIFIC GW QUALITY CRITERIA, NJDEP PRACTICAL QUANTITATION LIMITS, AND LABORATORY REPORTING LIMITS FOR AQUEOUS SAMPLES

| **Analyte[1]** | **Accutest Method** | **Test America Method** | **CAS No.** | **NJDEP Specific GW Quality Criteria (µg/L)** | **NJDEP PQL (µg/L)** | **Accutest RL (µg/L)** | **Test America RL (µg/L)** |
|---|---|---|---|---|---|---|---|
| **TAL Metals** | | | | | | | |
| Aluminum | SW846 6020B | SW846 6010B | 7429-90-5 | 200 | 30 | 100 [7] | 50 [7] |
| Antimony | SW846 6020B | SW846 6020 | 7440-36-0 | 6 | 3 | 4 [7] | 0.25 |
| Arsenic | SW846 6010B | SW846 6020 | 7440-38-2 | 0.02 | 3 | 3 | 0.25 |
| Barium | SW846 6010B | SW846 6020 | 7440-39-3 | 6000 | 200 | 200 | 200 |
| Beryllium | SW846 6010B | SW846 6020 | 7440-41-7 | 1 | 1 | 1 | 0.1 |
| Cadmium | SW846 6020B | SW846 6020 | 7440-43-9 | 4 | 0.5 | 2 [7] | 0.25 |
| Calcium | SW846 6010B | SW846 6010B | 8047-59-4 | NA | NA | 5000 | 5000 |
| Chromium - Hexavalent | SW846 3060A/7196A | SW846 3060A/7196A | 18540-29-9 | 70 [3] | 1 | 10 | 10 |
| Chromiun (total) | SW846 6020B | SW846 6020 | 16065-83-1 | 70 [3] | 1 | 1.4 [7] | 5 [7] |
| Cobalt | SW846 6010B | SW846 6010B | 7440-48-4 | NA | NA | 50 | 50 |
| Copper | SW846 6010B | SW846 6020 | 7440-50-8 | 1300 | 4 | 10 [7] | 0.5 |
| Iron | SW846 6010B | SW846 6020 | 8053-60-9 | 300 | 20 | 100 [7] | 15 |
| Lead | SW846 6010B | SW846 6010B | 7439-92-1 | 5 | 5 | 3 | 5 |
| Magnesium | SW846 6010B | SW846 6010B | 7439-95-4 | NA | NA | 5000 | 5000 |
| Manganese | SW846 6020B | SW846 6020B | 7439-96-5 | 50 | 0.4 | 2 [7] | 10 [7] |
| Mercury | SW846 7470A | SW846 7470A | 7439-97-6 | 2 | 0.05 | 0.200 [7] | 0.200 [7] |
| Nickel | SW846 6010B | SW846 6020 | 7440-02-0 | 100 | 4 | 10 [7] | 0.5 |
| Potassium | SW846 6010B | SW846 6010B | 7440-09-7 | NA | NA | 10000 | 5000 |
| Selenium | SW846 6010B | SW846 6020B | 7782-49-2 | 40 | 4 | 10 [7] | 2.5 |
| Silver | SW846 6010B | SW846 6010B | 7440-22-4 | 40 | 1 | 10 [7] | 5 [7] |
| Sodium | SW846 6020B | SW846 6010B | 7646-69-7 | 50,000 | 400 | 500 [7] | 250 |
| Thallium | SW846 6010B | SW846 6020 | 7440-28-0 | 0.5 | 2 | 2 | 0.1 |
| Vanadium | SW846 6020B | SW846 6020 | 7440-62-2 | 60 [4] | 1 | 10 [7] | 0.5 |
| Zinc | SW846 6010B | SW846 6020 | 7440-66-6 | 2000 | 10 | 10 [7] | 2 |

| Analyte[1] | Accutest Method | Test America Method | CAS No. | NJDEP Specific GW Quality Criteria (µg/L) | NJDEP PQL (µg/L) | Accutest RL (µg/L) | Test America RL (µg/L) |
|---|---|---|---|---|---|---|---|
| **TCL VOC** | | | | | | | |
| 1,1,1-Trichloroethane | SW846 8260B | SW846 8260B | 71-55-6 | NA | 1 | 1 | 1 |
| 1,1,2,2-Tetrachloroethane | SW846 8260B | SW846 8260B | 79-34-5 | 1 | 1 | 1 | 1 |
| 1,1,2-trichloro-1,2,2-trifluoroethane | SW846 8260B | SW846 8260B | 76-13-1 | 2000 | 1 | 5[7] | 1 |
| 1,1,2-Trichloroethane | SW846 8260B | SW846 8260B | 79-00-5 | 3 | 2 | 1 | 1 |
| 1,1-Dichloroethane | SW846 8260B | SW846 8260B | 75-34-3 | 50 | 1 | 1 | 1 |
| 1,1-Dichloroethene | SW846 8260B | SW846 8260B | 75-35-4 | 1 | 1 | 1 | 1 |
| 1,2,3-Trichlorobenzene | SW846 8260B | SW846 8260B | 87-61-6 | NA | NA | 5 | 1 |
| 1,2,4-Trichlorobenzene | SW846 8260B | SW846 8270C | 120-82-1 | 9 | 1 | 5[7] | 1 |
| 1,2-Dibromo-3-chloropropane | SW846 8260B | SW846 8260B | 96-12-8 | 0.02 | 0.02 | 0.02 | 1[9] |
| 1,2-Dibromoethane | SW846 8011 | SW846 8260B | 106-93-4 | 0.0004 | 0.03 | 0.02 | 1[9] |
| 1,2-Dichlorobenzene | SW846 8260B | SW846 8260B | 95-50-1 | 600 | 5 | 1 | 1 |
| 1,2-Dichloroethane | SW846 8260B | SW846 8260B | 107-06-2 | 0.3 | 2 | 1 | 1 |
| 1,2-Dichloropropane | SW846 8260B | SW846 8260B | 78-87-5 | 0.5 | 1 | 1 | 1 |
| 1,3-Dichlorobenzene | SW846 8260B | SW846 8260B | 541-73-1 | 600 | 5 | 1 | 1 |
| 1,4-Dichlorobenzene | SW846 8260B | SW846 8260B | 106-46-7 | 75 | 5 | 1 | 1 |
| 1,4-Dioxane | SW846 8260B | SW846 8260B | 123-91-1 | NA | NA | 130 | 1000 |
| 2-Butanone (MEK) | SW846 8260B | SW846 8260B | 78-93-3 | 300 | 2 | 10[7] | 10[7] |
| 2-Hexanone | SW846 8260B | SW846 8260B | 591-78-6 | NA | NA | 5 | 10 |
| 4-Methyl-2-pentanone(MIBK) | SW846 8260B | SW846 8260B | 108-10-1 | NA | NA | 5 | 10 |
| Acetone | SW846 8260B | SW846 8260B | 67-64-1 | 6000 | 10 | 10 | 10 |
| Benzene | SW846 8260B | SW846 8260B | 71-43-2 | 0.2 | 1 | 1 | 1 |
| Bromochloromethane | SW846 8260B | SW846 8260B | 74-97-5 | NA | NA | 5 | 1 |
| Bromodichloromethane | SW846 8260B | SW846 8260B | 75-27-4 | 0.6 | 1 | 1 | 1 |
| Bromoform | SW846 8260B | SW846 8260B | 75-25-2 | 4 | 0.8 | 4[7] | 1[7] |
| Bromomethane | SW846 8260B | SW846 8260B | 74-83-9 | 10 | 1 | 2[7] | 1 |
| Carbon disulfide | SW846 8260B | SW846 8260B | 75-15-0 | 700 | 1 | 2[7] | 1 |
| Carbon tetrachloride | SW846 8260B | SW846 8260B | 56-23-5 | 0.4 | 1 | 1 | 1 |

| Analyte[1] | Accutest Method | Test America Method | CAS No. | NJDEP Specific GW Quality Criteria (µg/L) | NJDEP PQL (µg/L) | Accutest RL (µg/L) | Test America RL (µg/L) |
|---|---|---|---|---|---|---|---|
| Chlorobenzene | SW846 8260B | SW846 8260B | 108-90-7 | 50 | 1 | 1 | 1 |
| Chloroethane | SW846 8260B | SW846 8260B | 75-00-3 | NA | NA | 1 | 1 |
| Chloroform | SW846 8260B | SW846 8260B | 67-66-3 | 70 | 1 | 1 | 1 |
| Chloromethane | SW846 8260B | SW846 8260B | 74-87-3 | NA | NA | 1 | 1 |
| cis-1,2-Dichloroethene | SW846 8260B | SW846 8260B | 156-59-2 | 70 | 1 | 1 | 1 |
| cis-1,3-Dichloropropene | SW846 8260B | SW846 8260B | 10061-01-5 | 0.4 | 1 | 1 | 1 |
| Cyclohexane | SW846 8260B | SW846 8260B | 110-82-7 | NA | NA | 5 | 1 |
| Dibromochloromethane | SW846 8260B | SW846 8260B | 124-48-1 | 0.4 | 1 | 1 | 1 |
| Dichlorodifluoromethane | SW846 8260B | SW846 8260B | 75-71-8 | 1000 | 2 | 5 [7] | 1 |
| Ethylbenzene | SW846 8260B | SW846 8260B | 100-41-4 | 700 | 2 | 1 | 1 |
| Isopropylbenzene | SW846 8260B | SW846 8260B | 98-82-8 | 700 | 1 | 2 [7] | 1 |
| m,p-Xylene | SW846 8260B | SW846 8260B | 108-38-3 & 106-42-3 | 1000 [5] | 2 | 1 | 2 |
| Methyl Acetate | SW846 8260B | SW846 8260B | 79-20-9 | 7000 | 0.5 | 5 [7] | 2 [7] |
| Methyl Tert Butyl Ether | SW846 8260B | SW846 8260B | 1634-04-4 | 70 | 1 | 1 | 1 |
| Methylcyclohexane | SW846 8260B | SW846 8260B | 108-87-2 | NA | NA | 5 | 1 |
| Methylene chloride | SW846 8260B | SW846 8260B | 75-09-2 | 3 | 1 | 2 [7] | 1 |
| o-Xylene [5] | SW846 8260B | SW846 8260B | 95-47-6 | 1000 | 2 | 1 | 1 |
| Styrene | SW846 8260B | SW846 8260B | 100-42-5 | 100 | 2 | 5 [7] | 1 |
| Tetrachloroethene | SW846 8260B | SW846 8260B | 127-18-4 | 0.4 | 1 | 1 | 1 |
| Toluene | SW846 8260B | SW846 8260B | 108-88-3 | 600 | 1 | 1 | 1 |
| trans-1,2-Dichloroethene | SW846 8260B | SW846 8260B | 156-60-5 | 100 | 1 | 1 | 1 |
| trans-1,3-Dichloropropene | SW846 8260B | SW846 8260B | 10061-02-6 | 0.4 | 1 | 1 | 1 |
| Trichloroethene | SW846 8260B | SW846 8260B | 79-01-6 | 1 | 1 | 1 | 1 |
| Trichlorofluoromethane | SW846 8260B | SW846 8260B | 75-69-4 | 2000 | 1 | 5 [7] | 1 |
| Vinyl chloride | SW846 8260B | SW846 8260B | 75-01-4 | 0.08 | 1 | 1 | 1 |
| Xylene (total) | SW846 8260B | SW846 8260B | 1330-20-7 | 1000 | 2 | 1 | 3 [7] |

| Analyte[1] | Accutest Method | Test America Method | CAS No. | NJDEP Specific GW Quality Criteria (µg/L) | NJDEP PQL (µg/L) | Accutest RL (µg/L) | Test America RL (µg/L) |
|---|---|---|---|---|---|---|---|
| **TCL SVOC** | | | | | | | |
| 1,1'-Biphenyl | SW846 8270C | SW846 8270C | 92-52-4 | 400 | 10 | 2 | 10 |
| 1,2,4,5-Tetrachlorobenzene | SW846 8270C | See Note below [8] | 95-94-3 | NA | NA | 5 | Use Accutest [8] |
| 2,3,4,6-Tetrachlorophenol | SW846 8270C | See Note below [8] | 58-90-2 | 200 | 3 | 5 [7] | Use Accutest [8] |
| 2,4,5-Trichlorophenol | SW846 8270C | SW846 8270C | 95-95-4 | 700 | 10 | 5 | 10 |
| 2,4,6-Trichlorophenol | SW846 8270C | SW846 8270C | 88-06-2 | 1 | 20 | 5 | 10 |
| 2,4-Dichlorophenol | SW846 8270C | SW846 8270C | 120-83-2 | 20 | 10 | 5 | 10 |
| 2,4-Dimethylphenol | SW846 8270C | SW846 8270C | 105-67-9 | 100 | 20 | 5 | 10 |
| 2,4-Dinitrophenol | SW846 8270C | SW846 8270C | 51-28-5 | 10 | 40 | 20 | 30 |
| 2,4-Dinitrotoluene | SW846 8270C | SW846 8270C | 121-14-2 | NA | NA | 2 | 2 |
| 2,6-Dinitrotoluene | SW846 8270C | SW846 8270C | 606-20-2 | NA | NA | 2 | 2 |
| 2-Chloronaphthalene | SW846 8270C | SW846 8270C | 91-58-7 | 600 | 10 | 5 | 10 |
| 2-Chlorophenol | SW846 8270C | SW846 8270C | 95-57-8 | 40 | 20 | 5 | 10 |
| 2-Methylnaphthalene | SW846 8270C | SW846 8270C | 91-57-6 | NA | NA | 2 | 10 |
| 2-Methylphenol | SW846 8270C | SW846 8270C | 95-48-7 | NA | NA | 2 | 10 |
| 2-Nitroaniline | SW846 8270C | SW846 8270C | 88-74-4 | NA | NA | 5 | 20 |
| 2-Nitrophenol | SW846 8270C | SW846 8270C | 88-75-5 | NA | NA | 5 | 10 |
| 3&4-Methylphenol | SW846 8270C | SW846 8270C | 108-39-4 & 106-44-5 | NA | NA | 2 | 10 |
| 3,3'-Dichlorobenzidine | SW846 8270C | SW846 8270C | 91-94-1 | 0.08 | 30 | 5 | 20 |
| 3-Nitroaniline | SW846 8270C | SW846 8270C | 99-09-2 | NA | NA | 5 | 20 |
| 4,6-Dinitro-o-cresol | SW846 8270C | SW846 8270C | 534-52-1 | NA | NA | 20 | 30 |
| 4-Bromophenyl phenyl ether | SW846 8270C | SW846 8270C | 101-55-3 | NA | NA | 2 | 10 |
| 4-Chloro-3-methyl phenol | SW846 8270C | SW846 8270C | 59-50-7 | NA | NA | 5 | 10 |
| 4-Chloroaniline | SW846 8270C | SW846 8270C | 106-47-8 | 30 | 10 | 5 | 10 |
| 4-Chlorophenyl phenyl ether | SW846 8270C | SW846 8270C | 7005-72-3 | NA | NA | 2 | 10 |
| 4-Nitroaniline | SW846 8270C | SW846 8270C | 100-01-6 | NA | NA | 5 | 20 |
| 4-Nitrophenol | SW846 8270C | SW846 8270C | 100-02-7 | NA | NA | 10 | 30 |

| Analyte[1] | Accutest Method | Test America Method | CAS No. | NJDEP Specific GW Quality Criteria (µg/L) | NJDEP PQL (µg/L) | Accutest RL (µg/L) | Test America RL (µg/L) |
|---|---|---|---|---|---|---|---|
| Acenaphthene | SW846 8270C | SW846 8270C | 83-32-9 | NA | NA | 0.1 | 10 |
| Acenaphthylene | SW846 8270C | SW846 8270C | 208-96-8 | NA | NA | 0.1 | 10 |
| Acetophenone | SW846 8270C | SW846 8270C | 98-86-2 | 700 | 10 | 5 | 10 |
| Anthracene | SW846 8270C | SW846 8270C | 120-12-7 | 2000 | 10 | 0.1 | 10 |
| Atrazine | SW846 8270C | SW846 8270C | 1912-24-9 | 3 | 0.1 | 5 [9] | 10 [9] |
| Benzaldehyde | SW846 8270C | SW846 8270C | 100-52-7 | NA | NA | 5 | 10 |
| Benzo(a)anthracene | SW846 8270C SIM | SW846 8270C SIM | 56-55-3 | 0.05 | 0.1 | 0.1 | 0.05 |
| Benzo(a)pyrene | SW846 8270C SIM | SW846 8270C SIM | 50-32-8 | 0.005 | 0.1 | 0.1 | 0.05 |
| Benzo(b)fluoranthene | SW846 8270C SIM | SW846 8270C SIM | 205-99-2 | 0.05 | 0.2 | 0.1 | 0.05 |
| Benzo(g,h,i)perylene | SW846 8270C | SW846 8270C | 191-24-2 | NA | NA | 0.1 | 10 |
| Benzo(k)fluoranthene | SW846 8270C SIM | SW846 8270C | 207-08-9 | 0.5 | 0.3 | 0.1 | 0.05 |
| bis(2-Chloroethoxy)methane | SW846 8270C | SW846 8270C | 111-91-1 | NA | NA | 2 | 10 |
| bis(2-Chloroethyl)ether | SW846 8270C | SW846 8270C | 111-44-4 | 0.03 | 7 | 2 | 1 |
| bis(2-Chloroisopropyl)ether | SW846 8270C | SW846 8270C SIM | 108-60-1 | 300 | 10 | 2 | 0.02 |
| bis(2-Ethylhexyl)phthalate | SW846 8270C | SW846 8270C | 117-81-7 | 2 | 3 | 2 | 10 [9] |
| Butyl benzyl phthalate | SW846 8270C | SW846 8270C | 85-68-7 | 100 | 1 | 2 [7] | 10 [7] |
| Caprolactam | SW846 8270C | SW846 8270C | 105-60-2 | NA | NA | 2 | 10 |
| Carbazole | SW846 8270C | SW846 8270C | 86-74-8 | NA | NA | 2 | 10 |
| Chrysene | SW846 8270C | SW846 8270C SIM | 218-01-9 | 5 | 0.2 | 0.1 | 0.05 |
| Dibenzo(a,h)anthracene | SW846 8270C | SW846 8270C SIM | 53-70-3 | 0.005 | 0.3 | 0.1 | 0.05 |
| Dibenzofuran | SW846 8270C | SW846 8270C | 132-64-9 | NA | NA | 5 | 10 |
| Diethyl phthalate | SW846 8270C | SW846 8270C | 84-66-2 | 6000 | 1 | 2 [7] | 10 [7] |
| Dimethyl phthalate | SW846 8270C | SW846 8270C | 131-11-3 | NA | NA | 2 | 10 |
| Di-n-butyl phthalate | SW846 8270C | SW846 8270C | 84-74-2 | 700 | 1 | 2 [7] | 10 [7] |
| Di-n-octyl phthalate | SW846 8270C | SW846 8270C | 117-84-0 | 100 | 10 | 2 | 10 |
| Fluoranthene | SW846 8270C | SW846 8270C | 206-44-0 | 300 | 10 | 0.1 | 10 |
| Fluorene | SW846 8270C | SW846 8270C | 86-73-7 | 300 | 1 | 0.1 | 10 [7] |
| Hexachlorobenzene | SW846 8270C SIM | SW846 8270C SIM | 118-74-1 | 0.02 | 0.02 | 0.02 | 0.02 |

| Analyte[1] | Accutest Method | Test America Method | CAS No. | NJDEP Specific GW Quality Criteria (µg/L) | NJDEP PQL (µg/L) | Accutest RL (µg/L) | Test America RL (µg/L) |
|---|---|---|---|---|---|---|---|
| Hexachlorobutadiene | SW846 8270C | SW846 8270C | 87-68-3 | 0.4 | 1 | 1 | 1 |
| Hexachlorocyclopentadiene | SW846 8270C | SW846 8270C | 77-47-4 | 40 | 0.5 | 20[7] | 10[7] |
| Hexachloroethane | SW846 8270C | SW846 8270C | 67-72-1 | 2 | 7 | 5 | 1 |
| Indeno(1,2,3-cd)pyrene | SW846 8270C | SW846 8270C SIM | 193-39-5 | 0.05 | 0.2 | 0.1 | 0.05 |
| Isophorone | SW846 8270C | SW846 8270C | 78-59-1 | 40 | 10 | 2 | 10 |
| Naphthalene | SW846 8270C | SW846 8270C | 91-20-3 | 300 | 2 | 0.1 | 10[7] |
| Nitrobenzene | SW846 8270C | SW846 8270C | 98-95-3 | 4 | 6 | 2 | 1 |
| N-Nitroso-di-n-propylamine | SW846 8270C | SW846 8270C | 621-64-7 | 0.005 | 10 | 2 | 1 |
| N-Nitrosodiphenylamine | SW846 8270C | SW846 8270C | 86-30-6 | 7 | 10 | 5 | 10 |
| Pentachlorophenol | SW846 8270C SIM | SW846 8270C SIM | 87-86-5 | 0.3 | 0.1 | 0.3[7] | 0.2[7] |
| Phenanthrene | SW846 8270C | SW846 8270C | 85-01-8 | NA | NA | 0.1 | 10 |
| Phenol | SW846 8270C | SW846 8270C | 108-95-2 | 2000 | 10 | 2 | 10 |
| Pyrene | SW846 8270C | SW846 8270C | 129-00-0 | 200 | 0.1 | 0.1 | 10[7] |
| **TCL PCBs** | | | | | | | |
| Aroclor 1016 | SW846 8082 | SW846 8082 | 12674-11-2 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1221 | SW846 8082 | SW846 8082 | 11104-28-2 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1232 | SW846 8082 | SW846 8082 | 11141-16-5 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1242 | SW846 8082 | SW846 8082 | 53469-21-9 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1248 | SW846 8082 | SW846 8082 | 12672-29-6 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1254 | SW846 8082 | SW846 8082 | 11097-69-1 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1260 | SW846 8082 | SW846 8082 | 11096-82-5 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1262 | SW846 8082 | SW846 8082 | 37324-23-5 | 0.02 | 0.5 | 0.5 | 0.5 |
| Aroclor 1268 | SW846 8082 | SW846 8082 | 11100-14-4 | 0.02 | 0.5 | 0.5 | 0.5 |
| **Miscellaneous** | | | | | | | |
| Cyanide | SW846 9012B | SW846 9012A | 57-12-5 | 100 | 6 | 10[7] | 10[7] |
| Extractable Petroleum Hydrocarbons (EPH)[6] | NJ DEP EPH | See Note Below[10] | NA | None Noted | NA | 0.8 | Use Accutest[10] |
| Phenols | SW846 9066 | SW846 9065 | 108-95-2 | 2000 | 10 | 200[7] | 50[7] |
| Cation Exchange Capacity (CEC) | SW846 9081 | See Note Below[8] | NA | NA | NA | NA | Use Accutest[8] |
| pH | SW846 9040C | SW846 9045C | NA | NA | NA | NA | NA |

| Analyte[1] | Accutest Method | Test America Method | CAS No. | NJDEP Specific GW Quality Criteria (µg/L) | NJDEP PQL (µg/L) | Accutest RL (µg/L) | Test America RL (µg/L) |
|---|---|---|---|---|---|---|---|
| eH | ASTM D1498-76 | SM2580 | NA | NA | NA | NA | NA |
| Ferrous Iron [2] | SM3500Fe-B | SM 3500Fe-D | 15438-31-0 | NA | NA | 200 | 100 [10] |
| Carbon Oxygen Demand (COD) [2] | SM5220C | SM 5220D | NA | NA | NA | 20,000 or | 10000 |
| Biological Oxygen Demand (BOD) [2] | SM5210B | SM 5210B | NA | NA | NA | 2000 | 2000 |
| Sulfide [2] | SM4500S-F | SM9034 | 18496-25-8 | NA | NA | 1000 | 1000 |
| Total Organic Carbon (TOC) | SM5310 B | SM5310 B | NA | NA | NA | 1000 | 1000 |
| Total Organic Halides (TOX) | SW846 9020B M | See Note Below [8] | NA | NA | NA | 50 | Use Accutest [8] |
| Ignitability | SW846 1010A | SW846 1020A | NA | NA | NA | NA | NA |
| Reactivity | SW846 9034 | SW846 9034 | NA | NA | NA | NA | NA |
| Corrosivity | SM9040C | SM9045C | NA | NA | NA | NA | NA |
| Total Suspended Solids (TSS) | SM 2540D | SM 2540D | NA | NA | NA | NA | NA |
| Total Dissolved Solids (TDS) | SM 2540C | SM 2540C | NA | 500,000 | 10000 | 10000 | 10000 |
| Chloride | SM 4500Cl-C | SM 4500Cl-E | NA | 250,000 | 2000 | 2000 | 10000 [7] |

**Notes:**

[1] – The individual RIWPs will indicate the parameters/analytes that will be analyzed.

[2] - Cr+6 Reanalysis may require these additional parameters if the matrix spike/matrix spike duplicate do not meet QC requirements.

[3] - GW criteria is for total chromium

[4] - GW criteria is for vanadium pentoxide

[5] - GW criteria is for total xylenes

[6] - GW criteria is for Oil & Grease & Petroleum Hydrocarbons

[7] - The laboratory RLs exceed the NJDEP PQLs; however, the laboratory RLs are less than the NJDEP Specific GW Quality Criteria and thus are acceptable.

[8] – Test America does not perform this analysis, thus the analysis will be performed by Accutest.

**Acronyms:**

CAS - Chemical Abstracts System Registration Number
NA - not available for this constituent
NJDEP New Jersery Department of Environmental Protection
PCB - Polychlorinated Biphenyl
PQL - Practical Quantitation Level as defined in N.J.A.C. 7:9C-1.4
RL - Reporting Limit
SVOC- Semivolatile Organic Compound
TAL - Target Analyte List
TCL - Target Compound List
µg/L – microgram per liter
VOC - Volatile Organic Compound

## TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY

| Matrix [1] | Analyses [1] | Quality Assurance Samples | Sampling Frequency | Criteria |
|---|---|---|---|---|
| AIR | Chromium (Total and Hexavalent) | Field Blank | 1/day from same lot number as sample filters | <MDL [8] |
| | Particulates ($PM_{10}$) | Field (Blind) Duplicate (co-located) | 1/20 samples (5% of total) or minimum of 1/week | RPD < 50% |
| WIPES | Chromium [4] (Total and Hexavalent) | Field Blank | 1/day from same lot number as the sample wipes | <RL [2] |
| SOIL, CHIP, CONCRETE, SWEEP, MASONRY<br>(including TCLP and/or SPLP, as applicable) | TCL VOCs<br>TCL SVOCs<br>TCL PCBs<br>TAL Metals<br>Hexavalent Chromium [4]<br>EPH<br>Phenols<br>Cyanide | Field Blank | Either 1/day or 10% of the total number of samples collected, but not more than 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 50% |
| | | MS/MSD | 1/20 samples (5% of total) | See method [3] |
| | Wet Chemistry [5] | Field Blank | Either 1/day or 10% of the total number of samples collected, but not more than 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 50% |
| | Geotechnical [6] | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 50% |
| | Waste Characteristics [7] | | | |

## TABLE 6-1 QUALITY CONTROL SAMPLE SUMMARY (continued)

| Matrix [1] | Analyses [1] | Quality Assurance Samples | Sampling Frequency | Criteria |
|---|---|---|---|---|
| AQUEOUS | TCL VOCs | Trip Blank | 1/cooler | < RL [2] |
| | | Field Blank | 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |
| | | MS/MSD | 1/20 samples (5% of total) | See method [3] |
| | TCL SVOCs<br>TCL PCBs<br>TAL Metals<br>Hexavalent Chromium [4]<br>EPH<br>Phenols<br>Cyanide | Field Blank | 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |
| | | MS/MSD | 1/20 samples (5% of total) | See method [3] |
| | Wet Chemistry [5] | Field Blank | 1/day | < RL [2] |
| | | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |
| | Waste Characteristics [7] | Field (Blind) Duplicate | 1/20 samples (5% of total) | RPD < 30% |

Notes:

[1] - These are proposed matrices and analytes, refer to the RIWP for the specific matrices and analytes.

[2] - Refer to Tables 5-1 and 5-2 for the analyte specific RL.

[3] – Refer to the specific analytical methods for the MS/MSD QC Criteria.

[4] – Hexavalent chromium analysis includes Eh and pH analysis on every sample.

[5] – Wet Chemistry analyses may include BOD, CEC, COD, TDS, TSS, TOC, TOX, Alkalinity, Chloride, Ferrous iron, Nitrate, Nitrite, Phosphate, and Sulfide.

[6] – Geotechnical analyses may include moisture content, permeability, specific gravity, grain size, bulk density, Atterberg limits, and unconfined compressive strength.

[7] – Waste Characteristic analyses may include ignitability, reactivity, moisture content, and corrosivity.

[8] - Refer to the specific air monitoring work plan.

Acronyms:

| | | | |
|---|---|---|---|
| EPH | Extractable Petroleum Hydrocarbons | TAL | Target Analyte List |
| MDL | Method Detection Limit | TCL | Target Compound List |
| PCB | Polychlorinated Biphenyl | TDS | Total Dissolved Solids |
| $PM_{10}$ | Particulates | TOC | Total Organic Carbon |
| RL | Reporting Limit | TOX | Total Organic Halides |
| RPD | Relative Percent Difference | TSS | Total Suspended Solids |
| SOP | Standard Operating Procedure | VOC | Volatile Organic Compound |
| SVOC | Semivolatile Organic Compound | | |

# Appendix A

# Field Change Request Form

## FIELD CHANGE REQUEST

## PPG INDUSTRIES - NON-RESIDENTIAL SITES

CHANGE NUMBER _______

(To be completed by requesting party)

| | |
|---|---|
| ACO Site Number: | Site Name: |

| | | |
|---|---|---|
| Requesting Party*: | Signature: | Date: |

Change Description:

Reason for Change:

Implementation Schedule:

-----------------------------------------------------------------------------------------------------------------------------

(To be completed by concurring party)

| | | |
|---|---|---|
| Project Manager*: | Signature: | Date: |

Comments:

| Technical Contact Name and Affiliation | Phone Number |
|---|---|
| **Tom Cozzi, NJDEP** | (609) 633-1408 |
| **Prabal Amin, Technical Consultant (Weston Solutions)** | (732) 417-5857 |
| **Brian McPeak, JCO Site Administrator Project Manager** | (732) 216-6364 |
| **Brian McGuire, Project Manager, PPG Industries** | (412) 492-5683 |
| **W. B. Kennedy, Jr., PPG Industries, Remediation Manager** | (330) 753-2783 |
| **Bob Falotico, AECOM Principal-in-Charge** | (978) 589-3183 |
| **Scott Mikaelian, AECOM Program Manager** | (732) 564-3624 |
| **Rich Feinberg, AECOM Field Operations Leader** | (732) 233-4552 |

# Appendix B

# Field Standard Operating Procedures and Project Operating Procedures

APPENDIX B
AECOM FIELD POPs and SOPS
PPG FSP/QAPP

| POP or SOP No. | POP or SOP TITLE | SOURCE | ORIGINAL POP or SOP DATE | REVISION NO. | REVISION DATE |
|---|---|---|---|---|---|
| PPG 001 | Recording of Field Data | AECOM | June 2010 | 0 | N/A |
| PPG 002 | Chain of Custody Procedures | AECOM | June 2010 | 0 | N/A |
| PPG 003 | Packaging and Shipment of Environmental Samples | AECOM | June 2010 | 0 | N/A |
| PPG 004 | Operation and Calibration of a Photoionization Detector | AECOM | June 2010 | 0 | N/A |
| PPG 005 | Surface and Subsurface Soil Sampling Procedures and Boring Log Template | AECOM | June 2010 | 0 | N/A |
| PPG 006 | Monitoring Well Construction and Installation | AECOM | June 2010 | 0 | N/A |
| PPG 007 | Monitoring Well Development | AECOM | June 2010 | 0 | N/A |
| PPG 008 | Low Flow Groundwater Sampling | AECOM | June 2010 | 0 | N/A |
| PPG 009 | Hydraulic Conductivity Tests | AECOM | June 2010 | 0 | N/A |
| PPG 010 | Chip Sampling | AECOM | June 2010 | 0 | N/A |
| PPG 011 | Wipe Sampling | AECOM | June 2010 | 0 | N/A |
| PPG 012 | Concrete Core Sampling | AECOM | April 2010 | 0 | N/A |
| PPG 013 | Sweep Sampling | AECOM | June 2010 | 0 | N/A |
| PPG 014 | Decontamination of Field Equipment | AECOM | June 2010 | 0 | N/A |
| PPG 015 | Procedures for Acid Testing of Green-Grey Mud and COPR | AECOM | March 2010 | 0 | N/A |
| PPG 016 | Field Screening for Grain Size Procedures | AECOM | June 2010 | 0 | N/A |
| PPG- 017 | Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor | AECOM | June 2010 | 1 | N/A |
| PPG-018 | SOP No. 2000-226 Calibration/Operation/Maintenance of MiniVol™ Tactical Air Sampler (TAS) | AECOM | June 2010 | 1 | N/A |
| PPG-019 | Sample Collection of Airborne Hexavalent Chromium using Airmetrics MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2 | AECOM | May 2010 | 0 | N/A |
| PPG-020 | Operation and Calibration of a Hydrogen Sulfide Monitor | AECOM | May 2010 | 0 | N/A |
| PPG-021 | Field and Laboratory Measurement of pH | AECOM | December 2009 | 2 | 12/29/2009 |
| PPG-022 | Field and Laboratory Measurement of Dissolved Oxygen | AECOM | June 2010 | 2 | 12/29/2009 |
| PPG-023 | Field and Laboratory Measurement of Temperature | AECOM | December 2009 | 2 | 12/29/2009 |
| PPG-024 | Calibration and Operation of the Mamotte 2020 Turbidimeter | AECOM | May 2010 | DRAFT | 5/26/2010 |
| PPG-025 | Calibration and Operation of the YSI 6-Series Water Quality Meter for Temperature, pH, Dissolbed Oxygen, Conductivity and Oxidation Reduction Potential | AECOM | May 2010 | DRAFT | 5/26/2010 |
| PPG-026 | Operation/Field Calibration of the Baseline BTX Model 1030A GC, SOP No. 2600-150A | AECOM | October 2004 | 1 | 10/1/2004 |
| PPG-027 | Changing the BTX Span Value(s) for an Air Monitoring System, Procedure No. 2000-119 | AECOM | May 2008 | 0 | 6/4/2008 |
| PPG-028 | Standard Operating Procedure for the Niton XL3t 600 XRF | AECOM | June 2010 | 0 | 6/15/2010 |

Project Operating Procedure

# Recording of Field Data

Procedure Number:  PPG 001

Revision No.: 0

Revision Date:  June 2010

Date: 6/28/2010

POP Author

Kathleen Wooley

Date: 6/28/2010

QA Reviewer

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

# Recording of Field Data

## Contents

Project Operating Procedure

# Recording of Field Data

POP No.: PPG 001
Revision: 0
Date: June 2010

## 1.0 Scope and Applicability

### 1.1 Purpose and Applicability

This Project Operating Procedure (POP) provides instructions for recording data when documenting a sample collection event, field measurements, or a site visit. Field data may be recorded in field logbooks, on standardized forms, as annotated maps, as photo documentation, or electronically. Chain-of-custody records are also considered field data; however, these records are specifically addressed in POP PPG 002 Chain of Custody Procedures and POP PPG 003 Packaging and Shipment of Environmental Samples.

## 2.0 Health and safety considerations

**2.1** Not Applicable

## 3.0 Interferences

**3.1** Not Applicable

## 4.0 Equipment and materials

The following materials are necessary for this procedure:

- Bound field logbook (preferably waterproof, such as Rite-in-Rain™)
- Standardized field data sheets (refer to individual POPs for test pit logs, boring logs, groundwater sample collection logs, etc.)
- Pen or SharpieTM
- Watch or other time-keeping device

The following materials may also be needed:

- Site maps
- Clipboard
- Three-ring binder or equivalent
- Camera
- Hand-held electronic recording device (e.g., PDA, laptop, or tablet PC)

## 5.0 Procedures

### 5.1 General

Field activities vary widely and no general rules can specify the exact information that must be recorded for each event. However, the field records must contain sufficient detail so that persons going to the site could reconstruct a particular situation without reliance on the collector's memory.

Field logbooks may be supplemented by standardized forms (e.g., well construction and development, sample collection forms, drum logs). In that case, the logbook provides a chronology of events, summary of personnel on site, and a narration of events not covered by the standardized forms. It is recommended that the details recorded on the standardized forms not be replicated in the logbook due to the potential for transcription errors and inconsistencies. References to standardized forms must be included in the logbook.

Entries will be recorded legibly in permanent ink (a black ballpoint pen is preferable) and will be signed and dated. No erasures or obliterations will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark which is initialed and dated by the sampler, and the correct information added.

Pencils should not be used. If a ballpoint pen cannot be used because of adverse weather conditions (rain or freezing temperatures), a fine-point Sharpie™ is an acceptable substitute. If conditions are such that only pencil can be used, an explanation must be included in the logbook and the affected data should be photocopied, signed as verified copy, and maintained in the project files as documentation that the data has not been changed.

Information to be recorded should address the questions of who, where, what, when, how, and why. A specific list of information that should be recorded is included in Table 1.

Entries will be objective, factual, and free of personal feelings or inappropriate language. Cryptic notes and undefined abbreviations or acronyms should be avoided.

Information will be made in as close to real time as possible. Information recorded significantly after the fact must be dated as such.

### 5.2 Field Logbooks

Field logbooks will be bound water-proof field survey books or notebooks with consecutively numbered pages.

Logbooks will be assigned to field personnel, and will be identified by a unique document number. The logbook should be kept in the field person's possession or in a secure location during field activities and archived in the project files upon completion of the field program.

Logbooks should be specific to a project. Multiple projects should not be included in one logbook because of document retention and evidentiary reasons.

The title page of each logbook will contain the following:

- Person to whom the logbook is assigned, AECOM office location, and phone number,
- The logbook number,
- Project name and number, and
- Start and end dates of work covered by the logbook.

Logbook entries documenting sample collection or field measurements must clearly identify the task being completed (for example, water level measurements, headspace readings). Units must be included for all measurements.

For ease of reference, it is recommended that a new page be started for each sampling day and that the time be recorded in the far left column. Each day's entries will be signed and dated by the person making the entries. A diagonal line across the bottom of the page will indicate the end of an entry.

### **5.3** Standardized Forms

- At a minimum, each form must include a title identifying the activity being documented and the project identification (name and number).
- Each form must be signed and dated by the person completing the form.
- There should be no blank spaces on the form. Each space must be filled in with the information requested or "NA" (not applicable).
- Forms should not be loose, but should be maintained in an organized manner (e.g., clipboards, binders).

### **5.4** Maps and Drawings

Maps and drawings that document final sampling locations and which are separate from the field logbook must be referenced in the logbook. These maps or drawings must include the project name and number, site identification and location, and must be signed and dated by the person recording the locations.

Maps and drawings must include compass orientation and scale.

### **5.5** Photographs and Other Photo Documentation

Photo documentation, if permitted at the site, can provide invaluable information on site conditions, sample locations, and the sample itself.

Photographs, videos, or slides must be cross-referenced to entries in the field logbook or on a photo documentation log. Information to be recorded includes name of photographer, date, time, direction faced, description of subject, and sequential number of the photograph and roll number. An indication of scale is also helpful. Image-enhancing techniques (lenses, film) should also be noted.

### **5.6** Electronic Files

Electronically captured data may include data logging systems and hand-held electronic recording devices such as PDAs, laptops, or tablet PCs.

Field data that is captured electronically must be cross-referenced in the field logbook. Information to be recorded includes the identity of the person recording the data, instrument make and model number, measurement time and date, and file identification.

Sufficient backup systems must be in place to protect against the loss of data. Electronic files must be saved to a disk or backed up immediately upon completion. The backup disk or other media (CD, flash drive) should then be stored in a secure location separate from the laptop, tablet, or PDA.

Files must be uniquely identified and should be stored in the project files on the network. An unedited version of the file must be maintained and all subsequent manipulations tracked.

## 6.0 Quality assurance / quality control

Field records provide evidence and support for technical decisions, interpretations, and judgments. It is therefore critical that procedures and systems be in place to ensure that they are legible, identifiable, and retrievable, and protected from loss or damage. In addition, client or regulatory requirements, or the end use of the data (e.g., to support litigation) may determine the format in which the data must be recorded. For example, some projects may require that all field information be recorded in the field logbook and may not allow the use of standardized forms. The requirements necessary to meet the data quality objectives for a particular project will be defined in the site-specific workplan and/or Sampling and Analysis Plan (SAP) hereafter referred to as the project plan.

The field records will be reviewed by the Field Team Leader, or by the Project Manager or his/her designate, for accuracy, completeness, and adherence to the requirements of this POP. At a minimum, this must occur at the end of the field event. For field activities of extended duration, it is recommended that this review occur more frequently (e.g., daily or weekly).

If information recorded in the field is transcribed to another format, the original record must be retained for comparison purposes.

Periodic copying of the field records should be considered to insure against the loss or destruction of the original documents.

## 7.0 Data and records management

At the end of the field program, original field records must be placed in the project files and maintained for a certain retention time. The duration of record retention will be determined by project-specific requirements, or, in the absence of project requirements, by AECOM Corporate policy.

## 8.0 Personnel qualifications and training

The Project Manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan. In the absence of a Field Team Leader, the Project Manager is responsible for ensuring that field records are reviewed and approved as described below.

The Field Team Leader is responsible for reviewing and approving the field records for accuracy, completeness, and conformance to the procedures in this POP.

Field personnel are responsible for recording data according to the procedures outlined in this POP.

## 9.0 References

POP PPG 002 Chain of Custody Procedures

POP PPG 003 Packaging and Shipment of Environmental Samples

USACE. 2001. Requirements for the Preparation of Sampling and Analysis Plans. EM 200-1-3. United States Army Corps of Engineers. 1 February 2001.

USEPA. 2004. Contract Laboratory Program Guidance for Field Samplers. OSWER 9240.0-35. EPA540-R-00-003. United States Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. August 2004.

USEPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. United States Environmental Protection Agency, Region 4, Athens, GA. November 2001.

USEPA. 1998. Test Methods for Evaluating Solid Wastes. Physical/Chemical Methods (SW-846). Third edition, including all final updates.

USEPA. 1992. RCRA Ground-water Monitoring: Draft Technical Guidance. United States Environmental Protection Agency, Office of Solid Waste, Washington, DC. November 1992.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

**Table 1. Specific Information to Be Recorded**

| |
|---|
| Site name and location |
| Personnel on site (AECOM, clients, site contacts, regulators, oversight personnel, subcontractors, general public) |
| Results of phone calls, conversations |
| Chronology of activities, including mobilization, investigatory activities, and demobilization |
| Weather conditions (initial and any changes; temperature, barometric pressure, wind conditions, precipitation) |
| Tidal stage (if applicable) |
| Inspections of equipment, materials, supplies (problems, corrective action) |
| Subcontractor name, description of services to be provided, and any issues (problems, stand by time) |
| Description of major equipment (drill rigs, backhoe, survey vessels, sampling platforms) |
| Field measurements<br>• Description of procedure<br>• Instruments (make, model, serial number, lamp)<br>• Instrument calibration (date, time, personnel, standard, lot number, standard expiration date, true/measured results, units, corrective action, calibration checks and results)<br>• Results (including units of measure, any correction factors applied, documentation of calculations (if applicable)<br>• Date and time of measurement<br>• Identity of person performing the measurements<br>• Atmospheric conditions (if applicable) |
| Equipment decontamination procedures and materials |
| Well information (depth to water, static water depth, condition of well) |
| Well purging information (procedure, equipment, volumes, pumping rate, criteria for acceptance, time and date) |

| |
|---|
| Presence and detection of immiscible layers, detection method, sampling method |
| Sampling information<br>• Procedures and equipment (type and material)<br>• Sample (soil) selection criteria/rationale (PID, staining, water table)<br>• Sample location identification (e.g., boring, well identification)<br>• Sample location description (sketch, GPS coordinates, compass and distance measurements from fixed points).<br>• Sample depth<br>• Sample flow rate/drawdown<br>• Sample description (recovery, moisture, color, odor, texture, turbidity, artifacts)<br>• Sample manipulations (filtration, homogenization, compositing, preservation)<br>• Sample date and time<br>• Unique sample ID<br>• Identity of sampler<br>• Sample parameters, containers (size/type), preservation<br>• QC samples (field duplicates, trip blanks, field/equipment blanks, MS/MSDs, split samples) – include ID, associated field sample, method of collection |
| Any pertinent field observations that could affect data quality (instrument problems, contamination sources) |
| Deviations from approved plan (schedule modifications, relocation or elimination of sample locations, change orders), including rationale |
| Investigation-derived waste (IDW) types, volumes, storage, and disposal |
| Health and safety (H&S) meetings, personal protective equipment (PPE) worn, H&S monitoring |

Project Operating Procedure

# Chain-of-Custody Procedures

Procedure Number: PPG 002

Revision No.: 0

Revision Date: June 2010

POP Author

Date: 6/28/2010

Kathleen Wooley

Project Manager

Date: 6/28/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Chain-of-Custody Procedures

POP No.: PPG 002
Revision: 0
Date: June 2010

## Contents

## List of Figures

# Project Operating Procedure

# Chain-of-Custody Procedures

## 1.0 Project Scope and applicability

Chain-of-custody (COC) is defined as the unbroken trail of accountability that ensures the physical security of samples, data, and records (EPA Glossary of Quality-Related Terms). This project operating procedure (POP) describes COC procedures applicable to environmental samples collected by AECOM during field sampling and analysis programs. Custody procedures within the laboratories analyzing the samples are not addressed.

Samples are physical evidence. The objective of COC procedures is to provide sufficient evidence of sample integrity to satisfy data defensibility requirements in legal or regulatory situations.

The National Enforcement Investigations Center (NEIC) of the U.S. Environmental Protection Agency (EPA) defines custody of evidence in the following manner:

- It is in your actual possession;
- it is in your view, after being in your physical possession;
- it was in your possession and then you locked or sealed it up to prevent tampering; or
- it is in a secure area.

This POP is to be utilized to conduct the work identified in the title of this POP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this POP are not applicable to the project, the POP will be updated as a subsequent revision.

## 2.0 Health and safety considerations

The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

The following may impact the legal or regulatory defensibility of the data:

- The samples are not accompanied by a COC form, and
- The information recorded on the COC form is incomplete, inaccurate, or differs from the information recorded on the sample containers.

## 4.0 Equipment and materials

The following materials are relevant to this procedure:

- COC Form (Figure 1)
- Sample labels
- COC tape or seal (Figure 2)
- Indelible pen or Sharpie™
- Clear plastic sealing tape

Materials identified in related POPs may also be needed.

## 5.0 Procedures

### 5.1 Pre-sample collection activities

Some measurement methods require preparation of sample collection media or special treatment of sample containers prior to sample collection. In these cases, COC procedures should be initiated with the media preparation or container treatment. This requires that sample identification numbers or media/container identification numbers be assigned. These numbers should be entered on the COC form, leaving room for the subsequent recording of the associated sample numbers. In this variation, the custodian responsible for media preparation or container treatment has the responsibilities outlined in Section 5.2, and the sampler or field sample custodian has the responsibilities stated in Section 5.3 when he or she receives the prepared media or treated containers. There are a number of acceptable approaches to this variation, and the detailed procedures should be defined in the project-specific Quality Assurance Project Plan (QAPP).

### 5.2 Sample collection phase

**5.2.1** As few people as possible should handle the samples. For certain programs, it is helpful if a single person is designated as the sample custodian (the person responsible for the care and custody of the samples until they are transferred to the laboratory for analysis).

**5.2.2** While in the field, sampling personnel should be able to testify that tampering of the samples could not occur without their knowledge. Examples of actions taken may include sealing the sample containers with COC tape or locking the samples in a secure area.

**5.2.3** If samples are to be shipped by commercial overnight carrier, the field sampler or sample custodian completes a COC form (Figure 1) for each cooler/package of samples and places the original of completed form inside the associated cooler/package before the package is sealed (a copy is retained and kept in the field record files). Each completed COC form should accurately list the sample identification numbers of the samples with which it is packaged, and should contain the identification number of the COC tape on the cooler/package. Representatives of commercial carriers are not required to sign the COC form. Refer to PPG POP 003 Packaging and Shipment of Environmental Samples for specific packaging procedures.

**5.2.4** If samples are hand carried to a laboratory, the person hand carrying the samples is the sample custodian. If the carrier is a different person than the one who filled out the COC form and packaged the samples, then that person transfers custody to the carrier by signing and dating each form in the "Relinquished By" section. The carrier then signs and dates each form in the adjacent "Received By" section. When the carrier transfers the samples to the laboratory, he or she signs and dates each form in the next "Relinquished By" section, and the laboratory sample custodian signs and dates each form in the adjacent "Received By" section.

**5.2.5** If samples are transmitted to the laboratory by courier, the procedures described in either Section 5.2.3 or 5.2.4 are followed, depending on whether the courier is a commercial courier or laboratory representative, and whether the cooler has been secured by COC seals prior to pick up by a laboratory courier.

### **5.3** Sample labeling

Labeling of samples occurs at the time of sample collection.

Waterproof, adhesive labels are preferred. Labels should be applied to the container, not the lid whenever possible. Additional interior labels may be required for certain biological samples.

Sample tags may be required for certain projects requiring a strict level of legal or regulatory data defensibility. If tags are utilized, their use will be addressed in the project-specific work plan or QAPP.

Labels should be completed in waterproof, indelible ink. Covering the label with clear plastic tape is recommended to protect the legibility of the label and to prevent the label from detaching from the sample container.

The following information should be recorded on the sample label:

- Project identification (project name and number/client/site)
- Field sample identification code (exactly as it appears on the COC form)
- Sampler’s initials
- Date and time of sample collection
- Analyses requested
- Preservation

### **5.4** Documentation of sample history

Sample history includes, but is not limited to, preparation of sample containers or collection media (for example, wipes), collection, handling (such as subsampling or compositing), storage, shipment, analytical preparation and analysis, reporting, and disposal.

Refer to PPG POP 001 Recording of Field Data, for specific guidance on documentation of field activities, field measurements, and sample collection.

### **5.5** Documentation of custody

It is recommended that a COC form (Figure 1 or equivalent) be initiated upon sample collection. If this is not feasible for a particular project, the COC form may be initiated at the time of sample packaging. If this is the case, the sample collection records will serve as the initial custody document and will document the collection of the sample (sample location and identification, date and time of collection, sampler, and parameters to be analyzed, including containers and preservatives).

The following information is recorded on the COC form:

- Project identification (AECOM project number, client, site name and location).
- Page number (for example, 1 of 2, 2 of 2).
- Field sample identification code. This code should be unique to the sampling event and to the program. This code should agree exactly with the field sample identification code recorded on the bottle label.
- Sampling point location (optional if recorded elsewhere in field records).
- Date and time of sample collection.
- Sample matrix (soil, water, air, etc.).
- Preservative.
- Analysis requested.
- Number of containers.
- Type of sample (grab or composite). Identifying if aqueous samples have been filtered in the field is recommended.
- Signature(s) of sampling personnel and signatures of all personnel handling, receiving, and relinquishing the samples.
- Date(s) and time(s) of each sample transfer.
- Sampler remarks. These comments may serve to alert the laboratory to highly contaminated samples or identify quality control (QC) sample requirements.
- Airbill number (if shipped by overnight commercial carrier).
- Laboratory name and address.

**5.6** COC tape numbers.

The COC is filled out completely and legibly in indelible ink. There should be no unexplained blank spaces. Blank lines should be lined out and initialed and dated.

Data will not be obliterated. Corrections are made, if necessary, by drawing a single line through and initialing and dating the error. The correct information is then recorded with indelible ink.

Information on the COC should agree exactly with that recorded on the sample containers. Discrepancies may result in the samples being incorrectly logged into the laboratory or delays in initiating sample analysis.

**5.7** Sample receipt and inspection

Upon sample receipt, the coolers or packages are inspected for general condition and the condition of the COC tape. The coolers or boxes are then opened and each sample is inspected for damage.

Sample containers are removed from packing material and sample label information is verified against the COC form.

The condition upon receipt, including any discrepancies or problems, is documented and the COC form is completed by signing and recording the date and time of receipt.

Receipt and inspection of samples by subcontractor analytical laboratories will adhere to written procedures established by the laboratory.

## 6.0 Quality assurance / quality control

The records generated in this procedure are subject to review by the sampling team leader, project manager, or designee.

The records generated in this procedure will become a part of the evidence reviewed in the data validation process.

## 7.0 Data and records management

The records generated in this procedure are part of the permanent record supporting the associated measurements and may include, as applicable, the COC forms, sample tags, carrier waybills, and field and laboratory records of sample history (collection, handling, storage, analysis, etc.).

Unanticipated changes to the procedures or materials described in this POP (deviations) should be appropriately documented in the project records.

Records associated with the activities described in this POP should be maintained according to the document management policy for the project.

## 8.0 Personnel qualifications and training

### **8.1** Qualifications and training

The individual executing these procedures should have read, and be familiar with, the requirements of this POP.

No specialized skills are necessary in order to implement these procedures; however, an understanding of the concept of custody is useful.

### **8.2** Responsibilities

The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

For certain sampling programs, the project manager, sampling team leader, or designee may assign an individual to serve as sample custodian. This individual is responsible for supervising the implementation of COC procedures in accordance with this POP and any project-specific work plans or QAPP.

## 9.0 References

American Society for Testing and Materials (ASTM). 2004. Standard Guide for Sample Chain-of-Custody Procedures. D 4840-99 (Reapproved 2004).

PPG POP 001 Recording of Field Data

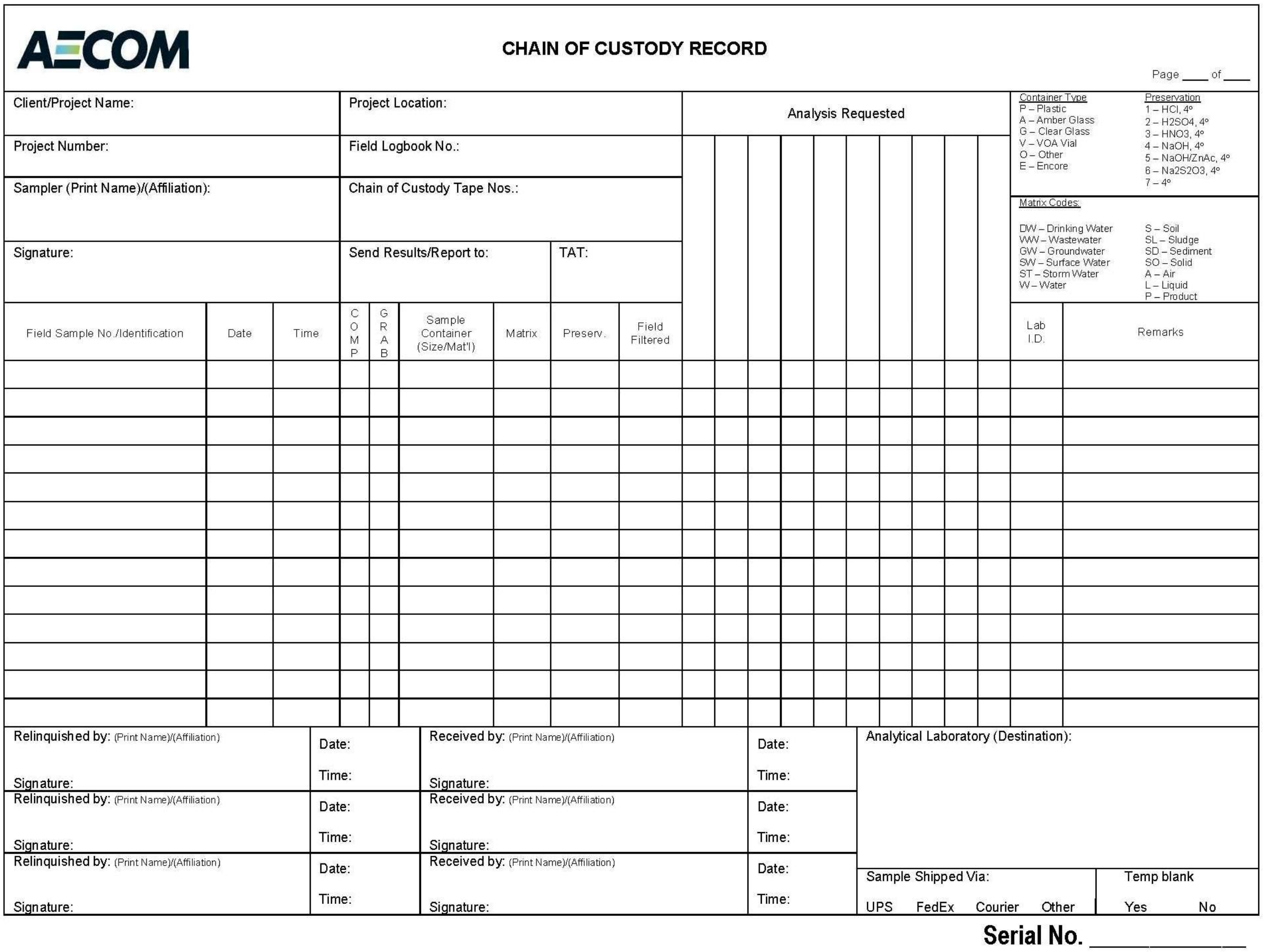
PPG POP 003 Packaging and Shipment of Environmental Samples

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

## 10.0 Revision history

| **Revision** | **Date** | **Changes** |
|---|---|---|
| 0 | June 2010 | Original POP |

## Figure 1. Chain-of-Custody Form



**CHAIN OF CUSTODY RECORD**

Page ____ of ____

| | | | |
|---|---|---|---|
| Client/Project Name: | Project Location: | | |
| Project Number: | Field Logbook No.: | | |
| Sampler (Print Name)/(Affiliation): | Chain of Custody Tape Nos.: | | |
| Signature: | Send Results/Report to: | TAT: | |

Container Type
P – Plastic
A – Amber Glass
G – Clear Glass
V – VOA Vial
O – Other
E – Encore

Preservation
1 – HCl, 4°
2 – H2SO4, 4°
3 – HNO3, 4°
4 – NaOH, 4°
5 – NaOH/ZnAc, 4°
6 – Na2S2O3, 4°
7 – 4°

Matrix Codes:

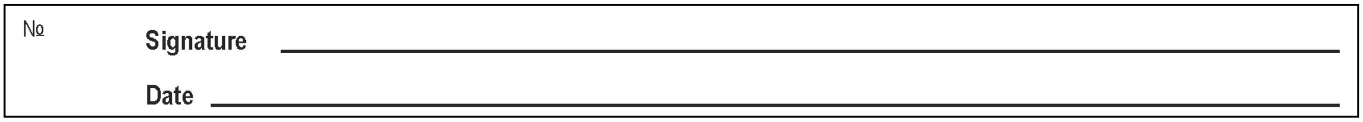
DW – Drinking Water
WW – Wastewater
GW – Groundwater
SW – Surface Water
ST – Storm Water
W – Water
S – Soil
SL – Sludge
SD – Sediment
SO – Solid
A – Air
L – Liquid
P – Product

| Field Sample No./Identification | Date | Time | COMP | GRAB | Sample Container (Size/Mat'l) | Matrix | Preserv. | Field Filtered | Analysis Requested | | | | | | | | | | Lab I.D. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

| | | | | |
|---|---|---|---|---|
| Relinquished by: (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | Received by: (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | Analytical Laboratory (Destination): |
| Relinquished by: (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | Received by: (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | |
| Relinquished by: (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | Received by: (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | Sample Shipped Via:<br>UPS FedEx Courier Other<br>Temp blank<br>Yes No |

**Serial No.** ____________

**Figure 2. Chain-of-Custody Tape**



№

**Signature** ______________________________

**Date** ______________________________

AECOM

Project Operating Procedure

# Packaging and Shipment of Environmental Samples

Procedure Number: PPG 003

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen A Wooley

Date: 6/28/2010

Project Manager

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Project Operating Procedure

# Packaging and Shipment of Environmental Samples

POP No.: PPG 003
Revision: 0
Date: June 2010
Page i of i

## Contents

## List of Figures

# Project Operating Procedure

# Packaging and Shipment of Environmental Samples

## 1.0 Project Scope and applicability

### **1.1** Purpose and Applicability

This Project Operating Procedure (POP) describes the procedures associated with the packaging and shipment of environmental samples. Two general categories of samples exist: environmental samples consisting of water and soil submitted for routine environmental testing, and waste material samples which include non-hazardous solid wastes and/or hazardous wastes as defined by 40 CFR Part 261 submitted for environmental testing or bench/pilot-scale treatability testing. Packaging and shipping procedures will differ for the two sample categories.

This POP is applicable to packaging and shipment of environmental samples submitted for routine environmental testing. Environmental samples are not considered a hazardous waste by definition; therefore, more stringent Department of Transportation (DOT) regulations regarding sample transportation do not apply. Environmental samples do, however, require fairly stringent packaging and shipping measures to ensure sample integrity as well as safety for those individuals handling and transporting the samples.

This POP is designed to provide a high degree of certainty that environmental samples will arrive at their destination intact. This POP assumes that samples will often require shipping overnight by a commercial carrier service, therefore, the procedures are more stringent than may be necessary if a laboratory courier is used or if samples are transported directly to their destination by a sampling team member. Should the latter occur, the procedures may be modified to reflect a lesser degree of packaging requirements.

Respective state or federal agency (regional offices) protocols may require or recommend specific types of equipment for use in sample packaging or a specific method of shipment that may vary from the indicated procedures. Deviations from this POP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the project work plan, and must be documented in the field project notebook when they occur.

### **1.2** General Principles

Sample packaging and shipment generally involves the placement of individual sample containers into a cooler or other similar shipping container and placement of packing materials and coolant in such a manner as to isolate the samples, maintain the required temperature, and to limit the potential for damage to sample containers when the cooler is transported.

## 2.0 Health and safety considerations

Sampling personnel should be aware that packaging and shipment of samples involves potential physical hazards primarily associated with handling of occasional broken sample containers and lifting of heavy objects. Adequate health and safety measures must be taken to protect sampling personnel from these potential hazards. The project Health and Safety Plan (HASP) generally addresses physical and other potential hazards. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing sampling, and must be adhered to as field activities are performed. In the absence of a HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

Not Applicable

## 4.0 Equipment and materials

- Sample coolers
- Sample containers
- Shipping labels
- Chain-of-custody records, custody seals
- Bubble wrap
- Vermiculite (granular), or styrofoam pellets
- "Blue Ice" refreezable ice packs, or ice cubes
- Transparent tape, or rubber bands
- Fiber tape
- Duct tape
- Zipper-lock plastic bags
- Trash bags
- Health and Safety supplies
- Equipment decontamination materials
- Field project notebook/pen

## 5.0 Procedures

### 5.1 General Information

### 5.1.1 Regulatory Information

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when any of the following conditions are applicable:

- Samples are being transported to a laboratory for analysis;
- Samples are being transported to the collector from the laboratory after analysis;
- Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

### 5.1.2 Sample Information:

The following information must accompany each shipment of samples on a chain-of-custody form (Figure 1) where each sample has an individual entry:

- Sample collector's name, mailing address and telephone number,
- Analytical laboratory's name, mailing address and telephone number,
- A unique identification of each sample,
- Sample description (matrix),
- Number and type of sample containers,
- Container size,
- Preservative,
- Type and method of analysis requested, and
- Date and time that the samples were collected and prepared for shipping,
- Special handling instructions, including notation of suspected high concentration samples.

### 5.1.3 Laboratory Notifications:

Prior to sample collection, the Project Manager, or designated alternative must notify the laboratory manager of the number, type and approximate collection and shipment dates for the samples. If the number, type or date of sample shipment changes due to program changes which may occur in the field, the Project Manager or alternate must notify the laboratory of the changes. Additional notification from the field is often necessary when shipments are scheduled for weekend delivery.

### **5.2** General Site Preparation

#### **5.2.1** Small Projects

Small projects of one or two days duration may require packaging and shipment of samples using the field vehicle as the sample preparation area. If sample coolers will be sent via third party commercial carrier service, adequate sample packaging materials should be sent to the project location in advance of sampling or purchased from stores located near the site.

#### **5.2.2** Large Projects

Multi-day or week sampling programs usually require rental of an office trailer or use of existing office/storage facilities for storage of equipment as well as for sample preparation. If possible, a designated area should be selected for storage of unused sample containers/coolers and another area for sample handling, packaging, and shipment. Handling of environmental samples should preferably be conducted in a clean area and away from unused sample containers to minimize the potential for cross contamination. Large quantities of packaging materials may require advance special ordering. Shipping forms/labels may be preprinted to facilitate shipping.

#### **5.2.3** Cooler Inspection and Decontamination

Laboratories will often re-use coolers. Every cooler received at a project location should be inspected for condition and cleanliness. Any coolers that have cracked interior or exterior linings/panels or hinges should be discarded as their insulating properties are now compromised. Any coolers missing one or both handles should also be discarded if replacement handles (i.e., knotted rope handles) can not be fashioned in the field. Replacement coolers may be purchased in the field if necessary.

The interior and exterior of each cooler should be inspected for cleanliness before using it. Excess strapping tape and old shipping labels should be removed. If the cooler interior exhibits visible contamination or odors it should be decontaminated in accordance with POP PPG 014 Decontamination of Field Equipment prior to use. Drain plugs should be sealed on the inside with duct tape.

#### **5.2.4** Other Considerations

VOC Samples - Sample containers used for VOC analysis may be grouped into a single cooler, with separate chain-of-custody record, to limit the number of trip blanks required for transportation and analysis. Individual VOC samples may also be placed into Zipper-lock bags to further protect the samples.

Contaminated Samples - Sample containers with presumed high contaminant concentrations should be isolated within their own cooler with each sample container placed into a Zipper-lock bag.

## **5.3** Sample Packaging Method

Sample packaging should be conducted in the following manner:

Place plastic bubble wrap matting over the base of each cooler or shipping container as needed. A 2- to 3-inch thickness layer of vermiculite may be used as a substitute base material.

Insert a clean trash bag into the cooler to serve as a liner.

Check that each sample container is sealed, labeled legibly, and is externally clean. Re-label and/or wipe bottles clean if necessary. Clear tape should be placed over the labels to protect them. Wrap each sample bottle individually with bubble wrap secured with tape or rubber bands. Place bottles into the cooler in an upright single layer with approximately one inch of space between each bottle. Do not stack bottles or place them in the cooler lying on their side. If plastic and glass sample containers are used, alternate the placement of each type of container within the cooler so that glass bottles are not placed side by side.

Insert cooler temperature blanks if required.

Place additional vermiculite, bubble wrap, and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler to a level which meets the approximate top of the sample containers. Packing material may require tamping by hand to reduce the potential for settling.

Place cubed ice or cold packs in heavy duty Zip-lock type plastic bags, close the bags, and distribute the packages in a layer over the top of the samples. Cubed ice should be double-bagged to prevent leakage. Loose ice should never be used. Cold packs should be used only if the samples are chilled before being placed in the cooler.

Add additional bubble wrap/styrofoam pellets or other packing materials to fill the balance of the cooler or container.

Obtain two pieces of chain of custody tape as shown in Figure 2 and enter the custody tape numbers in the appropriate place on the chain-of-custody form. Sign and date the chain-of-custody tape.

Complete the chain-of-custody form. If shipping the samples involves use of a third party commercial carrier service, sign the chain-of-custody record thereby relinquishing custody of the samples. Shippers should not be asked to sign chain of custody records. If a laboratory courier is used, or if samples are transported to the laboratory, the receiving party should accept custody and sign the chain-of-custody records. Remove the last copy from the form and retain it with other field notes. Place the original (with remaining copies) in a Zipper-lock type plastic bag and tape the bag to the inside lid of the cooler or shipping container.

Close the top or lid of the cooler or shipping container.

Place the chain of custody tape at two different locations (i.e., one tape on each side) on the cooler or container lid and overlap with transparent packaging tape.

Packaging tape should be placed entirely around the sample shipment containers. A minimum of two full wraps of packaging tape will be placed at least two places on the cooler.

Repeat the above steps for each cooler or shipping container.

### **5.4** Sample Shipping Method

Packaged sample coolers should be shipped using one of the following options:

#### **5.4.1** Hand Delivery

When a project member is transporting samples by automobile to the laboratory, the cooler should only be sealed with tape. In these cases, chain-of-custody will be maintained by the person transporting the sample and chain-of-custody tape need not be used. Chain-of-custody records should be relinquished upon delivery and a copy of the record retained in the project file.

#### **5.4.2** Laboratory Courier

Laboratory couriers are usually employees of the analytical laboratory receiving the samples. As such, they will accept custody of the samples and must be asked to sign the chain-of-custody records. Chain-of-custody records do not need to be sealed in the cooler although it is recommended that the coolers be sealed with tape. All other packaging requirements generally apply unless otherwise specified in the SAP.

If the laboratory courier is not authorized to accept custody of the samples, or if the requirements of the project plan preclude transfer to the laboratory courier, samples will be handled as described below in Section 5.4.3.

#### **5.4.3** Third Party Courier

If overnight shipment is required, a third party package delivery service should be used. Transport the cooler to the package delivery service office or arrange for package pick-up at the site. Fill out the appropriate shipping form or airbill and affix it to the cooler. Some courier services may use multi-package shipping forms where only one form needs to be filled out for all packages going to the same destination. If not, a separate shipping form should be used for each cooler. Keep the receipt for package tracking purposes should a package become lost. Please note that each cooler also requires a shipping label which indicates point of origin and destination. This will aid in recovery of a lost cooler if a shipping form gets misplaced. Never leave coolers unattended while waiting for package pick-up. Airbills or waybills will be maintained as part of the custody documentation.

### **5.5** Sample Receipt

Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain-of-custody form. The laboratory will verify that the chain-of-custody tape has not been broken previously and that the tape number corresponds with the number on the chain-of-custody record. The laboratory will note the condition of the samples upon receipt and will identify any discrepancies between the contents of the cooler and chain-of-custody. The analytical laboratory will then forward the back copy of the chain-of-custody record to the project manager to indicate that sample transmittal is complete.

## 6.0 Quality assurance / quality control

Sampling personnel should follow specific quality assurance guidelines as outlined in the site-specific work plan or QAPP. Proper quality assurance requirements should be provided which will specify sample packaging and shipment requirements if variations to the indicated procedures are necessary on a particular project.

The potential for samples to break during transport increases greatly if individual containers are not snugly packed into the cooler. Completed coolers may be lightly shake-tested to check for any loose bottles. The cooler should be repacked if loose bottles are detected.

Environmental samples are generally shipped so that the samples are maintained at a temperature of approximately 4°C. Temperature blanks may be required for some projects as a quality assurance check on shipping temperature conditions. These blanks usually are supplied by the laboratory and consist of a 40-ml vial or plastic bottle filled with tap water. Temperature blanks should be placed near the center of the cooler.

## 7.0 Data and records management

Documentation supporting sample packaging and shipment generally consists of chain-of-custody records and shipping records. In addition, a description of sample packaging procedures will be written in the field project notebook. All documentation will be retained in the project files following project completion.

## 8.0 Personnel qualifications and training

Sample packaging and shipment is a relatively simple procedure requiring minimal training and a minimal amount of equipment. It is, however, recommended that initial attempts be supervised by more experienced personnel. Sampling technicians should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present.

### **8.1** Sampling Technician

It is the responsibility of the sampling technician to be familiar with the procedures outlined within this POP and with specific sampling, quality assurance, and health and safety requirements outlined within the project-specific plans. The sampling technician is responsible for proper packaging and shipment of environmental samples and for proper documentation of sampling activities for the duration of the sampling program.

### **8.2** Sampling Coordinator

Large sampling programs may require additional support personnel such as a sampling coordinator. The sampling coordinator is responsible for providing management support such as maintaining an orderly sampling process, providing instructions to sampling technicians regarding sampling locations, and fulfilling sample documentation requirements, thereby allowing sampling technicians to collect samples in an efficient manner.

### **8.3** Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the activities in accordance with the project plan and this POP. The project manager is also responsible for ensuring that proper arrangements have been made with the designated analytical laboratory. These arrangements include, but are not necessarily limited to, subcontractor agreements, analytical scheduling, and bottle/cooler orders. The project manager may delegate some of these responsibilities to other project staff.

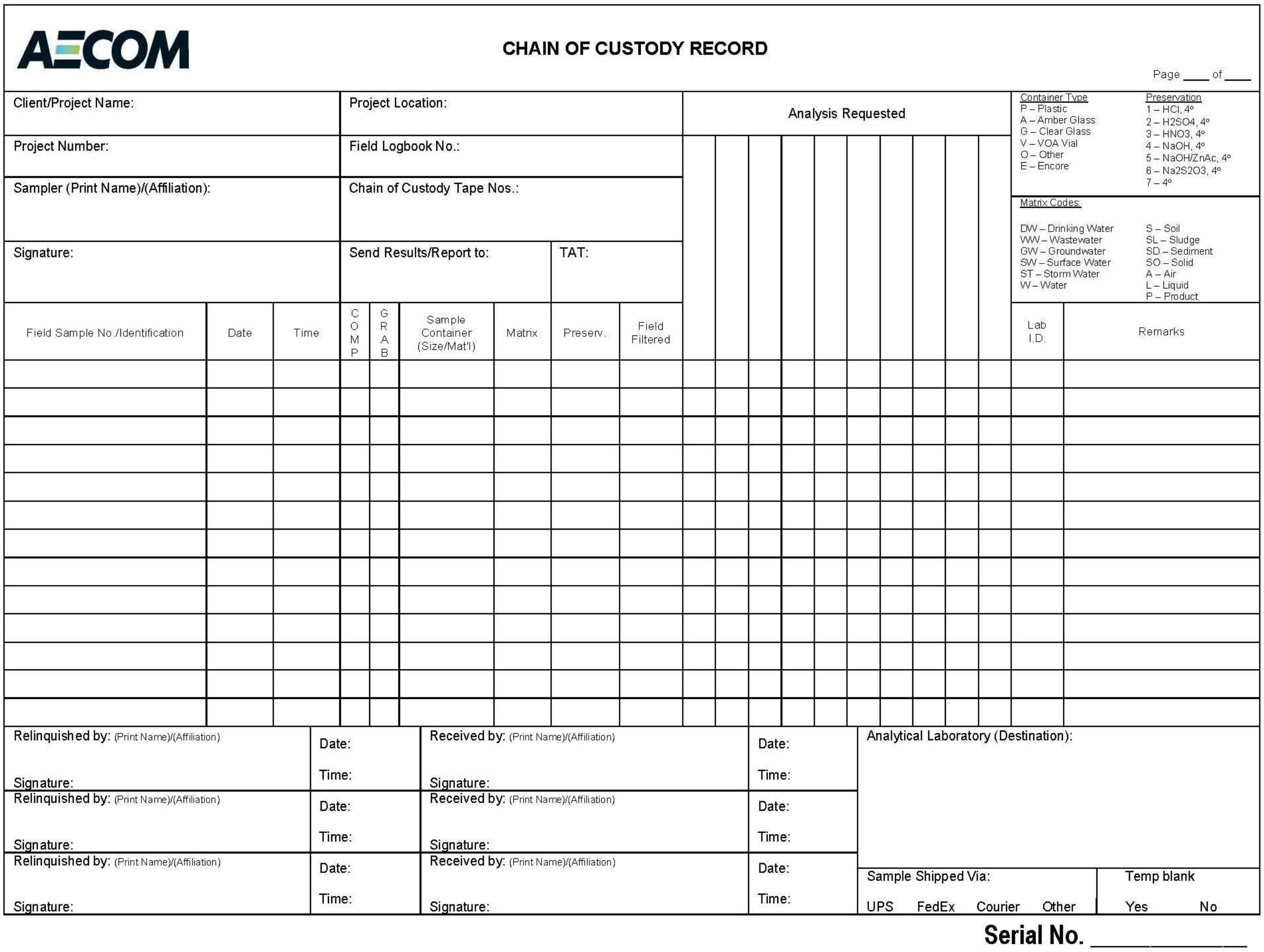
## 9.0 References

Not applicable.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

## Figure 1. Chain of Custody Form



**CHAIN OF CUSTODY RECORD**

Page ____ of ____

Client/Project Name:

Project Location:

Project Number:

Field Logbook No.:

Sampler (Print Name)/(Affiliation):

Chain of Custody Tape Nos.:

Signature:

Send Results/Report to:

TAT:

Analysis Requested

Container Type
P – Plastic
A – Amber Glass
G – Clear Glass
V – VOA Vial
O – Other
E – Encore

Preservation
1 – HCl, 4º
2 – H2SO4, 4º
3 – HNO3, 4º
4 – NaOH, 4º
5 – NaOH/ZnAc, 4º
6 – Na2S2O3, 4º
7 – 4º

Matrix Codes:

DW – Drinking Water
WW – Wastewater
GW – Groundwater
SW – Surface Water
ST – Storm Water
W – Water

S – Soil
SL – Sludge
SD – Sediment
SO – Solid
A – Air
L – Liquid
P – Product

| Field Sample No./Identification | Date | Time | COMP | GRAB | Sample Container (Size/Mat'l) | Matrix | Preserv. | Field Filtered | | | | | | | | | | | Lab I.D. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| **Relinquished by:** (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | **Received by:** (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: |
| **Relinquished by:** (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | **Received by:** (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: |
| **Relinquished by:** (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: | **Received by:** (Print Name)/(Affiliation)<br>Signature: | Date:<br>Time: |

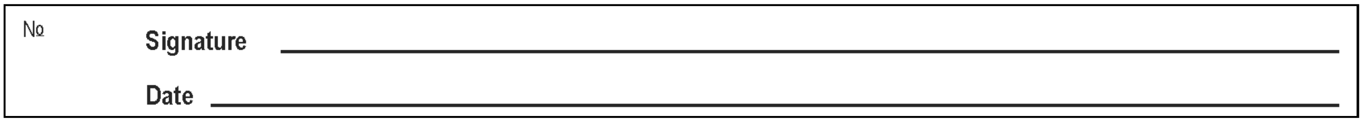
Analytical Laboratory (Destination):

Sample Shipped Via:
UPS FedEx Courier Other

Temp blank
Yes No

**Serial No.** ____________

**Figure 2. Chain of Custody Tape**



№

**Signature** ______________________________

**Date** ______________________________

AECOM

Project Operating Procedure

# Operation and Calibration of a Photoionization Detector

Procedure Number: PPG 004

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen A Wooley

Date: 6/28/2010

Project Manager

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

# Operation and Calibration of a Photoionization Detector

## Contents

# Project Operating Procedure

# Operation and Calibration of a Photoionization Detector

## 1.0 Project Scope and applicability

### 1.1 Purpose and Applicability

This document describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

PIDs routinely used by AECOM personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

### 1.2 Principle of Operation

The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.

The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.

Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive- biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

### **1.3** Specifications

Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 ppm isobutylene equivalent.

## 2.0 Health and safety considerations

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project HASP for instructions pertaining to instrument use in explosive atmospheres.

## 3.0 Interferences

Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

## 4.0 Equipment and materials

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated.

- Regulator for calibration gas cylinder
- Approximately 6 inches of Teflon® tubing
- Tedlar bag (optional)
- Commercially-supplied zero grade air (optional)
- "Magic Marker" or “Sharpie” or other waterproof marker
- Battery charger
- Moisture traps
- Spare lamps
- Manufacturer’s instructions
- Field data sheets or logbook/pen

## 5.0 Procedures

### 5.1 Preliminary Steps

Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

### 5.2 Calibration

The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.

Calibrate the instrument according to the manufacturer’s instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.

If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 5.4).

### 5.3 Operation

Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.

Calibrate the instrument as described in Section 5.2, following the manufacturer’s instructions. Record the calibration information in the field records.

The instrument is now operational. Readings should be recorded in the field records.

When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a “bump” test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.

At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 5.2) except that no adjustment will be made to the instrument. Record the information in the field records.

Recharge the battery after each use (Section 5.4).

When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

### **5.4** Routine Maintenance

Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer’s instructions for procedures and frequency.

All routine maintenance should be performed in a non-hazardous environment.

### **5.5** Troubleshooting Tips

One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.

Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.

Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.

Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or “flooded”. Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

## 6.0 Quality assurance / quality control

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.

Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within ±10%. If the instrument responds outside this tolerance, it must be recalibrated.

Checks of the instrument response (Section 5.5) should be conducted periodically and documented in the field records.

## 7.0 Data and records management

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number.
- Instrument manufacturer, model, and identification number.
- Operator's signature.
- Date and time of operation.
- Calibration gas used.
- Calibration check at beginning and end of day (meter readings before adjustment).
- Span setting after calibration adjustment.
- Meter readings (monitoring data obtained).
- Instances of erratic or questionable meter readings and corrective actions taken.
- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 5.5) or similar test.

## 8.0 Personnel qualifications and training

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

The field operator is responsible for verifying that the PID is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this POP and the project plan.

## 9.0 References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

AECOM

Project Operating Procedure

---

# Surface and Subsurface Soil Sampling Procedures

Procedure Number: PPG 005

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen A Woolley

Date: 6/28/2010

Project Manager

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Surface and Subsurface Soil Sampling Procedures

POP No.: PPG 005
Revision: 0
Date: June 2010
Page i of i

## Contents

## List of Attachments

# Project Operating Procedure

# Surface and Subsurface Soil Sampling Procedures

## 1.0 Project Scope and applicability

This project operating procedure (POP) is applicable to soil sampling. The procedure includes surface and subsurface sampling by various methods using hand auguring, test pit, direct-push, and split-spoon equipment. The procedure includes soil sampling for volatile organic compounds (VOCs). For project specific information (e.g. sampling depths, equipment to be used, and frequency of sampling), refer to the Quality Assurance Project Plan (QAPP) and/or Work Plan, which take precedence over these procedures.

Surface soil sampling, typically considered to be up to two feet below ground surface by EPA standards, is typically accomplished using hand tools such as shovels or hand augers. Test pit samples are considered subsurface samples, although normally collected via hand tools similar to surface soil sampling or by excavation machinery. Direct-push and split-spoon sampling offer the benefit of collecting soil samples from a discrete or isolated subsurface interval, without the need of extracting excess material above the target depth. These methods dramatically reduce time and cost associated with disposal of material from soil cuttings when compared to test pit sampling. In addition, direct-push and split-spoon sampling methods can obtain samples at targeted intervals greater than 15 feet in depth, allowing for discrete depth soil sampling while speeding up the sampling process. Direct-push methods work best in medium to fine-grained cohesive materials such as medium to fine sands, silts, and silty clay soils. Split-spoon sampling works well in all types of soil, but is somewhat slower than direct-push methods. Samples are composited so that each sample jar to be analyzed contains a homogenized representative portion of the interval samples. Due to potential loss of analytes, samples for volatile analysis are not composited. Samples for chemical analysis can be collected by any of the above-mentioned sampling methods, as disturbed soil samples. Undisturbed samples are collected, sealed, and sent directly to the laboratory for analysis. For undisturbed samples, the samples are not homogenized.

## 2.0 Health and safety considerations

All calibration, maintenance and servicing of soil sampling equipment and instrumentation should be performed in a safe area, away from hazardous locations.

Refer to the Site-Specific Health and Safety Plan for health and safety issues and equipment/instrumentation needed. General health and safety equipment includes a combustible gas indicator (CGI), photo/flame ionization detector (PID/FID), tyvek, gloves, safety glasses, and steel-toe boots.

The Site-Specific Health and Safety Plan should be followed during all site activities. Health and safety meetings should be held each day prior to the commencement of activities.

Before soil sampling commences, appropriate entities (e.g. DigSafe, New Jersey Call Before You Dig, local public works departments, company facilities, etc.) must be contacted to assure the anticipated soil sampling locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas. These entities will be notified by the drilling contractor at least three, but not more than ten business days prior to the start of drilling. Prior to conducting any intrusive operations, existing drawings and other available documentation will be reviewed to evaluate whether potential conflicts with underground utilities exist. If any doubt exists regarding the potential presence of subsurface utilities, a professional utility locating service will be retained to conduct surveys to clear proposed drilling locations. A variety of techniques are available to locate utilities, including ground penetrating radar, electromagnetic conductivity, radio frequency, audio frequency, and passive electric. The efficacy of each technique is dependent on the material used to construct the utility, type of utility, number and type of nearby utilities, and many other factors. As such, it is common practice to use more than one utility locating technique. The requirements for utility location and appropriate techniques will be determined once available information is gathered and evaluated. Soil boring, sampling, and monitoring well locations will be adjusted to avoid underground and overhead utilities. As an added precaution, vacuum boring to a depth of four feet or to the expected invert depth of the deepest utility at any given soil boring or well location may be conducted. However, if vacuum boring is required at certain locations, collection of shallow soil samples for laboratory analysis in the vacuumed zone will still be undertaken from the sidewall area of the vacuumed zone to ensure that shallow surface soil samples will be collected at all proposed off-site investigation locations. The shallow surface soil samples will be collected according the General Soil Sampling procedures in Section 5.1 and Surface Soil Sampling procedures in Section 5.2. All underground utility identification will be performed in accordance with AECOM SH&E SOP No. 726, located in the site-specific Health and Safety Plan (HASP).

## 3.0 Interferences

Low recovery of soil from sampling equipment will prevent an adequate representation of the soil profile and sufficient amount of soil sample. If low recovery is a problem, the hole may be offset and re-advanced, terminated, or continued using a larger diameter sampler.

Asphalt in soil samples can cause false positive results for hydrocarbons. To ensure samples are free of asphalt, do not collect sample from soil with possible asphalt. Note the sampling depth(s) and the depths at with the presence of asphalt are suspected.

Instrumentation interferences addressed in POPs for Calibration of the PID, Headspace Screening for Total Volatile Organics, and Equipment Decontamination Procedures must also be considered.

Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

## 4.0 Equipment and materials

The depth at which samples will be collected and the anticipated method of sample collection (direct-push, split-spoon, hand auger, shovel, or test pits) will be presented in the QAPP and/or Work Plan.

The following details equipment typically needed for soil sampling, based on the various methods. See the QAPP and/or Work Plan for specific detail of equipment and supply needs.

Depending on the nature of suspected contamination, field screening instrumentation may be used to direct sampling. Appropriate instrumentation and calibration standards should be available. If volatile organic contaminants are suspected and a PID will be used, refer to the equipment and instrumentation listed in the POP PPG 004 Operation and Calibration of a Photoionization Detector. Equipment in this POP includes but is not limited to:

- PID
- Calibration gas
- Tedlar® gas bags (for calibration)

If field screening methods include jar headspace screening for volatile organics, refer to the equipment and procedure in the POP for Headspace Screening for Total VOCs. Equipment in this POP includes but is not limited to:

- Clean soil (“drillers jars”) jars
- Aluminum foil

Appropriate decontamination procedures must be followed for sampling equipment. Refer to POP PPG 014 Decontamination of Field Equipment for the proper decon procedures.

The following general equipment is needed for all soil sampling, regardless of method:

- Stainless steel bowls
- Stainless steel trowels
- Appropriate sample containers for laboratory analysis
- CGI (as necessary – i.e. sites where explosive gasses may be encountered)
- Personal Protective Equipment (PPE)
- Log Book
- Cooler and ice for preservation
- Stakes and flagging to document sampling location

The following additional equipment is needed for volatile organic sampling:

- Electronic pan scale and weights for calibration
- Syringes or other discrete soil core samplers

The following additional equipment may be needed for surface and test pit soil sampling:

- Hand Auger

The following additional equipment may be needed for soil sampling from split-spoon equipment:

- Tape measure or folding carpenter's rule for recording the length of soil recovered in the split-spoon.

All subsurface drilling equipment will be provided and maintained by the subcontractor.

## 5.0 Procedures

### 5.1 General Soil Sampling Procedure for All Soil Sampling Methods

1. Record the weather conditions and other relevant on-site conditions.
2. Select the soil sampling location, clear vegetation if necessary, and record the sampling location identification number and pertinent location details.
3. Verify that the sampling equipment is properly decontaminated, in working order, and situated at the intended sampling location.
4. Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. Cover surfaces onto which soils or soil samplers will be placed (i.e. tables with polyethylene sheeting).
5. Follow the appropriate procedures listed below for either surface, split-spoon, direct push, or test pit sample collection (5.2, 5.3, 5.4, and 5.5 respectively).

7\. For projects located in New Jersey, see Section 5.6 for New Jersey-specific requirements for soil samples collected for volatile organics analysis.

6\. Collect soil samples according to procedures listed in Section 5.7 depending on project specific analyses.

7\. Record date/time, sample ID, and sample descriptions in the field logbook for field form. A sketch or description of the location should also be recorded so the sample location can be re-constructed.

8\. Immediately label (and tag if required) the sample containers and place them on ice, if required for preservation. Complete the COC form(s) as soon as possible.

9\. Dispose of all excess excavated soil in accordance with the site-specific QAPP and/or Work Plan. Soils may either be segregated based on level of contamination, stockpiled, drummed for disposal, or put back into the hole from which the soil came.

10\. Upon completion, clearly label a wooden stake or pin flag with indelible ink and stake or flag the sampling location.

11. Decontaminate the sampling equipment according to POP PPG 014 Decontamination of Field Equipment.

### **5.2** Surface Soil Sampling

The following procedures are to be used to collect surface soil samples. Surface soils are considered to be soils that are up to one (1) foot below ground surface, though state regulations and project objectives may define surface soils differently; therefore, the QAPP and/or Work Plan should be consulted for direction on the depth from which to collect the surface soil samples. Sampling and other pertinent data and information will be recorded in the field logbook and/or on field forms. Photographs will be taken as needed or as specified in the QAPP and/or Work Plan.

1. Gently scrape any vegetative covering until soil is exposed. Completely remove any pavement.
2. Remove soil from excavation with a trowel, hand auger, or shovel. Put soils within the sampling interval in a stainless steel bowl for homogenizing. Monitor the excavation as required in the site-specific HASP and/or QAPP and/or Work Plan (i.e., PID).

The criteria used for selecting surface soil locations for sampling may include the following:

- Visual observations (soil staining, fill materials)
- Other relevant soil characteristics
- Site features
- Screening results
- Predetermined sampling approach (i.e. grid or random)
- Sampling objectives as provided in the QAPP and/or Work Plan

3. For VOC analyses, collect representative soil samples directly from the recently-exposed sidewall of the excavation using a syringe or other soil coring device (e.g., TerraCore®, EnCore®). Follow procedures in Section 5.7.1 or 5.7.2 for VOC sampling.
4. Collect sufficient soil to fill all remaining sample jars into a stainless steel bowl. Homogenize the soil samples to obtain a uniform soil composition which is representative of the total soil sample collected according to the following procedure:
    a) Remove all rocks and non-soil objects using a stainless steel spoon or scoop. However, if the soils to be sampled contain chromite ore processing residue (COPR) nodules or chromate chemical production waste (CCPW) materials, **do not** remove these CCPW “non-soil objects” and document their presence in the field logbook.
    b) Form a cone shaped mound with the sample material, then flatten the cone and split the sample into quarters.

c) Use the stainless steel spoon/scoop to mix the quarter samples that are opposite.

d) After mixing the opposite quarters, reform the cone shaped mound.

e) Repeat this procedure a minimum of five (5) times, removing any non-soil objects and breaking apart any clumps.

### **5.3** Split-Spoon Sampling

1. At each boring location, the frequency and depth of split-spoon samples will be determined from the QAPP and/or Work Plan. Split-spoon samples may be collected continuously, intermittently, or from predetermined depths.
2. Standard penetration tests will be conducted according to ASTM D1586-99, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils to record the number of hammer blows required to advance the sampler each 6 inches of depth in the boring log.
3. Split-spoon samplers shall be driven into undisturbed soil by driving the spoon ahead of the drill augers/casing. In cohesive soils, or soils where the borehole remains open (does not collapse), two split-spoon samples may be taken prior to advancing the augers/casing.
4. After split-spoons are retrieved, open the split-spoon and measure the recovery of soil. If a PID will be used for screening, immediately scan the recovered sample for VOCs using a PID/FID. Scan the recovered soil by making a hole in the soil and placing the PID in or very close to the hole. Be very careful not to get soil on the tip of the PID. Take these PID scan readings every 6 inches along the split-spoon. Note any staining and/or presence of water. Record the highest PID reading and the depth at which it was observed along with other observations. If the project is in New Jersey, see Section 5.6 for state-specific procedures on determining where to collect VOC samples. All VOC samples should be collected (see Section 5.7.1 and 5.7.2) prior to logging the sample.
5. If headspace screening for VOCs is required in the QAPP and/or Work Plan, collect a soil sample and perform headspace screening according to the POP for Headspace Screening for Total VOCs.
6. Soils collected using the split-spoon sampler will be logged by the AECOM field representative using the procedure described in ASTM D2488-00 Standard Practice for Description and Identification of Soils. In addition to the description of the soils, blow counts, sample recovery, PID readings (headspace), and the depth to water will also be recorded.
7. Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 5.2.
8. The QAPP and/or Work Plan may specify that intervals to be sent to the laboratory be determined by visual observation and/or highest PID screening or headspace results,

which can only be determined once the boring is complete. In this instance, a VOC sample should be collected at each interval. The remainder of the soil from that interval will be set aside in a clearly labeled stainless steel bowl covered with aluminum foil. Once the boring has been completed and the sample interval has been determined, the remainder of the soil can be homogenized according to Section 5.2 and submitted for laboratory analysis.

9. Once a boring is complete and all required samples have been collected, the boring may be filled or a monitoring well or piezometer may be installed. Borings must be completed as specified in the QAPP and/or Work Plan.

### **5.4** Direct Push Sampling

At each boring location, the frequency of direct-push samples will be determined from the QAPP and/or Work Plan. Typically, samples with direct-push equipment are collected in 4 ft intervals.

1. Sample using either 2' or 4' Macro-Core samplers with acetate liners to obtain discrete soil samples at specific depths.
2. Cut open the acetate liner, and immediately scan the recovered sampler for VOCs using a PID/FID. Note any staining and/or presence of water. Record the highest PID reading and the depth at which it was observed along with other observations. If the project is in New Jersey, see Section 5.6 for state-specific procedures on determining where to collect VOC samples. All VOC samples should be collected (see Section 5.7.1 and 5.7.2) prior to logging the sample.
3. If required in the QAPP and/or Work Plan, collect a soil sample and perform headspace screening according to the POP for Headspace Screening for Total VOCs.
4. Soils collected using the direct-push sampler will be logged by the AECOM field representative using the procedure described in ASTM D2488-00 Standard Practice for Description and Identification of Soils. In addition to the description of the soils and sample recovery, PID readings (headspace), and the depth to water will also be recorded.
5. Collect the remainder of the sample into a stainless steel bowl. Homogenize the soil collected so that the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 5.2.
6. Once a boring is complete and all required samples have been collected, the boring may be filled or a monitoring well or piezometer may be installed. Borings must be completed as specified in the QAPP and/or Work Plan.

### **5.5** Test Pit Sampling

1. Excavate the test pit to the desired depth.
2. Using the excavator bucket, collect soil samples as specified in the QAPP and/or Work Plan. Collect a sample and perform screening analyses as required by the QAPP and/or Work Plan. If VOCs contamination is suspected,

perform headspace screening according to the POP for Headspace Screening for Total VOCs.

3. Collect the sample from center of the bucket to avoid potential contamination from the bucket.
4. VOC samples should also be collected from an undisturbed section soil in the excavator bucket. The top layer of exposed soil should be scraped away just prior to collecting the VOC samples. VOC samples should be collected according to the procedures in Section 5.7.1 and 5.7.2.
5. Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in section 5.2.
6. Dispose of all excavated soil according to the QAPP and/or Work Plan.

**5.6** Special considerations for projects in New Jersey

**5.6.1** All soil samples to be analyzed for volatile organics shall be collected as follows:

- A bulk sampling device that will collect an intact core (e.g., split-spoon) shall be used to minimize contaminant loss during sampling.
- Each core shall be field screened with a properly calibrated direct reading instrument equipped with a PID, flame ionization detector (FID), or other suitable instrument capable of detecting the contaminants pursuant to N.J.A.C. 7:26E-2.1(b) to select samples for volatile organics analysis using the following criteria if field measurement readings are above background:
    - The coring shall be extended until either background readings are achieved, ground water is encountered, or bedrock is encountered; and
    - An undisturbed sample from the six-inch interval registering the highest field measurement reading shall be collected, at a minimum, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4.
- If all intervals register the same field measurement reading or all field measurement readings do not exceed background:
    - The coring shall be extended to ground water, bedrock, or 10 feet, whichever is encountered first;
    - One undisturbed sample at a minimum, from the six-inch interval at the bottom of the soil boring shall be collected, using the appropriate sample collection method and sampling device for volatile organics analysis pursuant to the requirements specified in N.J.A.C. 7:26E-2.1(a)4; and

  - Contaminants that cannot be detected with field-screening instruments shall be sampled in accordance with the requirements at N.J.A.C. 7:26E-3.4(a).

- In all cases, samples shall be collected in discrete six inch increments. If more or less than a six inch increment is sampled because of poor sample recovery or other field logistical problems, an explanation shall be provided in the soil log.

## **5.7** Sample Collection Methods

### **5.7.1** Volatile Organics Sampling – Closed System Vials with Organic Free Water (low-level) and Methanol (high level)

For soils collected for analyses of volatile organics, including Volatile Petroleum Hydrocarbons (VPH) or other purgable compounds, a closed system is maintained. From collection through analysis, the sample bottles are not opened. The bottle kit for a routine field sample for these analyses will typically include four 40-mL VOA vials and one soil jar. Two 40-mL VOA vials will contain 5 mL organic free water (OFA) and magnetic stir bars (i.e., low level vials), and two VOA vials will contain 15 mL methanol with no magnetic stir bar (i.e., high level vial). These vials are provided by the laboratory and are pre-weighed. No sample labels are affixed to the VOA vials, as addition of a label would alter the vial weight. All information is recorded directly on the VOA vial using indelible marker. The soil jar is provided for percent solids determination. For VOC or VPH analyses, samples are collected prior to sample homogenization. Collect the VOC sample in accordance with the procedure described below.

1. Prior to sampling, weigh the 40-mL VOA vials received from the laboratory. Record this weight to the nearest 0.1 gram. This weight will be used to determine if the proper amount of soil has been added to the vial. In addition, the weight should be within 0.2 grams of the tare weight on the sample label. If the weight is off by more than 0.2 grams, do not use this vial as some of the OFA may have been lost.
2. Determine the soil volume necessary for the required sample weight, typically 5 grams:
   a) Prepare a 5 mL sampling corer (e.g., Terra Core®) or cut-off plastic syringe.
   b) Tare the sampler by placing it on the scale, and zeroing the scale.
   c) Draw back the plunger to the 5 gram mark or 5mL (5cc) mark on cut-off syringe, and insert the open end of the sampler into an undisturbed area of soil with a twisting motion, filling the sampler with soil. Note the location of the plunger with respect to the milliliter (cc) or other graduation printed on the sampler.

d) Weigh the filled sampler, and remove or add soil until the desired weight is obtained. Note the location of the plunger which corresponds to this weight. Do not use this sample for laboratory analysis.

3. Once the required soil volume has been determined, pull the plunger back to this mark and hold it there while filling the syringe for each sample.
4. Collect 5 grams of soil using the cut-off syringe or Terra Core® sample device. Extrude the 5-grams of soil into one of the low level 40-mL VOA vials. Quickly wipe any soil from the threads of the VOA vial with a clean Kimwipe® and immediately close the vial. It is imperative that the threads be free from soil or other debris prior to replacing the cap on the vial in order to maintain the closed system necessary for the analysis.
5. Gently swirl the vial so that all of the soil is fully wedded with the preservative.
6. Weigh the 40 mL vial with the sample contained. Sample weight should be within 0.5 grams (±10%) of the target weight. Record the sample weight.
7. Fill the other low level 40 mL VOA vial in this manner,
8. Repeat the process for the high level VOA vials.

NOTE: Depending on the laboratory, some high level VOA vials contain 10 mL or 15 mL of methanol. If this is the case, either 10 grams total or 15 grams total, respectively, should be extruded into the high level VOA vial (i.e., 2 or 3 Terra Core® volumes). In other words, the mass of soil in grams should be identical to the volume of methanol in mL (i.e., 1:1 ratio of soil to methanol).

9. Collect any additional QC sample collected (e.g., field duplicate, MS, and MSD) in the same manner as above.
10. Fill the 4-oz glass jar with soil from the same area for percent moisture determination.

### **5.7.2** Volatile Organics Sampling – En Core® Samplers

This preservation and sampling method employs the use of a small-diameter core sampler known as the En Core® sampler. The En Core® sampler is a one-time-use, volumetric sampling, storage and transportation device. It is designed to collect and store soil samples for transportation to the laboratory.

Soil should be collected using the En Core® sampler in accordance with the manufacturer's recommendations. A specially designed "T" handle, available from the manufacturer, is used to push the En Core® sampler into the soil matrix and to lock the sampler after collection. A copy of the manufacturer's instructions is provided as Attachment 2 of this POP.

A minimum of three (3) individual 5 gram En Core® samplers must be collected for each soil sample. Upon sample collection, label each En Core® sampler cap with the label provided by the manufacturer and return it to the airtight, resealable foil package. The 4-oz glass jar must be filled with soil from the same area from which the En Core® samplers were collected for the percent moisture determination. En Core® samplers should be iced (cooled to 4°C [+ 2°C]) or frozen (-7°C and -15°C) for later shipment to the laboratory. En Core® samplers can be shipped directly to the laboratory for VOC analysis; however, laboratory must extrude the soil from the En Core® sampler and analyze, chemically preserve or freeze the soil within 48 hours of sample collection. The soil samples must be extruded from the En Core® sampler into appropriate sample containers using a specially designed “T” handle push-rod tool available from the manufacturer. Soil cannot be scooped out of the En Core® sampler using a trowel or spatula as this can cause a significant loss of VOCs. The holding time for soil stored in an En Core® sampler can be extended if the soil is extruded by the laboratory within 48 hours to a sealed vial and frozen or chemically preserved until actual analysis. This method is appropriate for low- and medium-level analysis under USEPA CLP SOW and low and high-level analysis for USEPA SW846 Methodologies.

En Core® samplers must be stored in a contaminant free environment before use and during shipment. It is the responsibility of the field sampling team and sample container provider (i.e., the laboratory) to ensure contaminant free sample container integrity.

**5.7.3** Soil Sampling Method (All other analyses except VOC/VPH)

When all the required soil for a sampling location has been obtained, the soil can be homogenized as described in section 5.2. Collect sufficient volume to fill all of the remaining sample containers at least ¾ full for all other analyses. Homogenize the soil in a decontaminated stainless steel bowl, removing rocks, sticks, or other non-soil objects (with the exception of COPR nodules and CCPW materials) and breaking apart any lumps of soil prior to filling the remaining sample containers.

NOTE: Soil samples must contain greater than 30% solids for the data to be considered valid.

## 6.0 Quality assurance / quality control

Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

## 7.0 Data and records management

All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site log books with permanent ink. Data recorded will include the following:

- weather conditions
- arrival and departure time of persons on site
- instrument type, lamp (PID), make, model and serial number
- calibration gas used
- date, time and results of instrument calibration and calibration checks
- sampling date and time
- sampling location
- samples collected
- sampling depth and soil type
- deviations from the procedure as written
- readings obtained

## 8.0 Personnel qualifications and training

All field staff are required to be OSHA 40-Hour Health and Safety certified with a current annual 8-hour refresher prior to engaging in any field collection activities.

Prior to implementation of these soil sampling procedures, the field sampler will be instructed by a person experienced with these procedures. The field staff will demonstrate to the field team leader the proper set-up, calibration, operation, and routine maintenance of the instrumentation and hand-held equipment, as well as the proper procedures, used to collect soil samples.

## 9.0 References

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

AECOM SH&E SOP No. 726 Identifying Underground Utilities

POP PPG 004 Operation and Calibration of a Photoionization Detector

POP PPG 014 Decontamination of Field Equipment

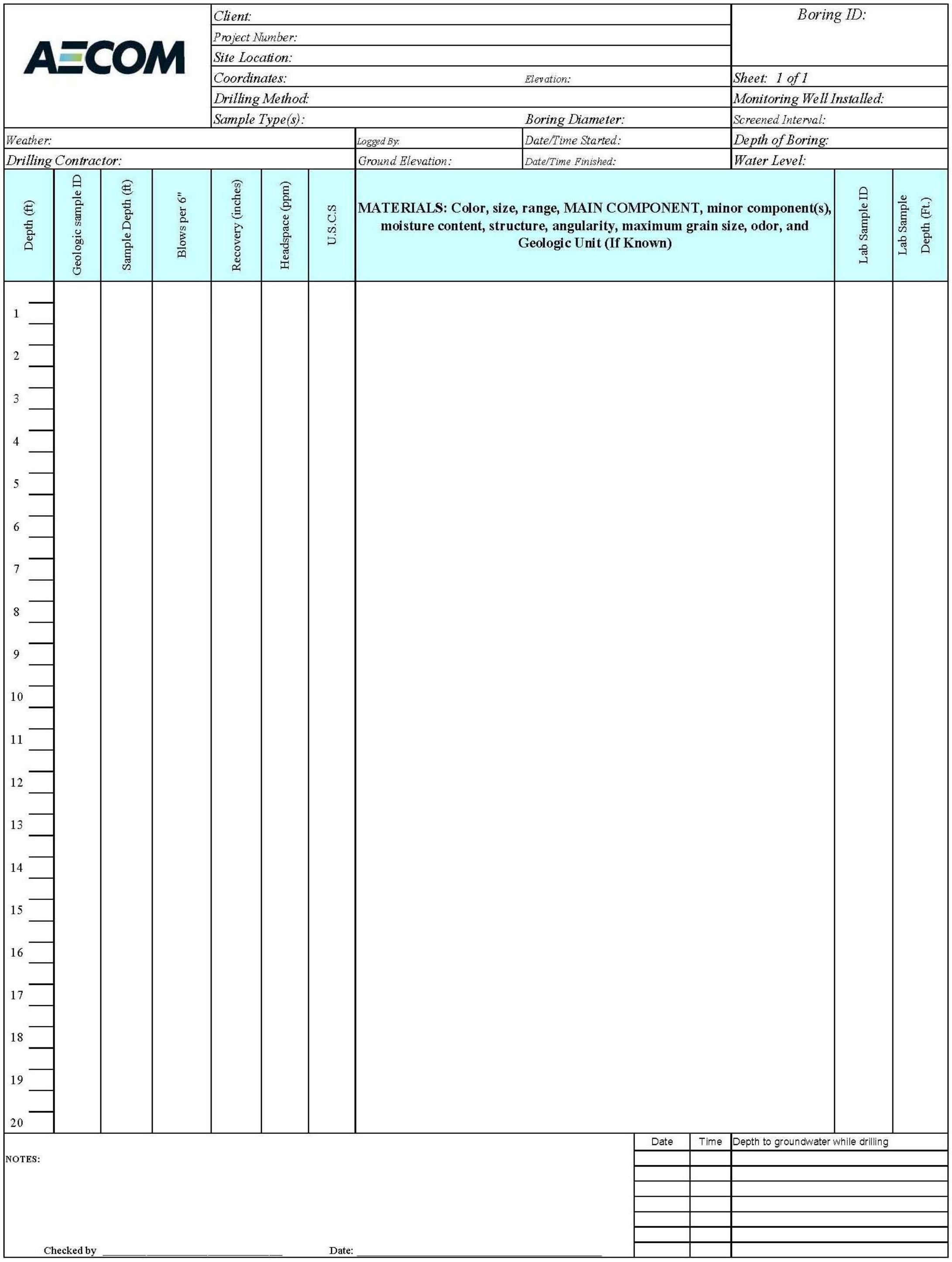
ASTM D1586-99, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM D2488-00 Standard Practice for Description and Identification of Soils

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

## Attachment 1. Example Boring Log



| | | | |
|---|---|---|---|
| AECOM | Client: | | Boring ID: |
| | Project Number: | | |
| | Site Location: | | |
| | Coordinates: | Elevation: | Sheet: 1 of 1 |
| | Drilling Method: | | Monitoring Well Installed: |
| | Sample Type(s): | Boring Diameter: | Screened Interval: |
| Weather: | Logged By: | Date/Time Started: | Depth of Boring: |
| Drilling Contractor: | Ground Elevation: | Date/Time Finished: | Water Level: |

| Depth (ft) | Geologic sample ID | Sample Depth (ft) | Blows per 6" | Recovery (inches) | Headspace (ppm) | U.S.C.S | MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known) | Lab Sample ID | Lab Sample Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

NOTES:

| Date | Time | Depth to groundwater while drilling |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Checked by ______________________ Date: ______________________

## Attachment 2. En Core® Sampler Sampling Procedures

# Disposable En Core® Sampler

**En Novative Technologies, Inc.**
1795 Industrial Drive
Green Bay, WI 54302
Phone: 920-465-3960 • Fax: 920-465-3963
Toll Free: 888-411-0757
*www.ennovativetech.com*

## Sampling Procedures

## Using The En Core® T-Handle

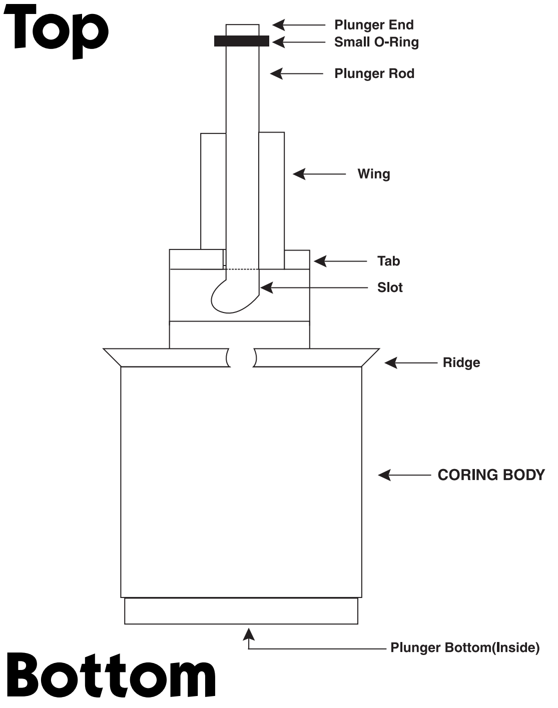
*NOTE:*

1. En Core® Sampler is a SINGLE USE device. It cannot be cleaned and/or reused.

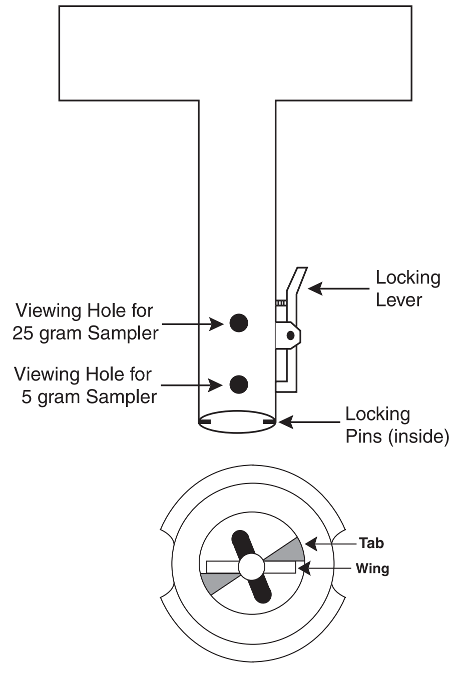
2. En Core® Sampler is designed to store soil. Do not use En Core Sampler to store solvent or free product!

3. En Core® Sampler must be used with En Core® T-Handle and/or En Core® Extrusion Tool exclusively. (These items are sold separately.)

### En Core®

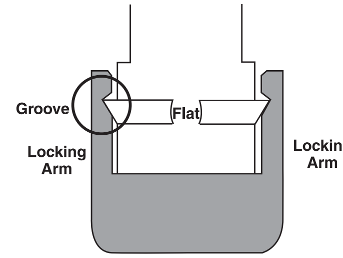


### En Core® T-Handle



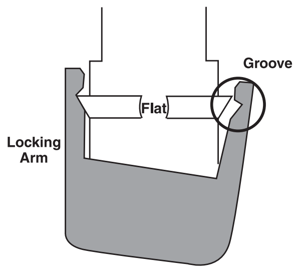
### Sampler Correctly Capped

(Locking arm grooves seated over coring body ridge.)



### Sampler Incorrectly Capped

(Cap appears crooked; locking arm grooves not fully seated over coring body ridge.)



**BEFORE TAKING SAMPLE:**

1. Hold **coring body** and push **plunger rod** down until **small o-ring** rests against **tabs**. This will assure that plunger moves freely.

2. Depress **locking lever** on En Core T-Handle. Place coring body, **plunger end first,** into open end of T-Handle, *aligning the (2)* ***slots*** *on the coring body with the (2)* ***locking pins*** *in the T-Handle*. Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.

**TAKING SAMPLE:**

3. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push Sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle **viewing hole**. Remove Sampler from soil. Wipe excess soil from coring body exterior.

4. Cap coring body while it is still on T-handle. *Push* **cap** over **flat** area of **ridge** *and twist* to lock **cap** in place. **CAP MUST BE SEATED TO SEAL SAMPLER (see diagram)**.

**PREPARING SAMPLER FOR SHIPMENT:**

5. Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until **wings** rest firmly against tabs (see plunger diagram).

7. Attach completed tear-off label (from En Core Sampler bag) to cap on coring body.

8. Return full En Core Sampler to zipper bag. Seal bag and put on ice.

# Disposable En Core® Sampler

## EXTRUSION PROCEDURES

## USING THE En Core® EXTRUSION TOOL

***CAUTION! Always use the Extrusion Tool to extrude soil from the En Core Sampler. If the Extrusion Tool is not used, the Sampler may fragment, causing injury.***

1. To attach En Core Sampler to En Core Extrusion Tool: Depress locking lever on Extrusion Tool and place Sampler, plunger end first, into open end of Extrusion Tool, aligning slots on coring body with pins in Extrusion Tool. Turn coring body clockwise until it locks into place. Release locking lever.

2. Rotate and gently push Extrusion Tool plunger knob clockwise until plunger slides over wings of coring body. (When properly positioned plunger will not rotate further.)

3. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. Remove cap from Sampler by rotating cap until locking arms are aligned with the flat area of ridge and pull cap off. To release soil core push down on plunger knob of En Core Extrusion Tool. Remove and properly dispose of En Core Sampler.

## Warranty and Disclaimers

IMPORTANT: FAILURE TO USE THE EN CORE® SAMPLER IN COMPLIANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED HEREIN VOIDS ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

**PRINCIPLE OF USE.** The En Core Sampler Cartridge System is a volumetric sampling system designed to collect, store and deliver a soil sample. The En Core Sampler comes in two sizes for sample volumes of approximately 25 or 5 grams. There are four components: the cartridge with a movable plunger; a cap with two locking arms; a T-handle (purchased separately); and an extrusion handle (purchased separately). NOTE: The En Core Sampler is designed to store soil. It is not designed to store solvent or free product.

The soil is stored in a sealed headspace-free state. The seals are achieved by three special Viton® * o-rings, two located on the plunger and one on the cap of the Sampler. At no time and under no condition should these o-rings be removed or disturbed.

**QUALITY CONTROL**. The cartridge is sealed in an airtight package to prevent contamination prior to use. Due to the stringent quality control requirements associated with the use of this system, the disposable cartridge is designed to be used only once.

**WARRANTY**. En Novative Technologies, Inc. ("En Novative Technologies") warrants that the En Core Sampler shall perform consistent with the research conducted under En Novative Technologies' approval, within thirty (30) days from the date of delivery, provided that the Customer gives En Novative Technologies prompt notice of any defect or failure to perform and satisfactory proof thereof. THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING, AS SOLELY DETERMINED BY EN NOVATIVE TECHNOLOGIES: (a) Damage caused by accident, abuse, mishandling or dropping; (b)Samplers that have been opened, taken apart or mishandled; (c)Samplers not used in accordance with the directions; and (d)Damages exceeding the cost of the sampler. Seller warrants that all En Core Samplers shall be free from defects in title. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY INFORMATION PROVIDED BY SALES REPRESENTATIVES OR IN MARKETING LITERATURE. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. En Novative Technologies' warranty obligations and Customer's remedies, except as to title, are solely and exclusively as stated herein.

**LIMITATION OF LIABILITY.** IN NO EVENT SHALL EN NOVATIVE TECHNOLOGIES BE LIABLE FOR ANTICIPATED PROFITS, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, DOWN TIME, REMEDIATION ACTIVITIES, REMOBILIZATION OR RESAMPLING, COST OF CAPITAL, SERVICE INTERRUPTION OR FAILURE OF SUPPLY, LIABILITY OF CUSTOMER TO A THIRD PARTY, OR FOR LABOR, OVERHEAD, TRANSPORTATION, SUBSTITUTE SUPPLY SOURCES OR ANY OTHER EXPENSE, DAMAGE OR LOSS, INCLUDING PERSONAL INJURY OR PROPERTY DAMAGE. En Novative Technologies' liability on any claim of any kind shall be replacement of the En Core Sampler or refund of the purchase price. En Novative Technologies shall not be liable for penalties of any description whatsoever. In the event the En Core Sampler will be utilized by Customer on behalf of a third party, such third party shall not occupy the position of a third-party beneficiary of the obligation or warranty provided by En Novative Technologies, and no such third party shall have the right to enforce same. All claims must be brought within one (1) year of shipment, regardless of their nature.

**En Novative Technologies, Inc.**
1795 Industrial Drive
Green Bay, WI 54302
Phone: 920-465-3960 • Fax: 920-465-3963
Toll Free: 888-411-0757
*www.ennovativetech.com*

The En Core™ Sampler is covered by One or More of the Following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271. Other U.S. and Foreign Patents Pending.

* Viton® is a registered trademark of DuPont Dow Elastomers.

AECOM

Project Operating Procedure

# Monitoring Well Construction and Installation

Procedure Number: PPG 006

Revision No.: 0

Revision Date: June 2010

POP Author
Date: 6/28/2010

Kathleen
Project Manager
Date: 6/28/2010

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

# Monitoring Well Construction and Installation

POP No.: PPG 006
Revision: 0
Date: June 2010

## Contents

## List of Attachments

# Project Operating Procedure

# Monitoring Well Construction and Installation

POP No.: PPG 006
Revision: 0
Date: June 2010

## 1.0 Project Scope and applicability

### 1.1 Purpose and Applicability

This Project Operating Procedure (POP) provides guidance for installing groundwater monitoring wells. Monitoring wells are installed to monitor the depth to groundwater, to measure aquifer properties, and to obtain samples of groundwater for chemical analysis.

This POP is applicable to installation of single monitoring wells within a borehole. The construction and installation of nested, multilevel or other special well designs is not covered within this POP as these type of wells are not frequently constructed. This POP applies to both overburden and bedrock monitoring wells.

Some states and EPA Regions have promulgated comprehensive guidelines for monitoring well construction and for subsurface investigation procedures. Deviations from this POP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the applicable Remedial Investigation Work Plan, and must be documented in the field project notebook when they occur.

### 1.2 General Principles

Monitoring well construction and installation generally involves drilling a borehole using conventional drilling equipment, installing commercially available well construction and filter/sealing materials, and development of the well prior to sampling. This POP covers well construction and installation methods only. Borehole drilling and well development methods are covered under POP PPG 005 Surface and Subsurface Soil Sampling Procedures and POP PPG 007 Monitoring Well Development, respectively.

### 1.3 Quality Assurance Planning Considerations

Field personnel should follow specific quality assurance guidelines as outlined in the site-specific QAPP.

The following aspects of monitoring well design and installation procedures depend on project-specific objectives which are addressed in the QAPP and in the Remedial Investigation Work Plan:

- Borehole drilling method and diameter,
- Type of construction materials for well screen, riser, filter pack and seals,
- Diameter of well materials,
- Length of well screen,
- Location, thickness, and composition of annular seals, and
- Well completion and surface protection requirements.

## 2.0 Health and safety considerations

Monitoring well installation may involve chemical hazards associated with materials in the soil or groundwater being investigated; and always involves physical hazards associated with drilling equipment and well construction methods. When wells are to be installed in locations where the aquifer and/or overlying materials may contain chemical hazards, a Health and Safety Plan (HASP) must be prepared and approved by the Health and Safety Officer before field work commences. This plan must be distributed to all field personnel and must be adhered to as field activities are performed.

## 3.0 Interferences

**3.1** Not Applicable

## 4.0 Equipment and materials

**4.1** Well Construction Materials

Well construction materials are usually provided by the drilling subcontractor and most often consist of commercially available flush-threaded well screen and riser pipe constructed of PVC or stainless steel with a minimum 2-inch inside diameter. The length of the screen and the size of the screen slots should be specified in the Remedial Investigation Work Plan.

**4.2** Well Completion Materials

Well completion materials include silica sand, bentonite, cement, protective casings and locks. Completion materials are generally provided by the drilling subcontractor.

**4.3** Other required materials include the following:

- Potable water supply
- Fiberglass or steel measuring tape
- Water level indicator
- Well construction diagrams (A typical well construction diagram is presented as Figure 1)
- Waterproof marker or paint (to label wells)
- Health and Safety supplies
- Equipment decontamination materials
- Field project notebook/pen

## 5.0 Procedures

### 5.1 General Preparation

#### 5.1.1 Borehole Preparation

Standard drilling methods should be used to achieve the desired drilling/well installation depths specified in the Remedial Investigation Work Plan. Soil sampling, if conducted, should be conducted in accordance with POP PPG 005 Surface and Subsurface Soil Sampling Procedures.

The diameter of the borehole must be a minimum of 2 inches greater than the outside diameter of the well screen or riser pipe used to construct the well. This is necessary so that sufficient annular space is available to install filter packs, bentonite seals, and grout seals. Bedrock wells may require reaming after coring in order to provide a large enough borehole diameter for well installation.

Rotary drilling methods requiring bentonite-based drilling fluids, if selected, should be used with caution to drill boreholes that will be used for monitoring well installation. The bentonite mud builds up on the borehole walls as a filter cake and permeates the adjacent formation, potentially reducing the permeability of the material adjacent to the well screen.

#### 5.1.2 Well Material Decontamination

Although new well materials (well screen and riser pipe) generally arrive at the site boxed and sealed within plastic bags, it is sometimes necessary to decontaminate the materials prior to their use. Well materials should be inspected by the Task Leader upon delivery to check cleanliness. If the well materials appear dirty, or if local or regional regulatory guidance requires decontamination, then well material decontamination should be performed by the drilling subcontractor.

### 5.2 Well Construction Procedure

#### 5.2.1 Depth Measurement

Once the target drilling depth has been reached, the drilling subcontractor will measure the total open depth of the borehole with a weighted, calibrated tape measure. Adjustments of borehole depth can be made at this time by drilling further or installing a small amount of sand filter material to achieve the desired depth. If drilling fluids were used during the drilling process, the borehole should be flushed at this time using potable water. The water table depth may also be checked with a water level indicator if this measurement cannot be obtained with the calibrated tape.

#### 5.2.2 Centralizers

Centralizers may be used but are not required. Centralizers are especially helpful for deep well installations where it may be difficult to position the well by hand.

Centralizers may not be necessary on shallow water table well installations where the well completion depth is within 25 feet of the ground surface.

### **5.2.3** Well Construction

The well screen and riser pipe generally are assembled by hand as they are lowered into the borehole. Before the well screen is inserted into the borehole, the full length of the slotted portion of the well screen as well as the unslotted portion of the top and bottom of the screen should be measured with the measuring tape. These measurements should be recorded on the well construction diagram. The maximum length of well screen (or open borehole in bedrock wells) for monitoring wells is 25 feet. In cases where low-flow sampling is intended in newly installed monitoring wells, the wells should be installed with no more than five feet of screen.

After the above measurement has been taken, the drilling subcontractor may begin assembling the well. As the assembled well is lowered, care should be taken to ensure that it is centered in the hole if centralizers are not used. The well should be temporarily capped before filter sand and other annular materials are installed.

### **5.2.4** Filter Sand Installation

The drilling subcontractor should fill the annular space surrounding the screened section of the monitoring well to at least 1 foot above the top of the screen with an appropriately graded, clean silica sand or fine gravel. In general, the filter pack should not extend more than 3 feet above the top of the screen to limit the thickness of the monitoring zone. If coarse filter materials are used, an additional 1-foot thick layer of fine sand should be placed immediately above the filter pack to prevent the infiltration of sealing components (bentonite or grout) into the filter pack. As the filter pack is placed, a weighted tape should be lowered in the annular space to verify the depth to the top of the layer. Depending upon depth, some time may be required for these materials to settle. If necessary, to eliminate possible bridging or creation of voids, placement of the sand pack may require the use of a tremie pipe. Tremie pipe sandpack installations are generally suggested for deep water table wells and for wells which are screened some distance beneath the water table.

### **5.2.5** Bentonite Seal Installation

An approximate 1-foot thick layer of slurry seal will be installed by the drilling subcontractor immediately above the well screen filter pack in all monitoring wells. The purpose of the seal is to provide a barrier to vertical flow of water in the annular space between the borehole and the well casing. Bentonite is used because it swells significantly upon contact with water. As an option, powdered bentonite may be mixed with water into a very thick slurry and a tremie pipe used to inject the seal to the desired depth.

### 5.2.6 Annular Grout Seal Installation

This grout seal should consist of a bentonite/cement mix with a ratio of bentonite to cement of between 1:5 and 1:20. The grout ratio should be chosen based on site conditions with a higher percentage of bentonite generally used for formations with higher porosity. A mud balance should be used if a specific mud density is required at a particular site. Grout slurry should be pumped into the annular space using a side-discharging tremie pipe located about 2 feet above the sand pack. Side discharge will help preserve the integrity of the sand pack.

In situations where the monitoring well screen straddles the water table, the seal will be in the unsaturated zone. Optionally, seals in this situation may be a cement/bentonite mixture containing up to 10 percent bentonite by weight. This type of mixture shall be tremied to the desired depth in the borehole.

Drill cuttings, even those known not to be contaminated, will not be used as backfill material.

### 5.2.7 Well Completion

The drilling subcontractor will cut the top of the well to the desired height and install a vented (if possible), locking cap. The upper portion of the well casing can optionally be drilled to allow venting. Well casings are usually cut to be a certain height above ground surface (typically 2.5 to 3 feet) or are cut to be flush with the ground surface.

### 5.2.8 Protective Casing/Concrete Pad Installation

The drilling subcontractor will install a steel guard pipe on the well as a protective casing. The borehole around the guard pipe will be dug out to an approximate 2 to 3-foot radius to a minimum depth of 1 foot at the center and 6 inches at the edges. After installing the protective casing, the excavation will be filled with a concrete/sand mix. The surface of the concrete pad will be sloped so that drainage occurs away from the well. Flush-mount protective casings may not require an extensive concrete pad and should be completed such that they are slightly mounded above the surrounding surface to prevent surface water from running over or ponding on top of the casing. It should be noted, however, that in areas subject to snowfall, flush-mount casings may have to be installed so that they are entirely flush with the ground surface as they may be damaged by snow plows.

Above-ground protective casings should also be vented or should have non-air tight caps. Flush mount installations should not be vented. Installation of additional guard pipes may be necessary around above-ground well completions in traffic areas. Protective casings should be lockable to prevent unauthorized access.

### 5.2.9 Well Numbering

The Task Leader will ensure that each well casing is identified with an indelible marker, paint, or stamp. This is particularly important with nested or paired wells to distinguish between shallow and deep wells. The well should be labeled on both the outside of the protective casing and inside beneath the protective casing lid.

### **5.2.10** Measuring Point Identification

The Task Leader will ensure that the measuring point from which water level measurements will be made at each well is marked along the upper edge of the well casing. PVC wells can easily be notched with a pocket knife or saw. Stainless steel wells (or PVC wells) can be marked with a waterproof marker on the outside of the well casing with an arrow pointing to the measuring point location. The measuring point is the point which will require surveying during the well elevation survey task.

### **5.2.11** Well Measurements

Upon completion, the following well measurements should be taken and recorded on the well construction diagram (Figure 1):

- Depth to static water level if water level has stabilized,
- Total length of well measured from top-of-well casing,
- Height of well casing above or below ground surface,
- Height of protective casing above ground surface,
- Depth of bottom of protective casing below ground surface (may be estimated).

Well screen filter pack, bentonite seal and annular seal thicknesses and depths should also be recorded on the well construction diagram.

### **5.2.12** Disposal of Drilling Wastes

Drill cuttings and other investigation-derived wastes such as drilling mud or well development/purge water must be properly contained and disposed of. Site-specific requirements for collection and removal of these waste materials should be outlined within the Remedial Investigation Work Plan. Containment of these materials should be performed by the drilling subcontractor.

### **5.2.13** Well Development

After installation of a well and prior to use of the well for water-level measurements or collection of water quality samples, development of the well shall be undertaken in accordance with POP PPG 007 Monitoring Well Development. Well development will be performed by the drilling subcontractor.

### **5.2.14** Well Elevation Survey

At the completion of the well installation program, all monitoring wells are to be surveyed by a surveying subcontractor in accordance with NJDEP requirements.

### 5.2.15 Double Casing

In boreholes where a shallow water-bearing zone is encountered above a deeper water bearing zone, casing will be installed to prevent downward migration between the water-bearing zones in accordance with N.J.A.C. 7.9D. The casing will be installed to a sufficient depth to prevent migration between the water-bearing zones, and the annular space between the casing and borehole, as well as the annular space between water-bearing zones, will be grouted. The grout will be allowed to set for a minimum of 24 hours prior to further advancement of the borehole.

In accordance with the NJDEP FSPM, installation of well couplets (e.g., shallow and deep) and well triplets (e.g., shallow, intermediate and deep) will be installed in separate boreholes since grout is less likely to invade well intakes (screens) if the wells are installed in separate boreholes. Care will be taken to assure that any confining unit between aquifer zones is not breached without providing adequate protection of underlying/overlying aquifers.

In accordance with Subchapter 2 (Requirements and Procedures for the Construction, Installation, Operation and Maintenance of Wells) NJAC 7:9D-2.1(a), *"monitoring wells, air sparging wells, soil vapor extraction wells, recovery wells, and wells or well points installed for environmental remediation projects"* are considered Category 3 wells for the purposes of establishing general and specific well construction standards[1].

In accordance with NJAC 7:9D-2.4, the following specific requirements also apply to Category 3 wells in unconsolidated aquifers where a confining layer(s) exist shall be constructed in accordance with the following:

1. The screened interval or the filter pack shall not extend across the interface of a confining layer.
2. Monitoring wells will be constructed in accordance with Figure 6.14 on Page 173 of 188 of the August 2005 NJDEP Field Sampling Procedures Manual (see below). The outer casing shall be driven to a minimum of one foot below the drilled borehole.

---

[1] The requirements in NJAC 7:9D-2.1(b)1, requiring a minimum of 20 feet of outer-most well casing into the confining layer or to the base of the confining layer is intended for water supply wells and in areas where there is salt water intrusion where double casing is needed to protect the water supply.

**Field Sampling Procedures Manual**
Chapter 6G – Page 173 of 188

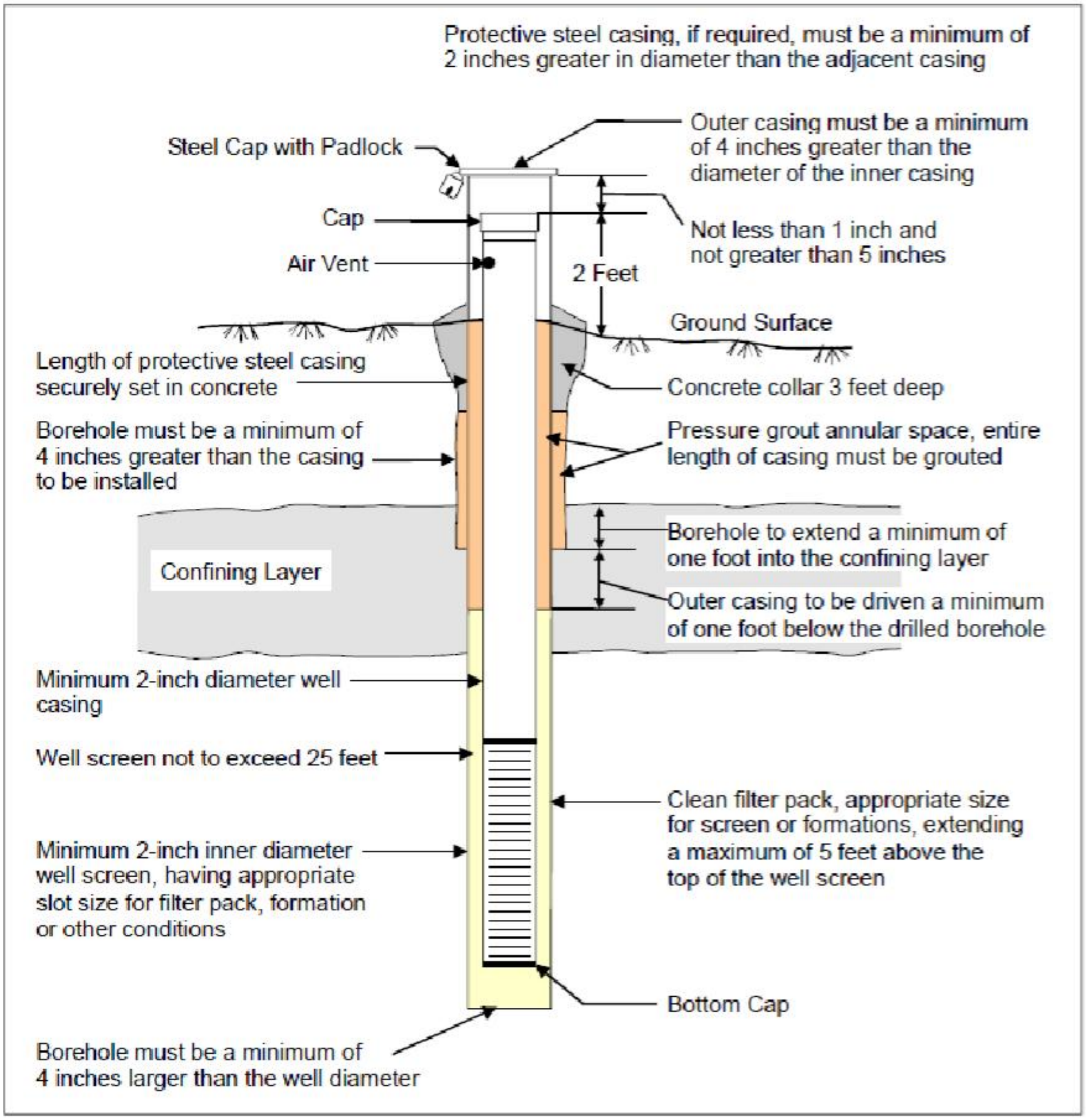


Figure 6.14 Confined Unconsolidated Aquifer Well

## 6.0 Quality assurance / quality control

Certain quality control measures should be taken to ensure proper well completion.

- The borehole will be checked for total open depth, and extended by further drilling or shortened by backfilling, if necessary, before any well construction materials are placed.
- Water level and non-aqueous phase liquid (NAPL) presence will be checked during well installation to ensure that the positions of well screen, sand pack, and seal, relative to water level, conform to project requirements.
- The depth to the top of each layer of packing (i.e., sand, bentonite, grout, etc.) will be verified and adjusted if necessary to conform to project requirements before the next layer is placed.
- If water or other drilling fluids have been introduced into the boring during drilling or well installation, samples of these fluids may be required for analysis of chemical constituents of interest at the site.

## 7.0 Data and records management

All well construction data will be recorded on the Monitoring Well Construction Detail form. A typical Monitoring Well Construction Detail form is presented as Figure 1. All wells will be referenced onto the appropriate site map. A field notebook and/or boring log will be used as additional means of recording data. In no case will the notebook or boring log take the place of the well construction diagram.

## 8.0 Personnel qualifications and training

Well construction and installation requires a moderate degree of training and experience as numerous drilling situations may occur which will require field decisions to be made. Inexperienced personnel will be supervised until they are capable of working on their own. Experienced drillers will be utilized, as they are also of great assistance with problem resolution in the field. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present.

### 8.1 Project Manager

It is the responsibility of the Project Manager to ensure that each project involving monitoring well installation is properly planned and executed. The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

### **8.2** Task Leader

The Task Leader for drilling activities will be a geologist or hydrogeologist. It is the responsibility of the Task Leader to directly oversee the construction and installation of the monitoring well by the drilling subcontractor to ensure that the well-installation specifications defined in the Remedial Investigation Work Plan are adhered to, and that all pertinent data are recorded on the appropriate forms.

### **8.3** Drilling Subcontractor

The drilling subcontractor is required to obtain the necessary permits and must be licensed in accordance with N.J.A.C. 7:9D. It is the responsibility of the drilling subcontractor to provide the necessary equipment for well construction and installation. Well construction materials should be consistent with project requirements. The drilling contractor will be licensed in accordance with applicable State regulations, and will be responsible for obtaining all necessary permits.

### **8.4** Surveying Subcontractor

It is the responsibility of the surveying subcontractor to provide one or more of the following well measurements as specified in the Remedial Investigation Work Plan: ground surface elevation, horizontal well coordinates, top of well casing elevation (i.e., top-of-casing, or measuring point elevation), and/or top of protective casing elevation.

## 9.0 References

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, WSC-310-91, 1991.

N.J.A.C. 7:9D Well Construction and Maintenance; Sealing of Abandoned Boreholes, 2007.

NJDEP “Field Sampling Procedures Manual,” August 2005.

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

POP PPG 005 Surface and Subsurface Soil Sampling Procedures

POP PPG 007 Monitoring Well Development

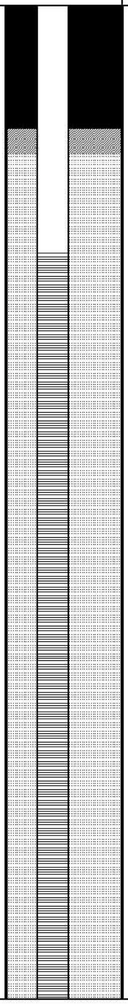
## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

## Attachment 1 – Monitoring Well Construction Log

AECOM

*Client:*
*Project Number:*
*Site Location:*
*BORING ID:*
*Coordinates:* *Elevation:*
*Sheet:*
*Drilling Method:* *hallow-stem auger (Air - rotatory)*
*Monitoring Well Installed:* *yes*
*Sample Type(s): Trowel, split-spoon sampling* *Boring Diameter: 6"*
*Screened Interval:*
*Weather:*
*Logged By:*
*Date/Time Started:*
*Depth of Boring:*
*Drilling Contractor:*
*Ground Elevation:*
*Date/Time Finished:*
*Water Level:*



| Depth (ft) | Geologic sample ID | Well Construction | Headspace w/ PID (ppm) | Depth to Water | MATERIALS: Color, size, range, MAIN COMPONENT, minor component(s), moisture content, structure, angularity, maximum grain size, odor, and Geologic Unit (If Known) | Lab Sample ID | Lab Sample Depth (Ft.) |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | | | | | | | |
| 19 | | | | | | | |
| 20 | | | | | | | |

**NOTES:** PRIVILEGED AND CONFIDENTIAL
ATTORNEY CLIENT PRIVILEGED. PREPARED AT THE REQUEST OF COUNSEL.
THIS IS A PRELIMINARY DRAFT. IT HAS BEEN PREPARED BASED
ON PRELIMINARY INFORMATION AND ON ASSUMPTIONS. NO ONE MAY
RELY ON THIS DRAFT. IT IS SUBJECT TO CHANGE AS ADDITIONAL
INFORMATION BECOMES AVAILABLE OR IS CLARIFIED.
Checked by ____________________ Date:______________

| Date | Time | Depth to groundwater while drilling |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

AECOM

Project Operating Procedure

# Monitoring Well Development

Procedure Number: PPG 007

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen Woolley

Date: 6/28/2010

Project Manager

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Monitoring Well Development

## Contents

# Project Operating Procedure

# Monitoring Well Development

## 1.0 Scope and Applicability

### **1.1** Purpose and Applicability

This POP describes the methods used for developing newly installed monitoring wells and/or existing wells which may require redevelopment/rehabilitation. This POP is applicable to monitoring wells and/or small diameter recovery wells and piezometers.

Monitoring well development and/or redevelopment is necessary for several reasons:

- To improve/restore hydraulic conductivity of the surrounding formations as they have likely been disturbed during the drilling process, or may have become partially plugged with silt,
- To remove drilling fluids (water, mud), when used, from the borehole and surrounding formations, and
- To remove residual fines from well filter materials and reduce turbidity of groundwater, therefore, reducing the chance of chemical alteration of groundwater samples caused by suspended sediments.

Respective state or federal agency (regional offices) regulations may require specific types of equipment for use or variations in the indicated method of well development. Deviations from this POP to accommodate other regulatory requirements should be reviewed in advance of the field program, should be explained in the Work Plan or Quality Assurance Project Plan (QAPP), and must be documented in the field logbook when they occur.

### **1.2** General Principles

Well development generally involves withdrawal of an un-specified volume of water from a well using a pump, surge block or other suitable method such that, when completed effectively, the well is in good or restored hydraulic connection with the surrounding water bearing unit and is suitable for obtaining representative groundwater samples or for other testing purposes.

## 2.0 Health and Safety Considerations

Monitoring well development may involve chemical hazards associated with materials in the soil or aquifer being characterized and may involve physical hazards associated with use of well development equipment. When wells are to be installed and developed on hazardous waste investigation sites, a Health and Safety Plan must be prepared and approved by the Health and Safety Officer before field work commences. This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all field project personnel, and must be adhered to as field activities are performed.

## 3.0 Interferences

Well development performed with inappropriate techniques or improper procedures may lead to groundwater monitoring data that is not representative of the formation. Careful consideration should be given to the monitoring well development method selected, and the procedures should be followed as presented in this POP.

Monitoring well development will be conducted a minimum of 8 hours after completion of the well construction to allow the grout to set.

## 4.0 Equipment and Materials

Well development can be performed using a variety of methods and equipment. The specific method chosen for development of any given well is governed by the purpose of the well, well diameter and materials, depth, accessibility, geologic conditions, static water level in the well, and type of contaminants present, if any.

The following list of equipment, each with their own particular application, may be used to develop and/or purge monitoring wells.

### 4.1 Bailer Purging

A bailer is used to purge silt-laden water from wells after using other devices such as a surge block. In some situations, the bailer can be used to develop a well by bailing and surging, often accompanied with pumping. A bailer should be used for purging in situations where the depth to static water is greater than 25 feet and/or where insufficient hydraulic head is available for use of other development methods.

### 4.2 Surge Block Development

Surge blocks are commercially available for use with Waterra™-type pumping systems or may be manufactured using a rubber or teflon "plunger" attached to a rod or pipe of sufficient length to reach the bottom of the well. Well drillers usually can provide surge blocks if requested. A recommended design is shown in Figure 1.

### 4.3 Pump Development

A pump is often necessary to remove large quantities of silt-laden ground water from a well after using the surge block. In some situations, the pump alone can be used to develop the well and remove the fines by overpumping. Since the purpose of well development is to remove suspended solids from a well and surrounding filter pack, the pump must be capable of moving some solids without damage. The preferred pump is a submersible pump which can be used in both shallow and deep ground water situations. A centrifugal pump may be used in shallow wells but will work only where the depth to static ground water is less than approximately 25 feet. Pumping may not be successful in low-yielding aquifer materials or in wells with insufficient hydraulic head.

### **4.4** Compressed Gas Development

Compressed gas, generally nitrogen from a tank or compressed air through a compressor, can be used to both surge and develop a monitoring well. The method works by injection of compressed gas at the bottom of the water column, driving sediment-laden water to the surface. Compressed gas can also be used for "jetting" - a process by which the gas is directed at the slots in the well screen to cause turbulence (thereby disturbing fine materials in the adjacent filter pack). Compressed gas is not limited by any depth range.

Since the compressed gas will be used to "lift" water from the monitoring well, provisions must be made for controlling the discharge from contaminated wells. This is generally accomplished by attaching a "tee" discharge to the top of the casing and providing drums to contain the discharged water. Gas-lifting should never be done in contaminated wells without providing a means to control discharge.

### **4.5** Other Required Materials:

- Well development records (Figure 2)
- Health and Safety equipment
- Equipment decontamination materials
- Water level indicator
- Water quality instrumentation: turbidity meter, pH, temperature, specific conductance meters, as required
- Field logbook/pen

## 5.0 Procedures

### **5.1** General Preparation

**5.1.1** Well Records Review: Well completion diagrams should be reviewed to determine well construction characteristics. Formation characteristics should also be determined from review of available boring logs.

**5.1.2** Site Preparation: Well development, similar to groundwater sampling, should be conducted in as clean an environment as possible. This usually requires, at a minimum, placing sheet plastic on the ground to provide a clean working area for development equipment.

**5.1.3** Monitoring well development will occur a minimum of 8 hours after completion of monitoring well construction, to allow the grout to set.

**5.1.4** IDW Containment: Provisions should be in place for collection and management of investigation-derived wastes (IDW), specifically well development water and miscellaneous expendable materials generated during the development process. The collection of IDW in drums or tanks may be required depending on project-specific requirements.

**5.1.5** Water Level/Well Depth Measurement: The water level and well depth should be measured with a water level indicator and written on the well development record. This information is used to calculate the volume of standing water (i.e., the well volume) within the well.

**5.1.6** Equipment Decontamination: All down-well equipment should be decontaminated prior to use in accordance with the NJDEP Field Sampling Procedures Manual. Refer to POP PPG 014, Decontamination of Field Equipment.

**5.1.7** Removal of Drilling Fluids: Drilling fluids such as mud or water, if used during the drilling and well installation process, should be removed during the well development procedure. It is recommended that a minimum of 1.5 times the volume of added fluid be removed from the well during development. Drilling muds should initially have been flushed from the drilling casing during the well installation procedure with water added during the flushing process. If the quantity of added fluid is not known or could not be reasonably estimated, removal of a minimum of 10 well volumes of water is recommended during the development procedure.

## **5.2** Development Procedures

### **5.2.1** Development Method Selection

The construction details of each well shall be used to define the most suitable method of well development. Some consideration should be given to the potential degree of contamination in each well as this will impact IDW containment requirements.

The criteria for selecting a well development method include well diameter, total well depth, static water depth, screen length, the likelihood and level of contamination, and characteristics of the geologic formation adjacent to the screened interval.

The limitations, if any, of a specific procedure are discussed within each of the following procedures.

### **5.2.2** General Water Quality Measurements

Measure and record water temperature, pH, specific conductance, and turbidity periodically during development using the available water quality instruments. These measurements will aid in determining whether well development is proceeding efficiently, will assist in identifying when well development is complete, will determine whether the development process is effective or not with any given well and, potentially, may identify well construction irregularities (i.e., grout in well, poor well screen slot-size selection). Water quality parameters should be checked a minimum of 3 to 5 times during the development process.

### **5.2.3** Bailer Procedure

- As stated previously, bailers shall preferably not be used for well development but may be used in combination with a surge block to remove silt-laden water from the well.
- When using a bailer to purge well water; select the appropriate bailer, then tie a length of bailer cord onto the end of it.

- Lower the bailer into the screened interval of the monitoring well. Silt, if present, will generally accumulate within the lower portions of the well screen.
- The bailer may be raised and lowered repeatedly in the screened interval to further simulate the action of a surge block and pull silt through the well screen.
- Remove the bailer from the well and empty it into the appropriate storage container.
- Continue surging/bailing the well until sediment-free water is obtained. If moderate to heavy siltation is still present, the surge block procedure should be repeated and followed again with bailing.
- Check water quality parameters periodically.

### **5.2.4** Surge Block Procedure

- A surge block effectively develops most monitoring wells. This device first forces water within the well through the well screen and out into the formation, and then pulls water back through the screen into the well along with fine soil particles. Surge blocks may be manufactured to meet the design criteria shown in the example (Figure 1) or may be purchased as an adaptor to fit commercially available well purging systems such as the Waterra system.
- Insert the surge block into the well and lower it slowly to the level of static water. Start the surge action slowly and gently above the well screen using the water column to transmit the surge action to the screened interval. A slow initial surging, using plunger strokes of approximately 3 feet, will allow material which is blocking the screen to separate and become suspended.
- After 5 to 10 plunger strokes, remove the surge block and purge the well using a pump or bailer. The returned water should be heavily laden with suspended silt and clay particles. Discharge the purged water into the appropriate storage container.
- Repeat the process. As development continues, slowly increase the depth of surging to the bottom of the well screen. For monitoring wells with long screens (greater than 10 feet) surging should be undertaken along the entire screen length in short intervals (2 to 3 feet) at a time. Continue this cycle of surging and purging until the water yielded by the well is free of visible suspended material.
- Check water quality parameters periodically.

### **5.2.5** Pump Procedure

- Well development using only a pump is most effective in monitoring wells that will yield water continuously. Theoretically, pumping will increase the hydraulic gradient and velocity of groundwater near the well by drawing the water level down. The increased velocity will move residual fine soil particles into the well and clear the well screen of this material. Effective development cannot be accomplished if the pump has to be shut off to allow the well to recharge.
- When using a submersible pump or surface pump, set the intake of the pump or intake line in the center of the screened interval of the monitoring well.
- Pump a minimum of three well volumes of water from the well and raise and lower the pump line through the screened interval to remove any silt/laden water.
- Continue pumping water from the well until sediment-free water is obtained. This method may be combined with the manual surge block method if well yield is not rapid enough to extract silt from the surrounding formations.
- Check water quality parameters periodically.

### **5.2.6** Compressed Gas Procedure

- Although the equipment used to develop a well using this method is more difficult to obtain and use, well development using compressed gas is considered to be a very effective method. This method is also not limited by well depth, well diameter, or depth to static water. Caution must be exercised, however, in highly permeable formations not to inject gas into the formation. Drilling subcontractors will often provide the necessary materials as well as perform this method , if requested. When using a compressor, an oil-less compressor should be used, or an oil trap/filter should be placed on the air discharge line which enters the well.
- Lower the gas line into the well, setting it near the bottom of the screened interval. Install the discharge control equipment (i.e., tee fitting) at the well head.
- Set the gas flow rate to allow continuous discharge of water from the well.
- At intervals during gas-lifting, especially when the discharge begins to contain less suspended material , shut off the air flow and allow the water in the well to backflush through the screened interval to disturb any bridging that may have occurred. Re-establish the gas flow when the water level in the well has returned to the pre-development level.
- Continue gas-lifting and/or jetting until the discharged water is free from suspended material.
- Check water quality parameters periodically.

**5.2.7** Special Considerations for Wells in Low-Permeability Formations

Wells installed in low-permeability formations may be difficult to develop due to the slow rate of recharge into the well resulting in the well purging dry before proper well development can be achieved. When developing wells under these circumstances, the addition of potable water to the well during development to maintain a sufficient well volume should be considered. Approval from all appropriate regulatory agencies, including permitting requirements, must be obtained prior to implementing this procedure modification. If implemented, the following must be followed:

- The well development record must document that the addition of potable water is being used to aid in the development of the well and the justification for doing so.
- The volume of water added to the well must be documented.

**5.2.8** A minimum of 1.5 times the volume of water added to the well must be purged from the well. The total volume of water purged should be recorded on the well development record to document that this has been performed.

## 6.0 Quality Assurance / Quality Control

Field project personnel should follow specific quality assurance guidelines as outlined in the QAPP. The plan should indicate the preferred method of well development at a particular site based on project objectives, aquifer conditions, and agency requirements. Specific well performance criteria such as low turbidity values to be achieved following well development should also be specified as well as any requirements for collection/containerization and disposal of well development water.

A well has been successfully developed when one or more of the following criteria are met:

- The sediment load in the well has been eliminated or greatly reduced. Regulatory requirements may be in place which state that water turbidity values ranging from 5 to 50 NTU must be achieved at the end of the development procedure. Use of a turbidity meter is required during the well development procedure to measure water turbidity if meeting a specific turbidity value is required by the regulations. Attaining low turbidity values in fine-grained formations may be difficult to achieve.
- Permeability tests yield repeatable hydraulic conductivity values.

## 7.0 Data and Records Management

The Monitoring Well Development Record (Figure 2) will be completed by the geologist or hydrogeologist conducting the development. In addition, a field logbook should be maintained documenting any problems or unusual conditions which may have occurred during the development process.

Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records. Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

Well development procedures vary in complexity. It is recommended that initial development attempts be supervised by more experienced personnel. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous waste materials are considered to be present. For wells that are located in New Jersey, all well development or redevelopment work shall be performed by a licensed well driller of the proper class in accordance with N.J.A.C. 7:9D-2.11(b).

**8.1** Responsibilities

**8.1.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.1.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

Standard References for Monitoring Wells, Massachusetts Department of Environmental Protection, WSC-310-91, 1991.

N.J.A.C. 7:9D Well Construction and Maintenance; Sealing of Abandoned Boreholes, 2007.

NJDEP “Field Sampling Procedures Manual,” August 2005.

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

## APPENDIX: DEFINITIONS

Bridging: A condition within the filter pack outside the well screen whereby the smaller particles are wedged together in a manner that causes blockage of pore spaces.

Hydraulic Conductivity: A characteristic property of aquifer materials which describes the permeability of the material with respect to flow of water.

Hydraulic Connection: A properly installed and developed monitoring well should have good hydraulic connection with the aquifer. The well screen and filter material should not provide any restriction to the flow of water from the aquifer into the well.

Permeability Test: Used to determine the hydraulic conductivity of the aquifer formation near a well screen. Generally conducted by displacing the water level in a well and monitoring the rate of recovery of the water level as it returns to equilibrium. Various methods of analysis are available to calculate the hydraulic conductivity from these data.

Static Water Level: The water level in a well that represents an equilibrium or stabilized condition, usually with respect to atmospheric conditions in the case of monitoring wells.

Well Surging: That process of moving water in and out of a well screen to remove fine sand, silt and clay size particles from the adjacent formation.

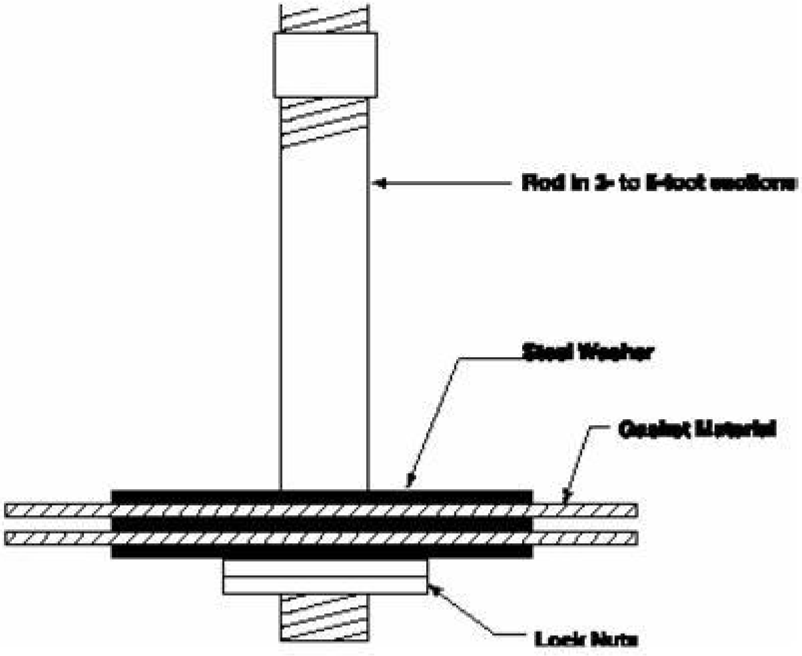
Well Purging: The process of removing standing water from a well to allow surrounding formation water to enter the well.

Well Screen: That portion of the well casing material that is perforated in some manner so as to provide a hydraulic connection to the aquifer. The perforated, or slotted, portion of a well is also known as the screened interval.

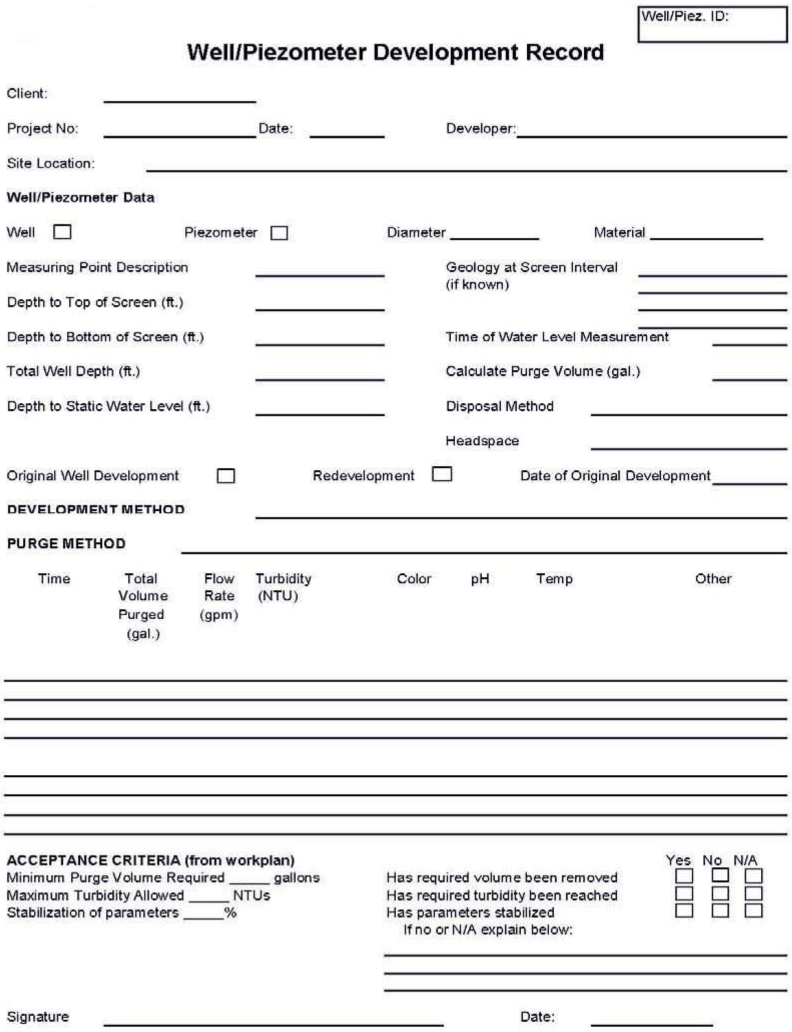
Figure 1 Recommended Surge Block Design

**SURGE BLOCK DESIGN**
**(Not to Scale)**

Steel washers should be 1/2" to 3/4" smaller in diameter than the well ID. Gasket can be rubber or leather and should be the same diameter or 1/8" smaller than the well ID to compensate for swelling of the leather/ Rod can be steel, fiberglass, or plastic but must be strong and lightweight.



### Figure 2 Well Development Record



Well/Piez. ID:

**Well/Piezometer Development Record**

Client: ____________

Project No: ____________ Date: ________ Developer: ____________________

Site Location: ______________________________

**Well/Piezometer Data**

Well ☐ Piezometer ☐ Diameter ________ Material ________

Measuring Point Description ________

Depth to Top of Screen (ft.) ________

Depth to Bottom of Screen (ft.) ________

Total Well Depth (ft.) ________

Depth to Static Water Level (ft.) ________

Geology at Screen Interval (if known) ________

Time of Water Level Measurement ________

Calculate Purge Volume (gal.) ________

Disposal Method ________

Headspace ________

Original Well Development ☐ Redevelopment ☐ Date of Original Development ________

**DEVELOPMENT METHOD** ______________________

**PURGE METHOD** ______________________

| Time | Total Volume Purged (gal.) | Flow Rate (gpm) | Turbidity (NTU) | Color | pH | Temp | Other |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**ACCEPTANCE CRITERIA (from workplan)**
Minimum Purge Volume Required _____ gallons
Maximum Turbidity Allowed _____ NTUs
Stabilization of parameters _____%

| | Yes | No | N/A |
|---|---|---|---|
| Has required volume been removed | ☐ | ☐ | ☐ |
| Has required turbidity been reached | ☐ | ☐ | ☐ |
| Has parameters stabilized | ☐ | ☐ | ☐ |

If no or N/A explain below:

______________________________

______________________________

______________________________

Signature ______________________________ Date: ________

AECOM

Project Operating Procedure

# Low Stress Groundwater Sampling Procedures

Procedure Number: PPG 008

Revision No.: 0

Revision Date: June 2010

POP Author
Date: 6/28/2010

Kathleen Wooley
QA Reviewer
Date: 6/28/2010

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

# Low Stress Groundwater Sampling Procedures

POP No.: PPG 008
Revision: 0
Date: June 2010
Page i of i

## Contents

## List of Figures

## List of Attachments

Project Operating Procedure

POP No.: PPG 008
Revision: 0
Date: June 2010

# Low Stress Groundwater Sampling Procedures

## 1.0 Project Scope and applicability

This procedure is for the collection of groundwater samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with the mobile particulates). The procedure emphasizes the need to minimize stress on the aquifer by using low pumping rates (below 1 liter per minute) and allowing minimal or no drawdown in order to collect samples with minimal alterations to water chemistry. The procedure also reduces the volume of purge water generated, thereby reducing disposal costs. A minimum purge volume, based on well screen length and whether the water level is below the top of the screen, is specified so that samples will be representative of the conditions of the groundwater flowing through the well screen.

The procedure is suited for monitoring wells that have a screen, or open interval, of 10 feet or less but is also applicable to wells with longer well screens. The monitoring wells must be sufficiently wide to simultaneously accept a submersible pump or intake tubing from a peristaltic pump, and the probe from an electronic water level indicator. The screened or open interval must be positioned to intercept the existing contaminant plume, and the monitoring well must be properly constructed, developed, and maintained. This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPL/DNAPL).

## 2.0 Health and safety considerations

All calibration, maintenance and servicing of the instrumentation should be performed in a safe area, away from hazardous locations.

Refer to the Site Specific Health and Safety Plan for additional Health and Safety issues.

## 3.0 Interferences

Contaminants that are known to adsorb to particulates, such as metals, PCBs, etc., will be impacted by elevated turbidity (i.e., >25 NTU). If the turbidity stabilizes above 25 NTU, samples for metals, PCBs, and other analyses that may be impacted by contaminants adsorbed to suspended particulates will be filtered using an in-line 0.45 micron filter prior to sample collection. However, groundwater samples to be used in Risk Assessment should not be filtered unless an unfiltered sample will also be submitted for the same analysis. Decisions to sample when turbidity remains above 10 NTU shall be made in consideration of the analyses that will be performed and the project objectives.

ORP is a difficult parameter to measure in the field because the length of time which is necessary for the probe to obtain an accurate measurement is too long to be conducive to use during low-stress monitoring. Consequently, ORP readings may continue to increase or decrease slowly over the purging period.

Gas bubbles present in discharge tubing during purging and sampling are a problem: Their presence indicates off-gassing from groundwater or poor purging connections in the airline or groundwater tubing. Sunlight can exacerbate this problem when low pumping rates are used. Check connections at the surface. If bubbles persist, check connections at the pump. Erect an umbrella to shade and insulate the transparent flow-through cell and tubing to prevent exposure to direct sunlight. During purging and sampling, observe the flow of groundwater in the sample tubing and keep the tubing filled with groundwater, removing all air pockets and bubbles, to the extent possible. Gas bubbles may be reduced by increasing flow, if possible, and keeping tubing and the transparent flow-through cells shaded. Monitor the flow-through cell for trapped gases which can impact the readings. Placing the flow-through cell at a 45 degree angle with the port side facing upwards can help remove air bubbles from the flow-through cell (see Figure 1).

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Pump tubing lengths above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

## 4.0 Equipment and materials

### **4.1** Submersible pumps, bladder pumps, positive displacement pumps, or peristaltic pump

In selecting the appropriate pump, the sampler must consider the head pressure the pump must overcome (the distance between the water level and the highest point over which the purge water must be raised), the depth to the desired sampling interval, the inner diameter of the inner well casing, the analyses to be performed, and the associated logistics (power source, well accessibility). The pump selected must have sufficient lift capacity for the head pressure anticipated. Peristaltic pumps are effective up to a depth to water of approximately 27 feet (note that this must be measured from the highest point that the water must be raised, such as the top of the outer casing). The pump must be sufficiently small to fit into the well along with the water level indicator. The associated pressure lines, power lines, and purge and intake lines must be sufficiently long to reach to the intended sampling interval. As per EPA guidance, peristaltic pumps or other pumps that use suction shall be avoided for sampling volatile compounds, gases (methane, ethane, ethene), and other parameters that may be impacted by degassing and pH modification. For these analyses, peristaltic pumps must not be used when project decisions hinge on detection of low concentrations of VOCs. ***Peristaltic pumps will not***

***be used for collection of any samples that include hexavalent chromium or VOCs as part of the analytical suite.***

### **4.2** Bladder Pump

The bladder pump system contains the following components: a pressurized cylinder of inert gas (typically nitrogen), a pump controller, air intake and discharge lines, and bladder pumps. Dedicated bladder pumps installed at some sites, may also have an extension designed to lower the pump intake below the level of the pump. The controller regulates total flow of nitrogen from the pressurized nitrogen cylinder to the pump assembly located in the well. AECOM typically samples one well per nitrogen cylinder. Note that if the bladder pumps are placed at the same depth in each well, multiple wells may be sampled simultaneously with one nitrogen cylinder. In this case, a three-way cross splitter with quick-connect air line fittings is attached to the tubing connected to the nitrogen cylinder. Up to three controllers can then be connected to the nitrogen cylinder. If nitrogen cylinders are not available, air compressors may be used to power the bladder pumps.

The tubing bundle connected to the pump has three components: an air line with fittings to the pump and the controller, a sample line, and a Teflon-coated support cable. The sample line, through which the purge water is removed, should be composed entirely of Teflon. In locations where dedicated bladder pumps are installed, the tubing bundle and support cable may be connected to a well plate recessed below the locking cap.

### **4.3** Peristaltic Pump

Peristaltic pumps are not submerged in the well, but remain outside of the well and function by pulling water to the surface. Use is therefore not approved for collection of samples requiring analysis for volatile organic compounds, gases, or other analyses that may be impacted by changes in pressure or pH, including hexavalent chromium. A peristaltic pump has a rotating pump head with stepless variable speed that compresses a short stretch of flexible (Pharmed) silicone tubing to pull water up from the well using mechanical peristalsis. The sample water does not come into direct contact with the pump. Teflon tubing is connected to either end of the silicone tubing. The pumps typically used by AECOM, the GeoPump or GeoPump II by GeoTech, operate off an external 12 V battery or 120 V AC power source. Commercially available “JumpStart” 12 volt batteries are typically preferred since electrical hookup is typically not available; since they are safe, easy to carry, and easy to recharge; and since the potential contamination issues associated with use of a generator are avoided.

### **4.4** Submersible Pump

Submersible pumps used are typically electrical centrifugal pumps. A centrifugal submersible pump consists of impellers or vanes that are spun or rotated by a sealed electric motor. The spinning of the impellers that causes water to be accelerated outward and then upward into the pump's discharge line. The higher the pumping rate, the greater the potential for sample alteration by sample agitation, increased turbulence and pressure changes in the sample. However, maintaining flow in the low-flow range (less than 1,000 mL per minute) is considered acceptable. A centrifugal submersible pump is usually suspended in a monitoring well by a support cable. Electrical submersible pumps typically used by AECOM are the Grundfos Redi-Flo 2, or similar. These are centrifugal pumps constructed of stainless steel and Teflon, and the motors are cooled and lubricated with water rather than with hydrocarbon-based coolants and lubricants that could contaminate groundwater samples. The pumps can achieve flow rates as low as 100 mL per minute. The pumps require a 115 or 230 volt electrical supply, therefore a generator is typically required. Pumps are available for wells 2" in diameter or larger.

### **4.5** Tubing suited to the pumps and flow-through cells to be used

Teflon or Teflon-lined polyethylene tubing are preferred for all parameters. Stainless steel tubing may be used for sampling organics, but is not recommended for inorganics. PVC, polypropylene or polyethylene may be used for sampling inorganics. Pharmaceutical-grade (e.g. Pharmed) silicon tubing shall be used around the rotor head of the peristaltic pump, and if necessary as a connecting tubing to the flow-through cells. Inner tubing diameter should be kept to the smallest size possible to reduce the generation of air pockets during low flow. Tubing typically used with the peristaltic pumps is Teflon of 1/4-inch outside diameter, and 3/16-inch outside diameter.

### **4.6** Electronic water level indicator: Solinst Model 101 or similar

Inner casing diameter and pump diameter should be considered in selecting a water level indicator that will fit into the well with the pump. A smaller diameter probe may be required for smaller wells.

### **4.7** High-Density Polyethylene (HDPE) Y connectors and tubing clamps

These allow for removal of an aliquot of purge water prior to the flow-through cell for turbidity analysis.

### **4.8** Flow controllers and compressed inert gases for submersible bladder pumps

QED Model MP-10 Flow controller and nitrogen gas are typically used unless nitrogen is an analyte of interest. Portable air compressors may be used in place of compressed gas (e.g., QED Well Wizard).

### **4.9** Power source

Marine battery, battery pack, compressed gas and flow-controller, or generator and heavy duty extension cords depending on pump

#### **4.9.1** Bladder Pumps

For bladder pump operation, the cylinders of inert compressed gas or portable air compressors function with the flow controller as the power source, although the flow controller does require batteries.

#### **4.9.2** Peristaltic Pumps

The peristaltic pumps typically used by AECOM require an external 12 volt battery or 120 volt AC power source. Commercially available 12 volt batteries designed for jump-starting a car battery (“JumpStart” or similar) are preferred since electrical hookup is typically not available; since they are safe, easy to carry, and easily rechargeable; and since the potential contamination issues associated with use of a generator are avoided.

#### **4.9.3** Submersible Pumps

An external power source is required. If use of a generator is required, precautions must be taken to avoid cross-contamination when handling fuel and when locating the generator to prevent contamination of the samples and sampling equipment by fumes and exhaust.

### **4.10** Water Quality Meter with Transparent Flow-Through Cell

YSI 6820 Water Quality Meter and transparent Flow-through cell with 610DM data manager, or similar model

### **4.11** Turbidity Meter

LaMotte 2020 turbidity meter, or similar model

### **4.12** Other Equipment

- Photoionization Detector (PID)
- Tarp, umbrellas, or other means to shade the tubing, flow-through cells, and water quality meters from direct sunlight
- Graduated cylinders
- Watch with seconds hand
- Graduated plastic purge buckets or carboys
- Well information consisting of well casing diameter, depth to bottom, depth to top and bottom of screened interval, desired depth for sample collection, depth of pump intake (if dedicated pumps are in place) and results of synoptic water level measurements and LNAPL/DNAPL survey.

## 5.0 Procedures

This section includes the procedures for performing field activities that should be conducted prior to sampling, procedures for purging the wells using the different pumps, and the sampling and post-sampling procedures (which are the same for the different pump types).

### **5.1** Pre-Sampling Field Activities

Prior to beginning sampling activities in any wells, all required synoptic water level measurements and well soundings should be completed in accordance with the POP for Water Level Measurements.

Wells should be inspected for the presence of DNAPL or LNAPL. Wells with NAPL cannot be sampled using low-flow techniques, and must be sampled with an alternative sampling method, such as bailing.

All non-dedicated down-well measuring devices will be thoroughly decontaminated before sampling and between monitoring locations.

Sampling should begin at the monitoring well likely to have the lowest levels of contamination, generally upgradient or farthest from the site or suspected source, and proceed such that the most contaminated wells are sampled last.

Record the monitoring location identification number. Check the monitoring location for damage or evidence of tampering, and record observations.

Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. This helps to prevent contamination of the sampling equipment by the soil, reduces wear on the sampling equipment due to dirt, and reduces the likelihood that contaminated purge water will spill into the surface soil.

Unlock the protective outer casing (if present) and remove the outer well cap.

Remove the inner well cap, and measure the well headspace and breathing zone for total organic vapors. If it is windy, stand upwind of the well to conduct measurements. For well headspace, place the intake of the PID approximately two inches below the plane formed by the top of the inner casing. Measure the total volatile organic concentrations in the breathing zone. Record both readings. Use the breathing zone concentrations to determine appropriate health and safety measures in accordance with the site-specific health and safety plan.

### **5.2** Purging the Wells

The procedure for sampling with bladder pumps is as follows:

Connect all the lines to the pump. If a dedicated bladder pump is in place, the tubing will already be connected to the pump and is likely connected to the well plate.

Carefully lower the pump to the desired sampling depth using the suspension cable. Take care to minimize disturbance and contact with the well walls which could knock rust or other deposits into the standing water. Secure the pump using the suspension cable.

Connect the pump power cable to the power source. Bladder pumps are driven by compressed gas or air through a controller. The controller typically requires batteries. Connect the regulator, pressurized inert gas cylinder or air compressor, flow controller, and pump. If using compressed gas, use a crescent wrench to attach the regulator to the pressurized nitrogen cylinder. Connect the air line from the regulator to the intake valve of the flow controller. Connect the air line from the outflow valve of the flow controller to the airline to the dedicated bladder pump.

Carefully install a flow-through cell on the sonde. Avoid touching the oxygen probe. Connect a purge water discharge line to the flow-through cell of the water quality meter.

Connect the purge water discharge line from the well to the water quality meter using a HDPE Y connector and pinch valve so that an aliquot of purge water can be obtained before the flow-through cell for turbidity measurements. Connect the discharge tubing from the well to the HDPE Y connector fitting using a short piece of silicone tubing. Attach a piece of silicone tubing to one end of the fitting and close it with a pinch value or check valve unit. Samples for turbidity measurements will be collected by opening this pinch valve. Connect the other end of the Y connector fitting to the lower of the two openings in the flow-through cell using silicon tubing and short pieces of Teflon tubing. Connect a piece of Teflon tubing to the out flow of the flow-through cell to the purge bucket. Use a short piece of silicon tubing at the cell. Be sure to use a piece of Teflon tubing sufficiently long to allow purge water to flow easily into the purge bucket.

Mount the sonde and flow-through cell assembly at a 45 degree angle to allow air bubbles to escape from the cell, and position the sonde such that any groundwater spills will be directed away from the sample.

Slowly open the valve on the regulator attached to the nitrogen cylinder until the pressure gauge reads approximately 60 pounds per square inch (PSI). Adjust the regulator on the flow controller to approximately 10 - 20 PSI.

Re-measure the static water level.

Determine the minimum purge volume required for the well. Samples should only be collected after the required volume has been removed from the well. For screen lengths of ten feet or less, a minimum volume of one saturated screen length plus drawdown volume must be removed. For screen lengths greater than ten feet, a minimum purge volume of three saturated screen lengths plus drawdown volume must be removed.

If the depth to water is less than the depth to the top of the screen, the screen is fully saturated and the minimum purge volume is one saturated screen length plus drawdown volume for screens of ten feet of less or three saturated screen lengths plus drawdown volume for screens greater than ten feet.

If the depth to water is greater than the depth to the top of the screen, calculate the well volume. Subtract the difference between the depth to water and the depth to the top of the screen from the well screen length to obtain the saturated well screen length. Round the saturated well screen length up to the nearest foot, and calculate the well volume using the volume per foot of screen length. Multiply the saturated well screen volume by three if the well screen length is greater than 10 feet.

Record the saturated well screen length and the saturated well screen volume on the sampling worksheet.

Start the flow controller and begin purging at the slowest rate possible.

- Note the purge start time.
- Collect all purge water in a bucket or carboy.

- Slowly increase the pressure at the controlled until discharge begins. The bladder pump controller should be set to allow for adequate recharge such that a maximum flow rate with no drawdown is achieved (generally 100-1,000 mL/min) and a smooth, even discharge flow is achieved. Refer to the historical flow controller settings for the well to select the starting controller pressure and intake and discharge intervals.
- Measure the flow rate using a graduated cylinder and time piece and monitor the water level and pumping rate.

Once drawdown has stopped and an acceptable flow rate established, begin monitoring indicator parameters and continue monitoring flow rate and water level.

- Record reading every three to five minutes, or as appropriate for the flow rate and flow-through cell volume. Use the water quality meter to monitor the following: temperature, pH, specific conductance, DO, and ORP. Use a turbidity meter to monitor turbidity.
- In the event that the well has extremely low recharge such that the lowest purge rate possible (100 mL/min or more, if equipment cannot effectively purge that slowly) continues to dewater the well, do not allow a water level that was above the top of the screen to drop below it, do not allow a water level already below the top of the screen to drop further, do not allow the water level to drop below the pump intake, and do not pump the well dry under any circumstances. Notify the field team leader of the situation. If all efforts to avoid dewatering the well have failed, a decision may be made to allow the well to recharge to a level sufficient to allow for collection of the necessary sample volume and to sample the well immediately. Record detailed notes concerning the sampling of the well.
- Stop purging when all parameters have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, the following criteria are met:
    - pH ± 0.1 unit
    - specific conductance and temperature ± 3%
    - turbidity < 10 NTU and ± 10 %
    - DO ± 10% (down to a detection limit of 0.5 mg/L)
    - ORP ± 10 mV
- The reporting limits presented are the lowest concentrations to which the instrument is considered linear and therefore accurate. Three consecutive readings below the reporting limits presented are considered to be stable.
- Readings should be recorded approximately every 5 minutes for flows in the range of 200 to 500 ml/min. Readings should be taken less frequently if the maximum flow rate is less than 100 ml/min because of the retention time in the flow-through cell. Each reading should represent a fresh aliquot of groundwater in the flow-through cell.
- Record the time at which the required minimum volume was removed, and record the total volume removed prior to sampling.

- If parameters do not stabilize, or turbidity remains greater than 5 NTU, or the minimum volume cannot be removed prior to the maximum purging time, contact the field team leader. Technical judgment will be used to ascertain when sampling should be commenced.

### **5.3** Sampling with Peristaltic Pumps

The procedure for sampling with peristaltic pumps is as follows:

Determine the depth at which the samples will be collected by referring to the QAPP. Samples are frequently collected from the most-contaminated interval, as determined by previous profiling investigations, or from the lower part of the screened interval, or the midpoint of the saturated screened interval. If possible, keep the pump intake at least two feet above the bottom of the well to minimize mobilization of sediment that may be present at the bottom of the well.

Connect the necessary tubing to the pump, using a Y connector fitting and pinch valve to split the flow prior to the flow-through cell in order to collect an aliquot for turbidity:

- Measure a new section of pharmaceutical-grade, 3/16-inch inner diameter (ID) silicon tubing and attach it to the peristaltic pump head.
- Note that the length of silicon tubing in contact with the sample should be kept to a minimum.
- Measure a new section of 3/16-inch ID Teflon tubing to extend from the depth of the intended sampling location to the intake end of silicon tubing. To do this and avoid contamination of the tubing, it is recommended that a decontaminated water level measurement tape be used to measure the tubing as it is lowered into the well. The water level indicator may be lowered into the well with the tubing, or allowed to run onto the clean plastic on the ground outside of the well. Since the tubing is typically stored on a roll, straightening the tubing as you put it into the well will help avoid catching the tubing on any obstructions in the well, such as the top of the well screen. Once the tubing is lowered to the desired depth, immediately secure the free end of the Teflon tubing to prevent it dropping into the well. Using a piece of silicon tubing, connect the outflow end of the Teflon tubing to the HDPE Y-connector. Then, using several pieces of Teflon tubing, connect the pinch valve and check valve units to one end of the Y-connector (through which samples for turbidity will be collected) and connect the other end of the Y-connector to the intake of the flow-through cell.

Connect the electrical clamps from the pump to the appropriate terminals on the 12 volt battery.

Note that reversing the connections will typically cause the pump to run in reverse, which could push air into the well and should be avoided.

Re-measure and record the static groundwater level after the tubing has been placed in the well, and the water level has been allowed to stabilize again.

Determine the minimum purge volume required for the well. Samples should only be collected after the required volume has been removed from the well. For screen lengths of ten feet or less, a minimum volume of one saturated screen length plus drawdown volume must be removed. For screen lengths greater than ten feet, a minimum purge volume of three saturated screen lengths plus drawdown volume must be removed.

If the depth to water is less than the depth to the top of the screen, the screen is fully saturated and the minimum purge volume is one saturated screen length plus drawdown volume for screens of ten feet of less or three saturated screen lengths plus drawdown volume for screens greater than ten feet.

If the depth to water is greater than the depth to the top of the screen, calculate the well volume. Subtract the difference between the depth to water and the depth to the top of the screen from the well screen length to obtain the saturated well screen length. Round the saturated well screen length up to the nearest foot, and calculate the well volume using the volume per foot of screen length. Multiply the saturated well screen volume by three if the well screen length is greater than 10 feet.

Record the saturated well screen length and the saturated well screen volume on the sampling worksheet.

Commence purging at the slowest possible flow rate and slowly increase the speed until discharge occurs. The pump rate should be set to allow for maximum flow rate (100-1,000 milliliters per minute) with no drawdown. Refer to historical purge information for recharge information. Under no circumstances should the well be pumped dry and once pumping is begun, it should not be interrupted until all sample volume has been collected. Collect all purge water in a bucket or carboy.

Once the stagnant volume in the tubing has been removed (see below for volume equation), drawdown has stopped, and an acceptable flow rate has been established, begin monitoring indicator parameters and continue monitoring flow rate and water level. Record readings every three to five minutes, or as appropriate for the flow rate and flow-through cell volume. Use the water quality meter monitor the following: temperature, pH, specific conductance, DO, turbidity, and ORP. .

- Tubing radius = r = 0.0104 ft.
- Volume of tubing = $r^2$ x length of tubing = V (in ft3)
- $ft^3$ x 28.316 = liters
- In the event that the well has extremely low recharge such that the lowest purge rate possible (100 mL/min or more, if equipment cannot effectively purge that slowly) continues to dewater the well, do not allow a water level that was above the top of the screen to drop below it,
- do not allow a water level already below the top of the screen to drop further,
- do not allow the water level to drop below the pump intake,
- do not pump the well dry under any circumstances.

- Notify the field team leader of the situation. If all efforts to avoid dewatering the well have failed, a decision may be made to allow the well to recharge to a level sufficient to allow for collection of the necessary sample volume and to sample the well immediately.
- Record detailed notes concerning the sampling of the well.

Stop purging when all parameters have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, the following criteria are met:

- pH ± 0.1 unit
- specific conductance and temperature ± 3%
- turbidity < 10 NTU and ± 10 %
- DO ± 10% (down to a detection limit of 0.5 mg/L)
- ORP ± 10 mV

The reporting limits presented are the lowest concentrations to which the instrument is considered linear and therefore accurate. Three consecutive readings below the reporting limits presented are considered to be stable.

Readings should be recorded approximately every 5 minutes for flows in the range of 200 to 500 ml/min. Readings should be taken less frequently if the maximum flow rate is less than 100 ml/min because of the retention time in the flow-through cell. Each reading should represent a fresh aliquot of groundwater in the flow-through cell.

Record the time at which the required minimum volume was removed, and record the total volume removed prior to sampling.

If parameters do not stabilize, or turbidity remains greater than 10 NTU, or the minimum volume cannot be removed prior to the maximum purging time, contact the field team leader. Technical judgment will be used to ascertain when sampling should be commenced.

### **5.4** Sampling with Submersible Pumps

The procedure for sampling with submersible pumps is as follows:

Prior to placing any equipment in the well, measure and record the static water level as described in the water level measurement Standard operating procedure.

Note the water level in relation to the top of the screen. If the static water level is above the top of the screen, care should be taken to prevent the water level from dropping below the top of the screen.

Determine the depth at which the samples will be collected by referring to the QAPP. Samples are frequently collected from the most-contaminated interval, as determined by previous profiling investigations, or from the lower part of the screened interval, or the midpoint of the saturated screened interval. If possible, keep the pump intake at least two feet above the bottom of the well to minimize mobilization of sediment that may be present at the bottom of the well.

Connect the pump to the power source. Submersible pumps are driven by an external power source.

If the use of a generator is required, it should be placed downwind of the sampling location to prevent exhaust from impacting the samples.

Care must be taken in handling the generator and gasoline to preclude cross-contamination of the samples and sampling equipment.

At a minimum, samplers must change gloves after handling the fuel or generator prior to sampling.

Carefully lower the pump to the desired sampling depth using the suspension cable. Take care to minimize disturbance and contact with the well walls which could knock rust or other deposits into the standing water.

Secure the pump using the suspension cable, and connect the ground from the pump.

Connect the purge water discharge line to the water quality meter using a splitter and pinch valve so that an aliquot of purge water can be obtained before the flow-through cell for turbidity measurements.

Connect the outflow end of the purge water line to the HDPE Y connector using a short piece of silicone tubing if necessary. Attach a piece of silicone tubing to one end of the Y and close it with a pinch value or check valve unit.

- Samples for turbidity measurements will be collected by opening this pinch valve.

Connect the other end of the Y connector to the lower of the two openings in the flow-through cell using Teflon tubing and short pieces of silicon tubing at the joints.

Connect a piece of Teflon tubing to the out flow of the flow-through cell to the purge bucket. Use a short piece of silicon tubing at the joint.

Be sure to use a piece of Teflon tubing sufficiently long to allow purge water to flow easily into the purge bucket.

Re-measure the static water level.

Determine the minimum purge volume required for the well.

Samples should only be collected after the required volume has been removed from the well.

For screen lengths of ten feet or less, a minimum volume of one saturated screen length plus drawdown volume must be removed.

For screen lengths greater than ten feet, a minimum purge volume of three saturated screen lengths plus drawdown volume must be removed.

If the depth to water is less than the depth to the top of the screen, the screen is fully saturated and the minimum purge volume is one saturated screen length plus drawdown volume for screens of ten feet of less or three saturated screen lengths plus drawdown volume for screens greater than ten feet.

If the depth to water is greater than the depth to the top of the screen, calculate the well volume. Subtract the difference between the depth to water and the depth to the top of the screen from the well screen length to obtain the saturated well screen length. Round the saturated well screen length up to the nearest foot, and calculate the well volume using the volume per foot of screen length. Multiply the saturated well screen volume by three if the well screen length is greater than 10 feet.

Record the saturated well screen length and the saturated well screen volume on the sampling worksheet.

Start the pump and begin purging at the slowest rate possible.

- Note the purge start time. Slowly increase the speed until discharge begins.
- The pump should be set to allow for adequate recharge such that a maximum flow rate with no drawdown is achieved (generally 100-1,000 mL/min).
- Refer to the historical flow controller settings for the well to select the starting controller pressure and intake and discharge intervals.

Collect all purge water in a bucket or carboy.

Measure the flow rate using a graduated cylinder and time piece and monitor the water level and pumping rate during purging.

Under no circumstances should purging be interrupted until all sample volume has been collected.

Once drawdown has stopped and an acceptable flow rate established, begin monitoring indicator parameters and continue monitoring flow rate and water level. Record reading every three to five minutes, or as appropriate for the flow rate and flow-through cell volume. Use the water quality meter to monitor the following: temperature, pH, specific conductance, DO, turbidity and ORP.

In the event that the well has extremely low recharge such that the lowest purge rate possible (100 mL/min or more, if equipment cannot effectively purge that slowly) continues to dewater the well, do not allow a water level that was above the top of the screen to drop below it, do not allow a water level already below the top of the screen to drop further, do not allow the water level to drop below the pump intake, and do not pump the well dry under any circumstances. Notify the field team leader of the situation. If all efforts to avoid dewatering the well have failed, a decision may be made to allow the well to recharge to a level sufficient to allow for collection of the necessary sample volume and to sample the well immediately. Record detailed notes concerning the sampling of the well.

Stop purging when all parameters have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, the following criteria are met:

- pH ± 0.1 unit
- specific conductance and temperature ± 3%
- turbidity < 10 NTU and ± 10 %
- DO ± 10% (down to a detection limit of 0.5 mg/L)
- ORP ± 10 mV

The reporting limits presented are the lowest concentrations to which the instrument is considered linear and therefore accurate. Three consecutive readings below the reporting limits presented are considered to be stable.

Readings should be recorded approximately every 5 minutes for flows in the range of 200 to 500 ml/min. Readings should be taken less frequently if the maximum flow rate is less than 100 ml/min because of the retention time in the flow-through cell. Each reading should represent a fresh aliquot of groundwater in the flow-through cell.

Record the time at which the required minimum volume was removed, and record the total volume removed prior to sampling.

If parameters do not stabilize, or turbidity remains greater than 10 NTU, or the minimum volume cannot be removed prior to the maximum purging time, contact the field team leader. Technical judgment will be used to ascertain when sampling should be commenced.

### **5.5** Sampling

Once purging has been completed, test for oxidants and sulfides as required for the analyses to be conducted and in accordance with standard operating procedures. Prior to commencing sampling,

- measure and record final water level, temperature, pH, specific conductance, DO, ORP, turbidity, and flow rate.
- disconnect the purge tubing from the flow-through cell, such that sample water will be collected directly from the tubing.

For the PPG Site 114 project, samples will be collected in the following order:

- VOCs
- Total Organic Halogens (TOX)
- Total Organic Carbon (TOC)
- SVOCs
- EPH

- PCBs
- Total Metals
- Dissolved Metals
- Phenols
- Cyanide
- Chloride
- Preserved Inorganics
- Non-preserved Inorganics

VOCs are always collected first, before other non-VOC parameters. During sample collection, allow the water to flow directly into and down the side of the sample container without allowing the tubing to touch the inside of the sample container or lid, in order to minimize aeration and maintain sample integrity.

### **5.6** Post-Sampling Field Activities

Preserve the samples as per standard operating procedures for preservation. Immediately label the sample containers with the sample collection date and time and place them on ice. Complete the COC forms as soon as possible.

Cease pumping and disassemble the purging and sampling equipment.

Replace the well cap and lock the outer protective casing.

Decontaminate the sampling equipment as per standard operating procedures for decontamination.

Dispose of all purge water as per the site-specific work plan.

## 6.0 Quality assurance / quality control

The tubing and lines associated with sampling pumps are typically long and awkward to handle, and careful handling is required to prevent introduction of contaminants into the well. It is therefore preferable for set-up and installation of sampling equipment to be performed by a team of at least two people in order to prevent contamination of equipment to be introduced into the well.

Duplicate measurements cannot effectively be taken using the flow-though cell, since two consecutive measurements taken are not measuring the same sample, and flow cannot be interrupted. Water quality parameters obtained should be compared to historical readings, and potential instrument issues should be considered in the event of major differences.

### 6.1 Pollution Prevention and Waste Management

Purge water volume is kept to a minimum through the use of the low-stress sampling procedures. When available, historical information on sampling rates for each well will be used in an attempt to minimize time spent determining the equilibrium flow rate and thereby minimizing purge water volume.

Lengths of Teflon tubing remove from each roll of tubing will be tracked to maximize use and minimize waste of remaining pieces.

Disposable tubing will be disposed of in accordance with the site-specific sampling and analysis plan.

Purge water will be containerized until purging and sampling activities at the well are completed. Purge water will then be disposed of in accordance with the site-specific sampling and analysis plan

## 7.0 Data and records management

All documentation will be conducted in accordance with standard documentation procedures.

Groundwater sampling information specific to each well will be recorded on the monitoring well sampling worksheet. An example monitoring well worksheet is included as Attachment 1 of this POP. Activities common to more than one well, samples collected, deviations from the sampling and analysis plan, and any other unusual occurrences will also be documented in the field logbook in accordance with standard documentation procedures.

## 8.0 Personnel qualifications and training

All field samplers are required to take the 40-hour OSHA health and safety training course and annual 8-hour refresher courses prior to engaging in any field collection activities.

For projects in New Jersey, field personnel collecting water quality indicator parameters (i.e., DO, pH, temperature, ORP, specific conductivity, and turbidity) must be certified by NJDEP for those parameters for which certification is offered as required by N.J.A.C. 7:26E-2.1(a)1.vii.

The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

Samplers will have a minimum of one-week's experience performing low-stress sampling prior to sampling without supervision

## 9.0 References

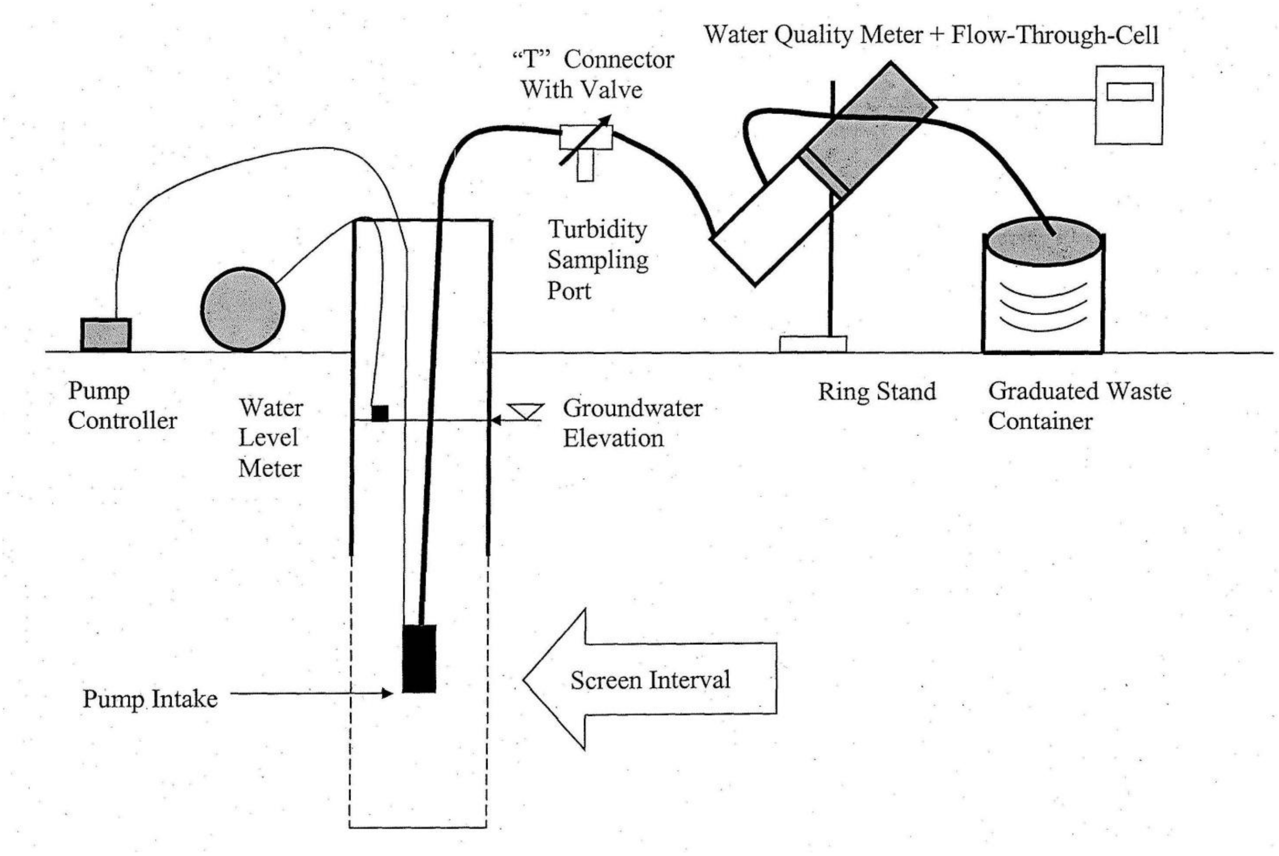
*U.S. Environmental Protection Agency, Region 1. Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells,* Revision 2, July 30, 1996.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, *Influence of Dissolved Oxygen Convection on Well Sampling*, Ground Water Monitoring & Remediation 27, no. 3: 49-58.

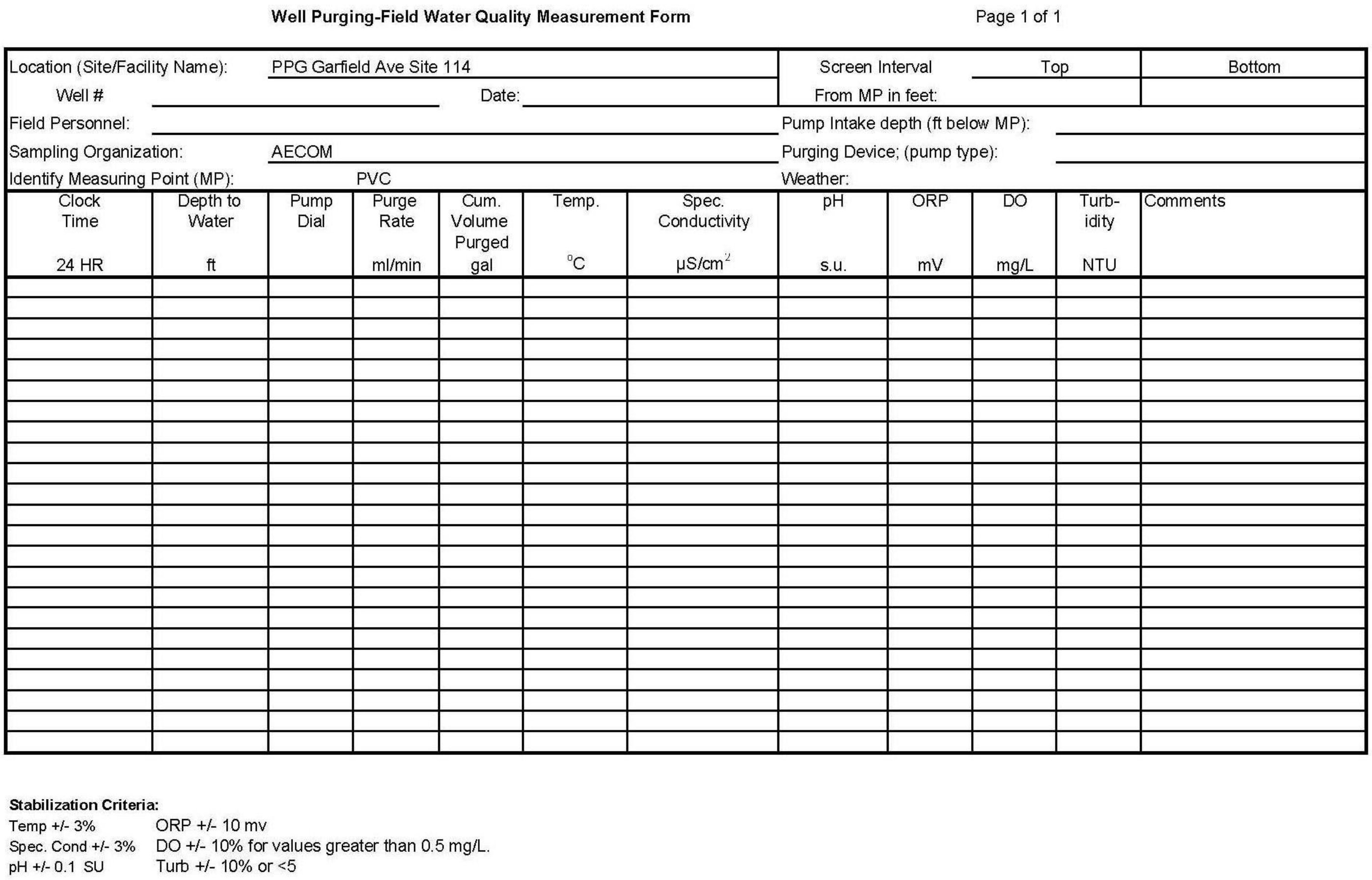
## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

**Figure 1: Low-Flow Setup Diagram**



## Attachment 1: Monitoring Well Sampling Worksheet



**Well Purging-Field Water Quality Measurement Form**

Page 1 of 1

Location (Site/Facility Name): PPG Garfield Ave Site 114
Well #
Date:
Screen Interval Top Bottom
From MP in feet:
Field Personnel:
Pump Intake depth (ft below MP):
Sampling Organization: AECOM
Purging Device; (pump type):
Identify Measuring Point (MP): PVC
Weather:

| Clock Time 24 HR | Depth to Water ft | Pump Dial | Purge Rate ml/min | Cum. Volume Purged gal | Temp. °C | Spec. Conductivity µS/cm$^2$ | pH s.u. | ORP mV | DO mg/L | Turb-idity NTU | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Stabilization Criteria:**

| | |
|---|---|
| Temp +/- 3% | ORP +/- 10 mv |
| Spec. Cond +/- 3% | DO +/- 10% for values greater than 0.5 mg/L. |
| pH +/- 0.1 SU | Turb +/- 10% or <5 |

AECOM

Project Operating Procedure

# Hydraulic Conductivity Tests – Pressure Transducer Method

Procedure Number:  PPG 009

Revision No.: 0

Revision Date:  June 2010

Date: 6/28/2010

POP Author

Kathleen [illegible]

Date: 6/28/2010

Project Manager

Annual review of this POP has been performed and the POP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

Project Operating Procedure

# Hydraulic Conductivity Tests – Pressure Transducer Method

POP No.: PPG 009
Revision: 0
Date: June 2010
Page i of i

## Contents

## List of Attachments

Project Operating Procedure

# Hydraulic Conductivity Tests – Pressure Transducer Method

## 1.0 Project Scope and applicability

### 1.1 Purpose and Applicability

This Project Operating Procedure (POP) describes the procedures for conducting rising head and falling head hydraulic conductivity tests (slug tests). Rising head/falling head tests are performed to determine the hydraulic conductivity of the soil or rock surrounding a monitoring well.

Hydraulic conductivity values are used for many purposes, including:

- To estimate rates of groundwater flow;
- To estimate responses of aquifers to applied stresses, such as pumping;
- To estimate the rate of movement of various chemicals in subsurface zones; and
- To construct and calibrate groundwater flow models.

In-situ tests to determine hydraulic conductivity can be conducted in open boreholes or in monitoring wells, and they can be variable-head tests or constant-head tests. The initial change in water levels required to begin the test can be produced by adding or removing a known volume of water using a pump or bailer, displacing water with a solid slug, or changing head conditions using pressurized gas. The water levels can be monitored using a water level tape or with a transducer. For the purpose of this POP, the method to perform a variable-head test in a monitoring well using a slug and transducer is outlined. Use of other test options must be fully described in the project-specific Work Plan.

Wells that contain high concentrations of contaminants or non-aqueous phase liquids may require specialized equipment which will not be damaged by the contaminants. Slug tests should not be performed in wells with non-aqueous phase liquid present.

### 1.2 General Principles

Hydraulic conductivity is a measure of the ability of a specific porous medium to transmit a specific fluid. Variable-head tests are performed by causing a sudden (instantaneous) rise or drop of the static water level in a well. Water levels are then monitored and recorded until the water level has returned to the condition prior to slug removal or insertion (i.e., static conditions) or sufficient data is collected to perform the hydraulic conductivity calculations.

### 1.3 Definitions

**1.3.1** Hydraulic Conductivity: The measure of the ability of a specific porous medium to transmit a specific fluid.

**1.3.2** Slug: Solid cylinder of teflon, PVC, or other material which is either lowered into the water inside the well to produce a temporary rise in the water level or removed to produce a temporary fall in the water level. If the cylinder is not solid, it should be sealed to prevent water leaking into the slug.

**1.3.3** Data Logger: A data logger is a computerized device which records in electronic memory the hydrostatic pressure (i.e., water level) measured by the transducer at specific, user-defined time intervals. The data logger and transducer may be combined in one device.

**1.3.4** Transducer: A probe lowered into a well that measures hydrostatic pressure which can be used to calculate the water level. The data logger and transducer may be combined in one device.

**1.3.5** Falling Head Test: Following the instantaneous rise in the static water level by inserting a slug, the drop in water level with respect to time is measured.

**1.3.6** Rising Head Test: Following the instantaneous lowering of the static water by extracting the slug, the rise of the water level with respect to time is measured.

### **1.4** Quality Assurance Planning Considerations

Personnel shall follow specific quality assurance guidelines as outlined in the site-specific Work Plan and/or Quality Assurance Project Plan (QAPP), hereafter referred to as the project plans. Proper quality assurance requirements shall be provided which will allow project objectives to be met. Quality assurance requirements typically require the collection of both the rising head and falling head data for comparison or performing the same test twice, although falling head tests may not be required for monitoring wells screened in a water table aquifer. The minimum initial change in well or borehole water level achieved by the slug should be a minimum of one foot to ensure that the formation is sufficiently stressed so that meaningful hydraulic conductivity values can be determined.

The data collected during slug tests shall be reviewed and analyzed by a hydrogeologist or similarly qualified personnel. Many factors affect the appropriate interpretation of slug test data.

## 2.0 Health and safety considerations

Hydraulic conductivity testing may involve chemical hazards associated with the potentially contaminated groundwater the testing equipment comes in contact with. Adequate health and safety measures must be taken to protect project personnel from potential chemical exposures or other hazards. The health and safety considerations for the site, including both potential physical and chemical hazards, shall be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

### **3.1** Not Applicable

## 4.0 Equipment and materials

Equipment required includes:

- Well records (boring, well logs, and well construction diagrams), if available
- Data logger(s)
- Transducer(s) with cable wire length sufficient to reach target depth and to reach from the well to the computer used to download data.
- Computer - with appropriate software and cables to download data from data logger
- Slugs - diameter dependent upon well diameter; the slug length is dependent on the length of the water column in the well but should provide a minimum of 1 foot displacement of the water column; slug materials may be specified by the project work plan.
- Nylon string
- Water level meter or steel tape
- Health and safety supplies
- Equipment decontamination supplies - Liquinox, buckets, brushes, plastic sheeting (around well to keep equipment clean), solvent (e.g., methanol), DI water, Kimwipes, and aluminum foil.
- Field logbook/standardized forms
- Pen

## 5.0 Procedures

### 5.1 Office Preparation

**5.1.1** Review boring, well logs, and well construction diagrams to determine the geologic medium to be tested (sand, silt, clay, etc.) and well depth, depth-to-water, and screen placement.

**5.1.2** Determine what slug diameter and length are to be used on the well. The larger the slug, the greater the water displacement, which results in more comprehensive data capture. The diameter of the well, the length of the water column, and the medium to be tested, will determine which slug to use. The slug must be short enough to be completely submerged beneath the static water level, thin enough to be placed in the well and have sufficient room for the transducer cable and there must be room beneath the bottom of the slug for the transducer.

**5.1.3** Procure appropriate supplies based on well construction (transducer, cable length, slug sizes).

**5.2** General Site Preparation

**5.2.1** The monitoring wells to be tested should have been previously developed and had sufficient time to equilibrate before the hydraulic conductivity testing is conducted. The water level in tightly sealed wells may need to equilibrate once opened and exposed to the atmosphere. Well construction diagrams are necessary to determine the well diameter, sand pack thickness, the depth of the monitoring well and the screened interval.

**5.2.2** Measure the static water level and well depth in each well to be tested and record the level in the field logbook or on the standard form.

**5.2.3** Confirm slug diameter and length to use in well. Record the slug length and diameter in the field logbook or on the standard form for use during data evaluation.

**5.2.4** Record the make, model, and serial number of transducer and data logger in field log book or on the standard form. If data logger saves to an electronic file, record specified file name in field log book. File name protocols may be specified in the project plans.

**5.2.5** Connect the transducer cable to the data logger, and program the logger in accordance with manufacturer's instructions. If using a device where the transducer and logger are combined in one unit, connect the unit to the computer and program it in accordance with manufacturer's instructions. A logarithmic time or very short time interval (typically 3 seconds or less) should be used for recording slug test data. The specified time interval should be outlined in the project plans, and the transducer should have sufficient memory to record data for the entire test duration.

**5.2.6** Lower the transducer into the well. The transducer must be set at a level that will not be disturbed during the test, especially at the insertion or removal of the slug. Ideally, the entire slug length should be below the water surface; however, due to well geometry, this may not be possible. Also, if possible, the transducer should be set a few feet above the base of the well, above the level of any sediment that may be present and may potentially interfere with transducer readings. If these ideal conditions are not present, appropriate notes shall be recorded in the field note book or on the standard form.

**5.2.7** The cable of the transducer should be fixed (e.g., with tape or a clamp) at the top of the well to stabilize it and hold it in place.

**5.2.8** Allow the water level to equilibrate to the static level (i.e., the water level observed prior to installing the transducer). Monitor with the transducer and/or the water level meter.

**5.2.9** When the water has returned to the static water level following installation of the transducer, measure the depth to water using a water level meter and record in the field log book or on the standard form. Also, measure and record an instantaneous pressure reading, if possible. This allows pressure readings to be tied to hydraulic head values. If the data logger requires input of a reference elevation, enter into the data logger an appropriate reference elevation that corresponds to the measured depth to water. Reference elevations may be set to zero, to the depth to water, or to a calculated hydraulic head (preferred). Record the reference elevation method in field log book or on the standard form.

**5.2.10** Tie nylon string to the slug and cut it to a length that will allow the top of the slug to be submerged beneath the static water level. The length of the string should not allow the slug to touch the transducer.

**5.3** Falling Head Test

**5.3.1** Lower the slug into the well so that the bottom of the slug is just above the water surface.

**5.3.2** Start the data logger recording and immediately lower the slug into the water in the well. The data logger should record a few measurements of static water level in the few seconds it takes to lower the slug. Care should be taken to lower the slug fast enough to produce a nearly instantaneous rise in the water level, but not so fast as to produce a wave when the slug enters the water. The top of the slug should be below the static water level, completely submerged.

**5.3.3** Monitor the data logger so that when the water level returns to the static level, the rising head test can be started (Sec. 5.4).

**5.3.4** If the hydraulic conductivity is low, it may take hours or more for the water level to return to static. In this situation the project hydrogeologist should determine a maximum duration for each test (typically 30 minutes).

**5.4** Rising Head Test

**5.4.1** When the falling head test is over, reset the data logger to begin a new test sequence. There should be no reason to re-set the reference elevation, unless the transducer moved during testing.

**5.4.2** Start the data logger recording. The data logger should record a few measurements of static water level prior to removal of the slug. The slug should be removed quickly so that an instantaneous fall in the water level occurs. Take care not to disturb the transducer when removing the slug.

**5.4.3** Terminate the rising head test when the water has returned to a static condition or the maximum test length duration determined by the project hydrogeologist has elapsed.

**5.4.4** If the hydraulic conductivity is low it may take hours or more for the water level to return to static. In this situation the project hydrogeologist should determine a maximum duration for each test (typically 30 minutes).

**5.5** Data Review and Download

**5.5.1** Some data logging equipment allows collected data to be reviewed and plotted on a graph in the field. Prior to moving to the next well location, it is beneficial to review the collected data to see if it appears acceptable. Common problems are that a well was insufficiently stressed (i.e., water level change from static less than 1 foot) or the transducer moved. Contact the project hydrogeologist if uncertain on the acceptability of test results. If the data is not acceptable or the project plans require it, the test should be repeated. Make appropriate notes in field log book or on standard form.

The collected data from all tests must be downloaded into a computer for quantitative analysis. This may be performed in the field or in the office but in the field is preferred. If renting equipment, do not return until the project hydrogeologist can preliminarily review downloaded data for completeness. Follow manufacturer's instructions.

**5.6** Equipment Decontamination

**5.6.1** All equipment which comes into contact with the groundwater (slugs, transducer, and water level tape) shall be decontaminated in accordance with POP PPG 014 Decontamination of Field Equipment before moving to the next location. The string, plastic sheeting, and any health and safety supplies (e.g. gloves) shall be properly disposed of in accordance with site requirements.

**5.7** Data Analysis

**5.7.1** Several methods are available for analyzing data obtained from hydraulic conductivity tests. Most methods incorporate graphical techniques, such as semi-log and log-log plots, to evaluate the data and select values for the calculations. Computer software is available to aid in evaluation.

Inherent in all analytical methods are simplifying assumptions concerning the aquifer properties and test methods. When selecting a particular analytical method, it is important to consider the basic assumptions that underlie the mathematical expressions. In many cases it may be advisable to evaluate the data using several methods and examine the range of hydraulic conductivities that are obtained. When reporting a calculated in-situ hydraulic conductivity, the analytical method(s) used should be referenced.

One of the major issues in determining the method to use is whether the aquifer is a water table (unconfined) aquifer or a confined aquifer. Falling head tests may overestimate hydraulic conductivity in water table aquifers if the screened interval is not fully submerged. Although the tests may be performed under such conditions and analyzed for comparative purposes to rising head tests, the limitations of falling head tests conducted in a water table aquifer should be appropriately considered and noted when reporting results or computing average values.

## 6.0 Quality assurance / quality control

The slug test and data analysis shall be performed under the supervision of a hydrogeologist or other qualified personnel. A hydrogeologist shall review all calculations and results.

Both rising and falling head tests or replicate tests may be conducted for quality control. If the rising and falling head results are not comparable, assess whether the transducer recorded accurate data.

The falling head test is not accurate for wells with screens that bracket the stabilized water table, because they will overestimate hydraulic conductivity. These tests may be performed in water table wells, but the results should not be used quantitatively.

## 7.0 Data and records management

Documentation for the field component of hydraulic conductivity tests shall include a minimum of the following:

- Project and site identification
- Measured groundwater levels (with water level tape and/or electronic files from the data logger)
- Slug dimensions
- Data logger / transducer number or instrument identification number/model
- Reference elevations, if available
- Other data logger programming inputs
- Relevant dates and times for start / finish and subsequent water-level measurements
- Weather conditions
- Identities of personnel performing the measurements
- Description of any events or conditions that could impact the quality of the test results

The information shall be recorded in a field logbook or on a standard field form (see Attachment 1). Analysis and results of the tests shall be documented in a technical memorandum and/or report as specified in the project plans.

## 8.0 Personnel qualifications and training

The field technician shall be properly trained in the process of hydraulic conductivity measurement and shall have specialized training and supervision in using the transducer and data loggers.

The slug test and data analysis shall be performed by or under the supervision of a hydrogeologist or other qualified personnel. A hydrogeologist shall review all calculations and results.

### **8.1** Project Manager

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plans.

### **8.2** Field Technician

It is the responsibility of the field technician to be familiar with the general principles of hydraulic conductivity testing and the testing equipment. The field technician is responsible for verifying that the equipment is in proper operating condition prior to use and for implementing the measurement procedures in accordance with this POP and the project plans.

### **8.3** Project Hydrogeologist

It is the responsibility of the project hydrogeologist to provide guidance to the field technician necessary to perform the measurements in accordance with this POP and the project plans and to perform and/or supervise the analysis of the data collected.

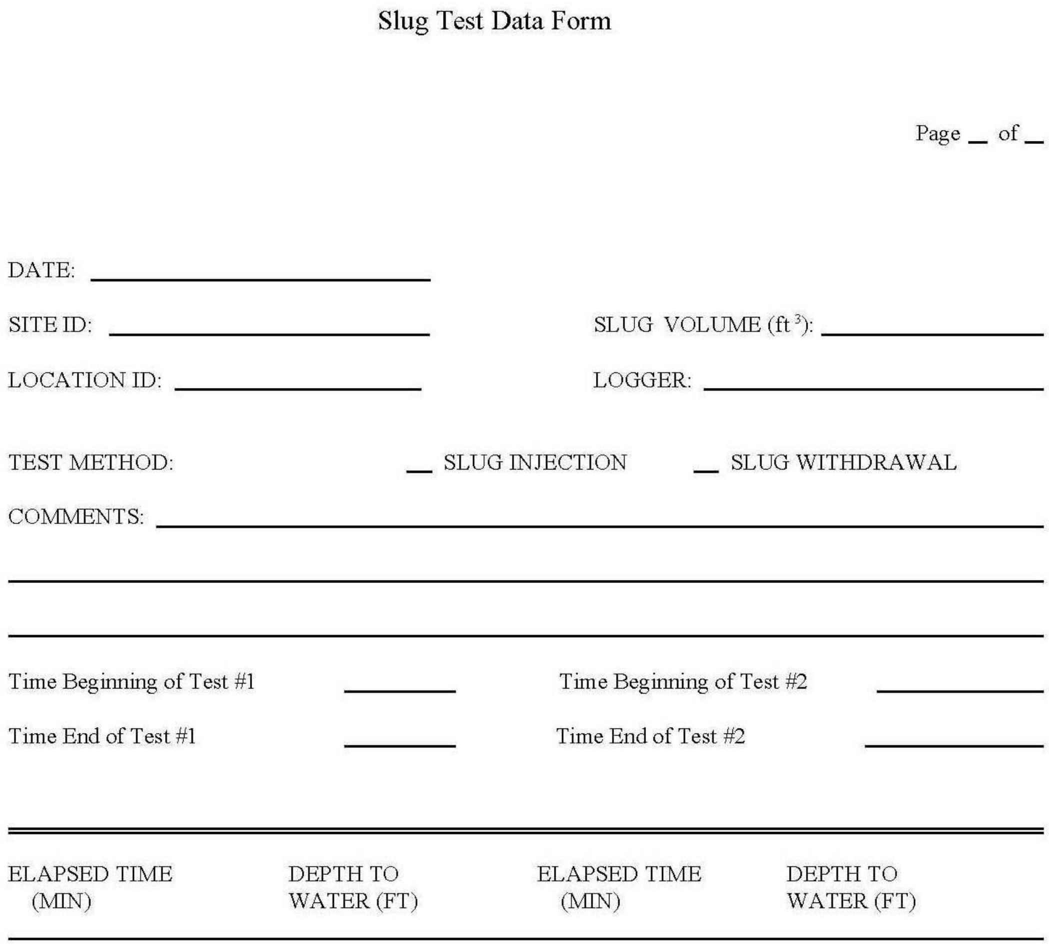
## 9.0 References

**9.1** Not Applicable.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

## Attachment 1 – Hydraulic Conductivity Test Log



Slug Test Data Form

Page __ of __

DATE: ______________________

SITE ID: ______________________

SLUG VOLUME ($ft^3$): ______________

LOCATION ID: ______________________

LOGGER: ______________________

TEST METHOD: __ SLUG INJECTION __ SLUG WITHDRAWAL

COMMENTS: ______________________

Time Beginning of Test #1 ________

Time Beginning of Test #2 ________

Time End of Test #1 ________

Time End of Test #2 ________

| ELAPSED TIME (MIN) | DEPTH TO WATER (FT) | ELAPSED TIME (MIN) | DEPTH TO WATER (FT) |
|---|---|---|---|

AECOM

Project Operating Procedure

# Chip Sampling

Procedure Number: PPG 010

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen [illegible]

Date: 6/28/2010

QA Reviewer

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: _________
Initials: ________ Date: _________

Project Operating Procedure

# Chip Sampling

## Contents

# Project Operating Procedure

# Chip Sampling

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) defines the procedures for the collection of chip samples to determine surficial contamination on porous surfaces (e.g., cement, brick, wood). These procedures are intended for samples to be analyzed for non-volatile analyses (e.g., PCBs, TCDD, and TCDF), and should not be used for volatile organic compound (VOC) analysis. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, and available surface area. Suggested sampling points include floors near process vessels and storage tanks, loading dock areas, etc. The sampling area should be large enough to provide a sufficient amount of sample for analysis (smaller sample volumes cause higher detection limits). To facilitate the calculations once the analytical data is received, the area sampled should be measured.

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

**3.1** Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

## 4.0 Equipment and Materials

To collect a chip sample, the following equipment is needed:

- Ruler, measuring tape, measuring wheel, or other similar measuring device
- Chalk
- Disposable nitrile gloves, safety glasses, and other PPE required in the site-specific HASP.
- Decontaminated beryllium copper or stainless steel chisel
- Hammer or electric hammer

- Dedicated natural bristle brush and a dust pan lined with aluminum foil or one that is dedicated, decontaminated and constructed of a pre-approved material which will not interfere with the contaminants of concern
- Glass sample containers
- Field logbook and pen with indelible ink

## 5.0 Procedures

**5.1** Mark off the sample collection location with chalk and measure the area.

**5.2** Don safety glasses, a new pair of disposable gloves, and any other PPE required in the site-specific HASP.

**5.3** Using the decontaminated chisel and hammer, break up the surface of the location to be sampled. An effort should be made to avoid scattering pieces out of the marked sampling area boundary. Any pieces that fall outside the sampling area should not be used. The area should be chipped to less than ¼” and preferably ⅛”.

**5.4** Record how deep chips were taken in the field logbook or field data sheet.

**5.5** Collect the chipped pieces using a dedicated, decontaminated dustpan and natural bristle brush and transfer the sample directly into the sample container.

**5.6** Repeat the process for each location to be sampled. Use new or decontaminated equipment at each location. Outer gloves must be changed before each sample is collected.

**5.7** Decontaminate the sampling equipment in accordance with POP PPG 014 Decontamination of Field Equipment.

## 6.0 Quality Assurance / Quality Control

**6.1** Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

**6.2** Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

## 7.0 Data and Records Management

**7.1** All data and information (e.g., sample collection method used) must be documented on field data sheets or within site log books with permanent ink.

**7.2** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.3** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

POP PPG 014 Decontamination of Field Equipment

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

AECOM

Project Operating Procedure

# Wipe Sampling

Procedure Number: PPG 011

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen Woolley

Date: 6/28/2010

QA Reviewer

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Wipe Sampling

POP No.: PPG 011
Revision: 0
Date: June 2010

## Contents

# Project Operating Procedure

# Wipe Sampling

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) defines the procedures for the collection of wipe samples to determine surficial contamination on non-porous surfaces (e.g., metal, glass). Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, and available surface area. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, migration pathways and available surface area. Suggested sampling points include process vessels, ventilation ducts and fans, exposed beams, windowpanes, etc. The area wiped should be large enough to provide a sufficient amount of sample for analysis (smaller sample volumes cause higher detection limits).

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

**3.1** To facilitate the collection of a wipe sample, a 3” x 3” gauze pad should be utilized. The use of filter paper for wipe sampling is not recommended. Filter paper will tend to rip and crumble if the surface wiped is slightly rough. If filter paper is to be used, it should be 4” diameter heavy gauge paper, such as Whatman #4 Filter Paper.

**3.2** Occasionally samples are desired from painted or waxed surfaces. Since hexane may degrade the finish or pick up interfering substances, an alternate solvent should be used. In this case, methanol or distilled/deionized water for semi-volatiles, pesticides and PCBs and distilled and deionized water alone for metals should be used. Surface interference should be recorded in the field logbook.

When samples are submitted for analysis, the laboratory should be instructed to rinse the sample jars with the appropriate extraction or digestion solvent, depending on the analysis to be performed, when transferring the sample to the extraction/digestion glassware. This will ensure that the entire sample has been removed from the sample container.

## 4.0 Equipment and Materials

To collect a chip sample, the following equipment is needed:

- Ruler or measuring tape
- Disposable nitrile gloves, safety glasses, and other PPE required in the site-specific HASP.
- Sterile, wrapped, 3” x 3” gauze pad
- Glass sample containers with appropriate pesticide-grade solvent or distilled/deionized water
- Field logbook and pen with indelible ink

## 5.0 Procedures

**5.1** Mark off the sample collection location. It is recommended that an area be premeasured (e.g. 25 cm x 25 cm) to allow for easier calculation of the final results. However, this is not always feasible and may be done after the area is wiped.

**5.2** Don safety glasses, a new pair of disposable gloves, and any other PPE required in the site-specific HASP.

**5.3** Remove the gauze pad from its sterile wrapping and soak it with the appropriate solvent. The solvent of choice may change based upon the analytes of interest and surface being sampled. Gauze pads for semi-volatiles, pesticide and PCB samples should be moistened in a 1:4 acetone/hexane mixture and those for metals with distilled/deionized water. The gauze pad should be soaked and excess squeezed out immediately before the collection of each sample. **Use of presoaked pads is not acceptable.** Alternate solvents may be acceptable for certain parameters, however, their approval for use will be at the discretion of NJDEP.

**5.4** Wipe the entire area to be sampled once in the horizontal direction and once in the vertical direction, applying moderate pressure. Wipe the entire area so that all the sample material is picked up.

**5.5** Place the gauze pad into the sample container.

**5.6** Repeat the process for each location to be sampled. Outer gloves must be changed before each sample is collected.

**5.7** A blank must always be collected for each wipe-sampling event at the frequency specified in the QAPP and/or Work Plan in order to ensure the quality of the data. The blank will help to identify potential introduction of contaminants from the pad, solvent, sample container or ambient air conditions. Collect the wipe blank as follows:

- Don a new pair of nitrile gloves
- Wet a gauze pad with the solvent or distilled/deionized water (for each collection parameter) and place the pad directly into the sample bottle.

## 6.0 Quality Assurance / Quality Control

**6.1** Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

**6.2** Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

## 7.0 Data and Records Management

**7.1** All data and information (e.g., sample collection method used) must be documented on field data sheets or within site log books with permanent ink.

**7.2** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.3** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

# Project Operating Procedure

---

# Concrete Core Sampling

Procedure Number: PPG 012

Revision No.: 0

Revision Date: April 2010

| | |
|---|---|
| POP Author | Date: |
| Project Manager | Date: |

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Concrete Core Sampling

## Contents

# Project Operating Procedure

# Concrete Core Sampling

POP No.: PPG 012
Revision: 0
Date: April 2010

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) defines the procedure that will be used for the collection of concrete core samples. Selected concrete cores will be removed from floor slabs, foundations, and other concrete structures. Subsamples of the cores will be obtained at various depth intervals using the procedure described hereinafter.

**1.2** A carbide drill bit attached to a rotary hammer will be used to obtain cuttings from a solid core. The cuttings are taken from the side of the core at selected intervals, based on visual evidence of chromium or other criteria (such as depth). Cores containing a thin band (<0.25 inch) of chromium at the bottom, will be chip sampled using a beryllium chisel. If the core disintegrates during sampling, the remaining portions will be pulverized with a beryllium hammer to obtain a representative sample.

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

**3.1** Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

## 4.0 Equipment and Materials

- Decontaminated carbide drill bit, 1 inch to 2 inch in diameter and approximately six inches in length;
- Power rotary hammer;
- Decontaminated beryllium copper or stainless steel chisel;
- Hammer;
- Engineers rule;
- Bristle brush, dedicated;
- Decontaminated glass bowl;

- Decontaminated/dedicated polyethylene or Teflon spoon;
- Polyethylene sheeting;
- Disposable nitrile gloves;
- Safety glasses; and
- Field logbook and pen with indelible ink

## 5.0 Procedures

**5.1** Photograph, in color, the core from the top, bottom and side. Record the photograph number in the field logbook. Sketch the specifics of each core (dimensions, staining,etc) in the field logbook.

**5.2** Brush the loose dirt from the bottom of the core.

**5.3** Measure the dimensions of the core to be sampled and select the sample intervals for the collection of the drill cuttings. Sketch specifics of the sample intervals in the field logbook.

**5.4** Beginning at the top of the core, drill holes around the perimeter at the first sampling interval and collect the cuttings on the polyethylene sheeting or in the glass bowl. Drill each hole approximately 3/8ths of the way through the core and stop. Rotate the core 90 degrees and drill again. Continue drilling holes around the perimeter of the core until enough sample cuttings are produced to sufficiently fill the sample collection jar for the analyses requested.

If the core breaks during drilling, collect the remaining portion of that interval with a dedicated beryllium chisel and hammer, and pulverize the chips on new polyethylene sheeting. The final pieces should be no larger than 1 centimeter in diameter.

**5.5** Transfer the sample cuttings from the sheeting or bowl to the sampling jar with a polyethylene or Teflon spoon.

**5.6** Repeat the process for each interval. Use new or decontaminated equipment at each interval. Outer gloves must be changed before each sample is collected.

**5.7** Decontaminate the sampling equipment in accordance with POP PPG 014 Decontamination of Field Equipment.

## 6.0 Quality Assurance / Quality Control

**6.1** Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

**6.2** Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

## 7.0 Data and Records Management

**7.1** All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site log books with permanent ink.

**7.2** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.3** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

POP PPG 014 Decontamination of Field Equipment

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | April 2010 | Original POP |

AECOM

# Project Operating Procedure

---

# Sweep Sampling

Procedure Number: PPG 013

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen Wooley

Date: 6/28/2010

Project Manager

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Sweep Sampling

## Contents

# Project Operating Procedure

# Sweep Sampling

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) defines the procedures for the collection of sweep samples to determine surficial contamination on porous (e.g., asphalt) or non-porous (e.g., metal) surfaces. These procedures are intended for samples to be analyzed for non-volatile analyses (e.g., PCBs, TCDD, and TCDF), and should not be used for volatile organic compound (VOC) analysis. Sweep sampling allows collection of dust/residue samples that may help in the assessment of contaminant determination and delineation. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, migration pathways and available surface area. Suggested sampling points include ventilation systems where dust can collect, floor surfaces near process vessels and storage tanks, or street gutters where contaminated sediments may have migrated and accumulated. The area sampled should be large enough to provide a sufficient amount of sample for analysis.

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

**3.1** Cross contamination from sampling equipment will be prevented by using dedicated sampling equipment and/or sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

## 4.0 Equipment and Materials

To collect a sweep sample, the following equipment is needed:

- Disposable nitrile gloves, safety glasses, and other PPE required in the site-specific HASP.
- Dedicated natural bristle brush
- Stainless steel spatula or dedicated spatula
- Dust pan lined with aluminum foil or one that is dedicated, decontaminated and constructed of a pre-approved material which will not interfere with the contaminants of concern

- Glass sample containers
- Field logbook and pen with indelible ink
- Camera (optional)

## 5.0 Procedures

**5.1** Identify the location to be sampled and document its description in the field log book or field data sheets. If necessary, take a picture of the location.

**5.2** Don safety glasses, a new pair of disposable gloves, and any other PPE required in the site-specific HASP.

**5.3** Using the dedicated natural bristle brush, sweep all residue in the area to be sampled into a decontaminated or dedicated dustpan.

**5.4** Use the decontaminated stainless steel or dedicated spatula to transfer the sample from the dustpan to the sample bottle(s).

**5.5** Repeat the process for each location to be sampled. Use dedicated or decontaminated equipment at each location. Outer gloves must be changed before each sample is collected.

**5.1** Decontaminate the sampling equipment in accordance with POP PPG 014 Decontamination of Field Equipment.

## 6.0 Quality Assurance / Quality Control

**6.1** Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

**6.2** Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

## 7.0 Data and Records Management

**7.1** All data and information (e.g., sample collection method used) must be documented on field data sheets or within site log books with permanent ink.

**7.2** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.3** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

POP PPG 014 Decontamination of Field Equipment

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

AECOM

# Project Operating Procedure

---

# Decontamination of Field Equipment

Procedure Number: PPG 014

Revision No.: 0

Revision Date: June 2010

Date: 6/28/2010

POP Author

Kathleen Woolley

Date: 6/28/2010

QA Reviewer

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Decontamination of Field Equipment

POP No.: PPG 014
Revision: 0
Date: June 2010

## Contents

# Project Operating Procedure

# Decontamination of Field Equipment

POP No.: PPG 014
Revision: 0
Date: June 2010

## 1.0 Project Scope and applicability

### 1.1 Purpose and Applicability

This POP describes the methods to be used for the decontamination of field equipment used in the collection of environmental samples. The list of field equipment may include a variety of items used in the collection of soil and/or water samples, such as split-spoon samplers, trowels, scoops, spoons, bailers and pumps. Heavy equipment such as drill rigs and backhoes also require decontamination, usually in a specially constructed temporary decontamination area.

Decontamination is performed as a quality assurance measure and a safety precaution. Improperly decontaminated sampling equipment can lead to misinterpretation of environmental data due to interference caused by cross-contamination. Decontamination protects field personnel from potential exposure to hazardous materials. Decontamination also protects the community by preventing transportation of contaminants from a site.

This POP emphasizes decontamination procedures to be used for decontamination of reusable field equipment. Occasionally, dedicated field equipment such as well construction materials (well screen and riser pipe) or disposable field equipment (bailers or other general sampling implements) may also require decontamination prior to use. The project-specific work plan should indicate the specific decontamination requirements for a particular project.

Respective state or federal agency (regional offices) regulations may require specific types of equipment or procedures for use in decontamination of field equipment. The project manager should review the applicable regulatory requirements, if any, prior to the start of the field investigation program.

### 1.2 General Principles

Decontamination is accomplished by manually scrubbing, washing, or spraying equipment with detergent solutions, tap water, distilled/deionized water, steam and/or high pressure water, or solvents. The decontamination method and agents are generally determined on a project-specific basis and must be stated in the Quality Assurance Project Plan (QAPP) and/or Work Plan.

Generally, decontamination of equipment is accomplished at each sampling site between collection points. Waste decontamination materials such as spent liquids and solids will be collected and managed as investigation-derived waste for later disposal. All decontamination materials, including wastes, should be stored in a central location so as to maintain control over the quantity of materials used or produced throughout the investigation program.

## 2.0 Health and safety considerations

Decontamination procedures may involve chemical exposure hazards associated with the type of contaminants encountered or solvents employed and may involve physical hazards associated with decontamination equipment. When decontamination is performed on equipment which has been in contact with hazardous materials or when the quality assurance objectives of the project require decontamination with chemical solvents, the measures necessary to protect personnel must be addressed in the project Health and Safety Plan (HASP). This plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing equipment decontamination, and must be adhered to as field activities are performed.

## 3.0 Interferences

Improper decontamination can result is sample contamination and affect the accuracy of data.

## 4.0 Equipment and materials

- Decontamination agents (per work plan requirements):
  - LIQUI-NOX, ALCONOX, or other phosphate-free biodegradable detergent,
  - Tap water,
  - Distilled/deionized water,
  - Nitric acid and/or hydrochloric acid,
  - Methanol and/or hexane, acetone, isopropanol.
- Health and Safety equipment
- Chemical-free paper towels
- Waste storage containers: drums, 5-gallon pails w/covers, plastic bags
- Cleaning containers: plastic buckets or tubs, galvanized steel pans, pump cleaning cylinder
- Cleaning brushes
- Pressure sprayers
- Squeeze bottles
- Plastic sheeting
- Aluminum foil
- Field logbook and pen with indelible ink

## 5.0 Procedures

### 5.1 General Preparation

**5.1.1** It should be assumed that all sampling equipment, even new items, are contaminated until the proper decontamination procedures have been performed on them or unless a certificate of analysis is available which demonstrates the items cleanliness.

Field equipment that is not frequently used should be wrapped in aluminum foil, shiny side out, and stored in a designated "clean" area. Small field equipment can also be stored in plastic bags to eliminate the potential for contamination. Field equipment should be inspected and decontaminated prior to use if the equipment appears contaminated and/or has been stored for long periods of time. Unless customized procedures are stated in the QAPP and/or Work Plan for decontamination of equipment, the standard procedures specified in this POP shall be followed.

**5.1.2** Establish the decontamination station within an area that is convenient to the sampling location. If single samples will be collected from multiple locations, then a centralized decontamination station, or a portable decontamination station should be established.

**5.1.3** An investigation-derived waste (IDW) containment station should be established at this time also. The project-specific work plan should specify the requirements for IDW containment. In general, decontamination solutions are discarded as IDW between sampling locations. Solid waste is disposed of as it is generated.

**5.2** Sampling conducted using bailers

**5.2.1** Field decontamination of bailers will not be conducted on this project. Only dedicated disposable bailers or laboratory decontaminated bailers will be used for sample collection in accordance with the FSPM.

**5.3** Decontamination for Organic Analyses

**5.3.1** This procedure applies to soil sampling and groundwater sampling equipment used in the collection of environmental samples submitted for organic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items. Submersible pump decontamination procedures are outlined in Section 5.4.

**5.3.2** Decontamination is to be performed before sampling events and between sampling points.

**5.3.3** After a sample has been collected, remove all gross contamination from the equipment or material by brushing and then rinsing with available tap water. This initial step may be completed using a 5-gallon pail filled with tap water. Steam or a high-pressure water rinse may also be conducted to remove solids and/or other contamination.

**5.3.4** Wash the equipment with a phosphate-free detergent and tap water solution. This solution should be kept in a 5-gallon pail with its own brush.

**5.3.5** Rinse with tap water or distilled/deionized water until all detergent and other residue is washed away. This step can be performed over an empty bucket using a squeeze bottle or pressure sprayer.

**5.3.6** Rinse with methanol or other appropriate solvent using a squeeze bottle or pressure sprayer. Rinsate should be collected in a waste bucket.

**5.3.7** Rerinse with deionized water to remove any residual solvent. Rinsate should be collected in the solvent waste bucket.

**5.3.8** Allow the equipment to air-dry in a clean area or blot with chemical-free paper towels before reuse. Wrap the equipment in tin foil and/or seal it in a plastic bag if it will not be reused for a while.

**5.3.9** Dispose of soiled materials and spent solutions in the designated IDW disposal containers.

**5.4** Decontamination for Inorganic (Metals) Analyses

**5.4.1** This procedure applies to soil sampling equipment used primarily in the collection of environmental samples submitted for inorganic constituents analysis. Examples of relevant items of equipment include split-spoons, trowels, scoops/spoons, bailers, and other small items.

**5.4.2** For plastic and glass sampling equipment, follow the steps outlined in 5.2 above, however, use a 10% nitric acid solution (acid in water) in place of the solvent rinse.

**5.4.3** For metal sampling equipment, follow the steps outlined in 5.2 above, however, use a 10% hydrochloric acid solution (acid in water) in place of the solvent rinse.

**5.5** Decontamination of Submersible Pumps

**5.5.1** This procedure will be used to decontaminate submersible pumps before and between ground-water sample collection points. This procedure applies to both electric submersible and bladder pumps. This procedure also applies to discharge tubing if it will be reused between sampling points.

**5.5.2** Prepare the decontamination area if pump decontamination will be conducted next to the sampling point. If decontamination will occur at another location, the pump and tubing may be removed from the well and placed into a clean trash bag for transport to the decontamination area. Pump decontamination is easier with the use of 3-foot tall pump cleaning cylinders (i.e., Nalgene cylinder) for the various cleaning solutions, although the standard bucket rinse equipment may be used.

**5.5.3** Sample tubing shall not be decontaminated in the field. Only dedicated tubing will be used for each well and disposed of upon completion of well sampling.

**5.5.4** Once the decontamination station is established, the pump should be removed from the well and the discharge tubing and power cord coiled by hand as the equipment is removed. If any of the equipment needs to be put down temporarily, place it on a plastic sheet (around well) or in a clean trash bag. If a disposable discharge line is used it should be removed and discarded at this time.

**5.5.5** As a first step in the decontamination procedure, use a pressure sprayer with tap water to rinse the exterior of the pump, discharge line, and power cord as necessary. Collect the rinsate and handle as IDW.

**5.5.6** Cut a short piece of dedicated tubing and attach it to the pump. Place the pump into a pump cleaning cylinder or bucket containing a detergent solution (detergent in tap water). Bend the tubing so that decontamination fluids can be recirculated back into the bucket. Holding the tubing/power cord, pump solution through the pump system. A minimum of one gallon of detergent solution should be pumped through the system. Collect the rinsate and handle as IDW.

**5.5.7** Place the pump into another cylinder/bucket containing a 10% solution of solvent (methanol, or other designated solvent) in distilled/deionized water. Bend the tubing so that decontamination fluids can be recirculated back into the bucket. Pump until the detergent solution is removed in accordance with the NJDEP FSPM, Chapter 2A, Section 2.4.4, page 17. Circulate the rinse solution for three or more system cycles. Collect the rinsate and handle as IDW.

**5.5.8** Place the pump into another cylinder/bucket containing distilled/deionized water. Bend the tubing so that decontamination fluids can be recirculated back into the bucket. Pump a minimum of 3 to 5 pump system volumes (pump and tubing) of water through the system. Vary the pump speed during decontamination and briefly raise the pump to introduce air during the decontamination procedure. Collect the rinsate and handle as IDW.

**5.5.9** Remove the pump from the cylinder/bucket and if the pump is reversible, place the pump in the reverse mode to discharge all removable water from the system. If the pump is not reversible the pump and discharge line should be drained by hand as much as possible. Collect the rinsate and handle as IDW.

**5.5.10** Refill the cylinder/bucket with clean potable water and run pump for 3 to 5 pump system volumes. Collect the rinsate and handle as IDW. Then, using a pressure sprayer with distilled/deionized water, rinse the exterior of the pump, discharge line, and power cord thoroughly, shake all excess water, then place the pump system into a clean trash bag for storage. If the pump system will not be used again right away, the pump itself should also be wrapped with aluminum foil before placing it into the bag.

**5.6** Decontamination of Bladder Pumps

**5.6.1** Most bladder pumps cannot be easily decontaminated in the field due to their unique construction. For that reason, bladder pumps are not employed on a well-to-well basis **unless** they are constructed with easy to clean parts and *disposable* bladders. If they are constructed with disposable bladders, proper decontamination should include removal, disposal, and replacement of the used bladder and a thorough eight-step decontamination procedure. Field cleaning of bladder pumps is acceptable only if the following conditions are met: 1) the bladder pump housing is constructed of stainless steel with an internal disposable bladder and 2) either the eight-step, Cold Regions decontamination method or the ultra clean decontamination method is employed as discussed in the NJDEP FSPM.

**5.7** Decontamination of Peristaltic Pumps

**5.7.1** A peristaltic pump is a self-priming suction lift (negative air pressure) pump utilized at the ground surface, which consists of a rotor with ball bearing rollers. One end of dedicated tubing is inserted into the well. The other end is attached to a short length of flexible tubing, which has been threaded around the rotor, out of the pump, and connected to a discharge tube. The liquid moves totally within the tubing, thus no part of the pump contacts the liquid. Tubing used for well evacuation may also be used for sample collection. Teflon®-lined polyethylene tubing is recommended for sampling. Tubing will be discarded and properly disposed of after each sample is collected.

**5.8** Decontamination of Large Equipment

**5.8.1** Consult the QAPP and/or Work Plan for instruction on the location of the decontamination station and the method of containment of the wash solutions. On large projects usually a temporary decontamination facility (decontamination pad) is required which may include a membrane-lined and bermed area large enough to drive heavy equipment (drill rig, backhoe) onto with enough space to spread other equipment and to contain overspray. Usually a small sump with pump is necessary to collect and contain rinsate. A water supply and power source is also necessary to run steam cleaning and/or pressure washing equipment.

**5.8.2** Upon arrival and prior to leaving a sampling site, all heavy equipment such as drill rigs, trucks, and backhoes should be thoroughly cleaned and then the parts of the equipment which come in contact or in close proximity to sampling activity should be decontaminated. This can be accomplished in two ways, steam cleaning or high pressure water wash and manual scrubbing. Following this initial cleaning, only those parts of the equipment which come in close proximity to the sampling activities (i.e., auger stems, rods, backhoe bucket) must be decontaminated in between sampling events.

**5.8.3** Occasionally, well construction materials such as well screen and riser pipe may require decontamination before the well materials are used. These materials may be washed in the decontamination pad, preferably on a raised surface above the pad (i.e., on sawhorses), with clean plastic draped over the work surfaces. Well materials usually do not require a multistep cleaning process as they generally arrive clean from the manufacturer. Usually, a thorough steam-cleaning of the interior/exterior of the well materials will be sufficient. The QAPP and/or Work Plan should provide specific guidance regarding decontamination of well materials.

## 6.0 Quality assurance / quality control

### **6.1** General Considerations

Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP. The QAPP guidelines typically require collection of equipment blank samples in order to determine the effectiveness of the decontamination procedure.

The decontamination method, solvent, frequency, location on site and the method of containment and disposal of decontamination wash solids and solutions are dependent on site logistics, site-specific chemistry, and nature of the contaminated media to be studied and the objectives of the study. Each topic must be considered and addressed during development of a decontamination strategy and should be outlined in the QAPP and/or Work Plan.

### **6.2** Solvent Selection

There are several factors which need to be considered when deciding upon a decontamination solvent. The solvent should not be an analyte of interest. The sampling equipment must be resistant to the solvent. The solvent must be evaporative or water soluble or preferably both. The applicable regulatory agency may have specific requirements regarding decontamination solvents. The QAPP and/or Work Plan should specify the type of solvent to be used for a particular project.

The analytical objectives of the study must also be considered when deciding upon a decontamination solvent. Pesticide-grade methanol is the solvent of choice for general organic analyses. It is relatively safe and effective. Hexane, acetone, and isopropanol are sometimes used as well. A 10% nitric acid in deionized water solution is the solvent of choice for general metals analyses. Nitric acid can be used only on Teflon, plastics and glass. If used on metal equipment, nitric acid will eventually corrode the metal and lead to the introduction of metals to the collected samples. Dilute hydrochloric acid is usually preferred over nitric acid when cleaning metal sampling equipment.

Equipment decontamination should be performed a safe distance away from the sampling area so as not to interfere with sampling activities but close enough to the sampling area to maintain an efficient working environment. If heavy equipment such as drill rigs or backhoes are to be decontaminated, then a central decontamination station should be constructed with access to a power source and water supply.

### **6.3** Field Blank Sample Collection

General guidelines for quality control check of field equipment decontamination usually require the collection of one field blank from the decontaminated equipment per day. The QAPP should specify the type and frequency of collection of each type of quality assurance sample.

Field blanks are generally made by pouring laboratory-supplied deionized water into, over, or through the freshly decontaminated sampling equipment and then transferring this water into a sample container. Field blanks should then be labeled as a sample and submitted to the laboratory to be analyzed for the same parameters as the associated sample. Field blank sample numbers, as well as collection method, time and location should be recorded in the field notebook.

## 7.0 Data and records management

Specific information regarding decontamination procedures should be documented in the project-specific field notebook. Documentation within the notebook should thoroughly describe the construction of each decontamination facility and the decontamination steps implemented in order to show compliance with the project work plan. Decontamination events should be logged when they occur with the following information documented:

- Date, time and location of each decontamination event
- Equipment decontaminated
- Method
- Solvents
- Notable circumstances
- Identification of field blanks and decontamination rinsates
- Method of blank and rinsate collection
- Date, time and location of blank and rinsate collection
- Disposition of IDW

Repetitive decontamination of small items of equipment does not need to be logged each time the item is cleaned.

## 8.0 Personnel qualifications and training

All sampling technicians performing decontamination must be properly trained in the decontamination procedures employed, the project data quality objectives, health and safety procedures and the project QA procedures. Specific training or orientation will be provided for each project to ensure that personnel understand the special circumstances and requirements of that project. Field personnel should be health and safety certified as specified by OSHA (29 CFR 1910.120(e)(3)(i)) to work on sites where hazardous materials may be present.

### **8.1** Sampling Technician

It is the responsibility of the sampling technician to be familiar with the decontamination procedures outlined within this POP and with specific quality assurance, and health and safety requirements outlined within project-specific work plans (HASP, QAPP, Work Plan, etc.). The sampling technician is responsible for decontamination of field equipment and for proper documentation of decontamination activities. The sampling technician is also responsible for ensuring that decontamination procedures are followed by subcontractors when heavy equipment requires decontamination.

### **8.2** Field Project Manager

The field project manager is responsible for ensuring that the required decontamination procedures are followed at all times. The project manager is also responsible for ensuring that subcontractors construct and operate their decontamination facilities according to project specifications. The project manager is responsible for collection and control of IDW in accordance with project specifications.

## 9.0 References

Not applicable.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

AECOM

Project Operating Procedure

---

# Procedures for Acid Testing of Green-Gray Mud and COPR

Procedure Number: PPG 015

Revision No.: 0

Revision Date: March 19, 2010

Date: March 19, 2010

POP Author

Craig W. MacPhee

Date: March 19, 2010

Project Manager

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

# Procedures for Acid Testing of Green-Gray Mud and COPR

POP No.: PPG 015
Revision: 0
Date: March 19, 2010
Page i of i

## Contents

Project Operating Procedure

# Procedures for Acid Testing of Green-Gray Mud and COPR

POP No.: PPG 015
Revision: 0
Date: March 19, 2010

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) is for acid testing of material suspected to be Green-Gray Mud or chromite ore processing residue (COPR). This procedure will be used on material that cannot be definitively identified as Green-Gray Mud or COPR through other techniques (e.g., visual, magnetic, XRF). The results of the procedure will be used as part of a weight-of-evidence approach to determine whether the material in question is Gray/green mud or COPR.

High levels of calcium (i.e., percent levels) are expected in Green-Gray Mud and possibly COPR. Hydrochloric acid (HCl) will be used in a controlled manner to determine if the suspected material contains calcium and is potentially Green-Gray Mud or COPR. The HCl will be added to the suspected material in a drop-wise manner and the material will be observed for a reaction.

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

**2.2** Due to the use of hydrochloric acid (HCl) this procedure, field personnel will be required to wear safety glasses and gloves when performing this procedure. The plastic dropper bottle for the HCl must be stored in a plastic container that is lined with acid neutralizing sorbent paper. The plastic container and dropper bottle must be labeled as HCl and also have a United Nations (UN) 1789 label (Figure 1). Refer to the job safety analysis (JSA) for this activity in the site-specific HASP for more detail.

## 3.0 Interferences

**3.1** Soils that contain carbonate salts/minerals other than calcium will also react with the HCl and may lead to false conclusion that calcium is present.

## 4.0 Equipment and Materials

- 16 ounce (oz) clear glass jars

- Labeled plastic dropper bottle containing 1:1 HCl (i.e., 6 normal [N] HCl)
- Labeled plastic storage container lined with acid neutralizing sorbent paper for plastic dropper bottle
- Extra acid neutralizing sorbent paper for spills
- Plastic scoop
- Nitrile gloves
- Safety glasses
- Field logbook and pen
- Site HASP
- Project Feasibility Study Work Plan (FSWP)
- Camera (optional)

## 5.0 Procedures

**5.1** Don safety glasses and nitrile gloves as instructed in the site-specific HASP.

**5.2** Use the plastic scoop to transfer a small amount (e.g., 5-10 grams) of the suspected material into a 16 oz clear glass jar.

Remove the plastic dropper bottle from its plastic storage container. Carefully open the dropper bottle and drop 2-3 drops of HCl onto the suspected material in the 16 oz clear glass jar. Observe the material for any reaction. If calcium or other carbonate salts/minerals are present, effervescing/foaming should occur. Observe the material for approximately 30 seconds and record the observations in the field logbook. If necessary, a camera can be used to photodocument the presence or absence of a reaction.

**5.3** Once the test is complete, replace the cap on the dropper bottle, and return the dropper bottle to its plastic storage container.

**5.4** Wait for any reaction that is occurring to subside, and dispose of the material in the soil stockpile.

**5.5** Rinse the 16 oz clear glass jar and dispose of the rinse water in accordance with the investigative derived waste (IDW) procedures for the site.

## 6.0 Quality Assurance / Quality Control

**6.1** The field notes generated from this procedure will be reviewed by the sampling team leader, project manager, or designee.

## 7.0 Data and Records Management

**7.1** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.2** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** Each person who performs this procedure will be trained by someone familiar with the procedure such that the procedure is performed in a consistent manner throughout the duration of the project. No field staff will perform this procedure without one-on-one training from another field staff that is familiar with the procedure.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | March 2010 | Original POP |

**Figure 1 – UN 1789 Label**

AECOM

Project Operating Procedure

---

# Wet Sieve for Grain Size Analysis for Soils with Chromium Procedures

Procedure Number: PPG 016

Revision No.: 0

Revision Date: June 2010

Kristen E Streit

Kristen Streit POP Author

Date: 6/29/2010

Craig W. MacPhee

Project Manager

Date: 6/29/2010

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: ________ Date: ________

Initials: ________ Date: ________

# Project Operating Procedure

# Wet Sieve

POP No.: PPG 016
Revision: 0
Date: June 2010

## Contents

# Project Operating Procedure

# Wet Sieve

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) defines basic techniques for field screening of wet soil to determine the percent by weight of COPR particles and grain size. Sieving will be done wet to avoid generation of dust.

## 2.0 Health and Safety Considerations

**2.1** The work will be conducted in accordance with the site specific HASP and the Job Safety Analysis. This procedure is specifically designed to prevent dusty conditions during soil handling. Due to the possibility of release of volatile organics and contamination of equipment, soil with MGP material and/or photoionizing detector readings over 10 ppm will not be processed.

## 3.0 Interferences

**3.1** Debris (twigs, roots, trash, etc) that is not removed from the soil prior to and during screening can lead to high bias in the amount for each screen. The addition of water may slightly increase the estimated weight of COPR nodules. The goal is to measure weight percent COPR to ±5%.

## 4.0 Equipment and Materials

- 5-gallon buckets
- 5-gallon bucket with holes drilled and lined with fine mesh
- 2-4 bricks
- Level D PPE with tyvek suit with booties and nitrile gloves
- Ear plugs
- Half face respirator (in the case of exceedence of air action levels)
- Scale capable of weighing at least 50 lbs ± 0.1 pounds
- Shovel
- 2”, 1”, ½”, ¼” and No. 7 sieve screens

- Additional screens No. 14 and No. 200
- Plastic tubs ( One 14-gallon tub and at least 10 smaller tubs)
- Munsell color chart
- Field Screening for Grain Size Field Form (Attachment 1)
- Field logbook and pen
- Site HASP
- Work Plan
- Screen Shaker
- Camera (optional)

## 5.0 Procedures

**5.1** Prior to initiation of sieving prepare the following equipment:

**5.1.1** A 5-gallon bucket with holes and mesh. Drill small diameter holes (3/8") in the bottom on the sides of a 5-gallon bucket. Adhere a fine mesh (No. 200) to the bottom and sides of the inside of the bucket. Make sure the mesh is smaller than the smallest tray being used in the shaker.

**5.1.2** Obtain two dedicated plastic containers for each sieve tray. Weigh each container and note the weight in both the field book and on the container. For each sieve size mark two plastic containers with the sieve size. You should have two plastic containers for each sieve size; one for the entire sieve size and one for chromium nodules.

**5.1.3** Place the sieve machine in a bermed area on a plastic sheet.

**5.2** Don the modified Level D PPE including tyvek suit with booties, nitrile gloves and hearing protection as instructed by the site-specific HASP.

**5.3** Inspect the five gallon bucket prior to processing. Each bucket should have a grid designation and a depth interval. These should be noted on the sieve collection form. Review the soil classification data sheet. If the sample contains MGP material or PID readings over 10 ppm, do not process and call the project manager.

**5.4** Place the 5-gallon bucket on the scale and record the weight on the field form.

**5.5** Soil will be collected from the excavation under a separate POP (see the Sample Collection POP for details).

**5.6** Weight the bucket containing the soil and record the weight on the field form.

**5.7** Fill the bucket with water so that it covers the soil. Allow the soil to soak in the water for at least 15 minutes to allow soil to soften.

**5.8** Place two bricks in the bottom of a 14 gal or greater plastic tub. Place the 5-gallon bucket with holes and mesh on top of the bricks.

**5.9** Transfer the soil and water that has been soaking in the bucket into the 5-gallon bucket with holes. Allow the water to drain from the bucket but make sure the soil does not dry out. Make sure the bottom of the bucket is not sitting in standing water (add more bricks if necessary to insure the bucket is out of the water).

**5.10** Dispose of the water in the frac tanks for off-site disposal.

**5.11** Weigh the filled 5-gallon bucket and record the weight on the field form. Subtract the initial weight of the bucket to determine the actual soil (and water) weight.

**5.12** Pour the contents of the 5-gallon bucket into the top of the Gilson Porta-Screen. If the sample weight was greater than 60 lbs. only pour half of the soil into the shaker at a time. If the sample is split be sure to combine the total at the end. **Follow the instructions provided by Gilson when operating the shaker** (Attachment 2).

**5.13** Transfer the contents of each tray into a separate pre-weighed dedicated grain size container. Weigh and record the weight on the field form making sure to subtract the container weight.

**5.14** Sort through each container and pull out the chromium nodule. Place the chromium nodules in another pre-weighed container. Once all the chromium nodules are separated from the soil, weigh and record the weight of each chromium nodule container making sure to subtract the container weight. COPR nodules are typically round and 1/8 to ¼ inch in size. Large particles and irregular shapes are possible. Suspect nodules can be scrapped or crushed for closer examination. Compare visual clues to sample COPR pellets.

**5.15** Calculate percent weight of COPR by the following equation:

Total weight of COPR pellets / Weight lf soil tested (prior to wetting) x 100%

**5.16** Dispose of soil and chromium nodules in the soil stockpile for off-site disposal.

## 6.0 Quality Assurance / Quality Control

**6.1** The field forms and field notes generated from this procedure will be reviewed by the sampling team leader, project manager, or designee.

## 7.0 Data and Records Management

**7.1** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.2** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** Each person who performs this procedure will be trained by someone familiar with the procedure such that the procedure is performed in a consistent manner throughout the duration of the project. No field staff will perform this procedure without one-on-one training from another field staff that is familiar with the procedure.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

ASTM, 1993, Standard Practice for Wet Preparation of Soil Samples for Particle Analysis and Determination of Soil Constants D 2217-85

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

## Attachment 1

## Soil Sieve Data Form

Date ____________

Staff ________________________________________________

Grid ID ___________________________ Depth Interval___________________________________

Does the sample contain MGP material or have a PID reading over 10 ppm Y/N **(if yes to either of these questions do not process and call the project manager)**

a. 5-gal bucket weight without soil ____________

b. 5-gal bucket and soil weight________________

c. Soil weight (b-a) ______________

d. 5-gal bucket and soil weight after soaking in water ________________

e. Wet soil weight (d-a)________________

**f. Empty plastic container weight (Soil and COPR container)**

2" material ____________ 1" material ___________ ½" material ___________

1/4" material ____________ No. 7 material ___________ No. 200 material__________

**g. Empty plastic container (COPR container)**

2" material ____________ 1" material ___________ ½" material ___________

1/4" material ____________ No. 7 material ___________ No. 200 material__________

**h. Plastic container with soil and COPR**

2" material ____________ 1" material ___________ ½" material ___________

1/4" material ____________ No. 7 material ___________ No. 200 material__________

**i. Soil and COPR weight (h-f)**

2" material ____________ 1" material ___________ ½" material ___________

1/4" material ____________ No. 7 material ___________ No. 200 material__________

**j. Plastic container with COPR weight**

2” material ____________ 1” material ___________ ½” material ___________

1/4” material ____________ No. 7 material ___________ No. 200 material__________

**k. COPR weight (j-g)**

2” material ____________ 1” material ___________ ½” material ___________

1/4” material ____________ No. 7 material ___________ No. 200 material__________

**l. Total COPR weight (∑k)** ___________

**m. Total COPR percent (l/e*100)**___________

**n. Grain size percentage (soil and COPR) (i/e * 100)**

2” material ____________ 1” material ___________ ½” material ___________

1/4” material ____________ No. 7 material ___________ No. 200 material__________

**o. COPR percentage by grain size (k/l*100)**

2” material ____________ 1” material ___________ ½” material ___________

1/4” material ____________ No. 7 material ___________ No. 200 material__________

Notes:____________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________

# Attachment 2

## Gilson Porta-Screen Operating Manual

# OPERATING MANUAL

## Gilson Porta-Screen®

## PS-3 & PS-4

02/23/2010

**PHONE:** 800-444-1508
740-548-7298

P.O. Box 200, Lewis Center, Ohio 43035-0200
**E-mail:** customerservice@gilsonco.com **Website:** www.globalgilson.com

**FAX:** 800-255-5314
740-548-5314

# SAFETY INSTRUCTIONS
# GILSON PORTA-SCREEN®

WHETHER YOU ARE THE OWNER, EMPLOYER, OPERATOR, OR MAINTENANCE PERSON FOR THIS MACHINE, SAFETY IS YOUR RESPONSIBILITY. YOU ARE RESPONSIBLE FOR OPERATING AND MAINTAINING THIS EQUIPMENT IN COMPLIANCE WITH THESE INSTRUCTIONS AND FOR USING COMMON SENSE. YOU SHOULD ALWAYS REVIEW AND COMPLETELY UNDERSTAND THESE SAFETY AND OPERATING INSTRUCTIONS BEFORE USING THIS MACHINE.

⚠ **DANGER**: This machine operates on electrical current. Improper use could result in electric shock, electrocution, injury by explosion, or even death.

1. **ALWAYS** make sure the motor and electrical components are appropriate and properly configured for your intended use and available power source. Porta-Screens are normally wired for 115 volts 60Hz and come with a 1/4 hp non-explosion-proof motor.

2. **ALWAYS** check electrical wiring for loose connections and for pinched or frayed wiring.

3. **ALWAYS** ground the Porta-Screen®. Connect its three-pronged plug to a properly-wired, three-pronged, grounded receptacle with appropriate electrical current for the machine.

4. **ALWAYS** disconnect and lock out the power supply before performing maintenance or repairs on your machine.

⚠ **DANGER**: The 1/4 hp, 115-volt motor of the Porta-Screen® has internal thermal protection. Therefore, the motor will automatically shut off if overloaded. The motor will restart by itself after cooling unless disconnected from its power source during cool-down.

⚠ **DANGER**: Do not use the Porta-Screen® in an explosive or hazardous atmosphere. It is not explosion-proof.

***Warning:*** Operate only in a properly-ventilated area.

***Warning:*** Level the Porta-Screen® before operation.

***Warning:*** Stop the Porta-Screen® if excessive vibration or machine movement occurs.

***Warning:*** Always take care not to pinch your fingers between the clamp levers and the machine frame.

***Warning:*** Do not operate without all guards and covers in place.

***Warning:*** Keep all parts of your body away from moving parts of the machine while it is operating.

***Warning:*** Do not wear loose clothing which might be caught in moving parts of the machine.

***Warning:*** Wear safety glasses, protective clothing, and hearing protection. Wear approved NIOSH/MSHA respirator as required by the sample to prevent your inhaling any dust which may be considered hazardous.

# Table of Contents

# Gilson Porta-Screen®

The Gilson Porta-Screen® is a portable shaker for field control of construction aggregates and for quality control in asphalt and ready-mix plants. It is designed for best separation in the 2" (50.8mm) to No. 16 (1.18mm) range. Model PS-3 holds five screen trays and a pan; PS-4's capacity is seven trays and a pan.

## 1.0 Unpacking & Installation

The Porta-Screen®, packed for shipment, weighs between 225 and 255 lbs, depending on the model and the number of trays packed inside. Use equipment to adequately to handle this weight safely.

1. The Porta-Screen® is shipped in a cardboard carton. Before you accept the shipment, check the carton for visible damage. Note any damage on the freight bill, and proceed with inspection.
2. Place the carton on its side so that you can remove the staples from the bottom. Open the bottom flaps and set the machine upright again. Lift off the carton and set it aside until you are sure that the Porta-Screen® is in acceptable condition.
3. Check the machine for shipping damage. If you find concealed damage after you have signed for the Porta-Screen®, call the delivering carrier immediately for an inspection. Save all packing materials, and leave the Porta-Screen® as it is.
4. Check the tag on the electric motor of the Porta-Screen® to be sure that the machine is wired as ordered.
5. Release clamping pressure on the Porta-Screen® trays by rotating the clamp levers outward and upward 180˚.
6. Remove trays by sliding them out the front of the machine.
7. Choose your operating site:

   A. The Porta-Screen® requires a properly-wired, three-pronged, grounded receptacle with appropriate electrical current for the machine.

   B. Choose a well-ventilated site.

   C. Set the Porta-Screen® on a solid, stable floor, platform, or other surface.

8. When you have placed the Porta-Screen® in its operating location, and each time you move it, level the unit by adjusting the three leveling legs.

   To extend a leg, place your foot on the edge of the pad, and lift up on the machine above the leg.

   To contract a leg, depress the leg lock tab, which extends from the case above each footpad.

   Use the bullseye level in the top frame crossbar as a guide.

   After you have placed the Porta-Screen® into service, observe the distribution of sample material in the trays at the end of a test. If the material is not evenly distributed, re-level the machine.

9. Reinstall the trays in the Porta-Screen®. Leave them unclamped.
10. Do not plug in the Porta-Screen® until you are ready to use it.

## 2.0 Operation

WHETHER YOU ARE THE OWNER, EMPLOYER, OPERATOR, OR MAINTENANCE PERSON FOR THIS MACHINE, SAFETY IS YOUR RESPONSIBILITY. YOU ARE RESPONSIBLE FOR OPERATING AND MAINTAINING THIS EQUIPMENT IN COMPLIANCE WITH THESE INSTRUCTIONS AND FOR USING COMMON SENSE. YOU SHOULD ALWAYS REVIEW AND COMPLETELY UNDERSTAND THESE SAFETY AND OPERATING INSTRUCTIONS BEFORE USING THIS MACHINE.

***Warning:*** Operate only in a properly ventilated area.

***Warning:*** Level the Porta-Screen® before operation.

***Warning:*** Stop the Porta-Screen® if excessive vibration or machine movement occurs.

***Warning:*** Always take care not to pinch your fingers between the clamp levers and the machine frame.

***Warning:*** Do not operate without all guards and covers in place.

***Warning:*** Keep all parts of your body away from moving parts of the machine while it is operating.

***Warning:*** Do not wear loose clothing which might be caught in moving parts of the machine.

***Warning:*** Wear safety glasses, protective clothing, and hearing protection. Wear approved NIOSH/MSHA respirator as required by the sample to prevent your inhaling any dust which may be considered hazardous.

**Procedure:**

Read and be sure you understand all safety, operating, and timer instructions, as well as specifications and procedures for your test.

1. Check to see that the Porta-Screen® is level.
2. Select and load the appropriate trays.

   Fill all the slots: five trays and pan for the PS-3
   seven trays and pan for the PS-4

   The Porta-Screen® will not clamp or operate properly unless fully loaded with trays. If your test requires fewer trays than the capacity of the Porta-Screen®, you may insert the required trays in the upper slots with the pan immediately below. Then fill the lower slots with extra trays.
3. Clamp the trays by rotating the clamp levers so that they point down.
4. Pour your sample into the top tray. Refer to the sample capacity information and be sure not to overload the Porta-Screen®.
5. Connect the three-pronged plug into a properly-wired, grounded receptacle with appropriate electrical current.
6. Set and activate the timer.
7. When the machine stops, unclamp the trays by rotating the clamp levers so they point up. Remove and empty the trays, following the directions in your test specifications.
8. When you have finished your test, unplug the machine. Do not reconnect power until you are ready to use the machine again.
9. Store clean, empty trays in the unit, leaving them unclamped.
10. Re-level the machine before the next use.

## 3.0 Sample Capacity

Capacity of the Porta-Screen® depends on the specifications of the test and the type and size of the material being tested. For any given sample, the Porta-Screen's maximum capacity is determined by the tray which has the largest load at the end of the test. This is the limiting tray.

**Coarse Aggregates:**

Minimum quantity of sample is usually established by the specifications of the test procedure. For example, ASTM C-136 "Specification for the Sieve or Screen Analysis of Fine and Coarse Aggregates" calls for the minimum weight of the test sample of coarse aggregates (density such as limestone or gravel) as follows:

| Normal Maximum Size of Particle mm (in) | Minimum Sample Weight kg (lb) |
|---|---|
| 9.5 (3/8) | 1 (2) |
| 12.5 (1/2) | 2 (4) |
| 19.0 (3/4) | 5 (11) |
| 25.0 (1) | 10 (22) |
| 37.5 (1-1/2) | 15 (33) |
| 50 (2) | 20 (44) |
| 63 (2-1/2) | 35 (77) |

These guidelines on minimum sample size quantities are for representative samples. Always take a much larger amount, perhaps from several spots in a storage bin or stockpile. Then combine and reduce them to the correct quantity by splitting.

With coarse series trays, (2" to No. 4), the limiting tray should have no more than one layer of particles over the wire cloth at the end of the test. Therefore, lightweight aggregates or coal must be tested in lower sample weights. High-density ores or pellets may be tested in larger amounts by weight. Many light materials are also soft, and test times should be limited to avoid degradation of the sample.

Most samples of up to 2" topsize can be handled in a single batch without difficulty. We do not recommend the use of trays with mesh sizes above 1-1/2", since larger particles become wedged in the mesh and make it difficult to remove the trays.

**Fine Aggregates:**

With fine series trays, (No. 8 to No. 200), the limiting tray should contain no more than approximately four grams per square inch of sieve surface at the end of a test. Assuming that the material is about the density of sand, there will be approximately 800 grams maximum on the limiting tray.

Since the Porta-Screen® is designed primarily for use in the 2" to No. 20 range, separations in finer sizes will not be as precise. If you are testing materials exclusively in the fine range, we recommend equipment specifically designed for this purpose, such as the Gilson Model SS-8R Sieve Shaker.

## 4.0 Maintenance & Disassembly

READ AND BE SURE YOU UNDERSTAND ALL SAFETY AND MAINTENANCE INSTRUCTIONS BEFORE PERFORMING MAINTENANCE ON YOUR PORTA-SCREEN®.

ALWAYS DISCONNECT AND LOCK OUT ELECTRIC POWER BEFORE PERFORMING MAINTENANCE.

**Clamping System:**

1. DISCONNECT AND LOCK OUT ELECTRIC POWER.
2. Load the Porta-Screen® with trays and pan, filling all the slots.
3. Rotate the clamp levers (#38) so that they point down.
4. Locate the clamp adjusting nuts (#9), which are on the lower ends of the four clamp tension rods (#7).
5. Tighten the nuts only enough to prevent the trays from rattling when the machine is operating.

### Lubrication:

1. DISCONNECT AND LOCK OUT ELECTRIC POWER.

2. Remove and set aside trays and pan.

3. Remove upper case cover.

4. Connection Rod Bearing:
   Lubricate the connecting rod bearing (#52) after every 80 to 100 hours of operation.

   a. Rotate drive shaft (#20) slightly by hand until the grease fitting at the lower end of the connecting rod (#50) is accessible. (Grease fitting may be pointing either to the front or to the back of the Porta-Screen®).

   b. Apply a small amount of any good-quality bearing grease.

   c. Proceed to shaft bearing lubrication.

5. Shaft Bearings:
   There are two bearings (#47), front and rear, on the drive shaft (#20), and two bearings (#41), front and rear, on each of the two counterweight shafts (#12, 13). Some Porta-Screens have sealed shaft bearings; others have shaft bearings with grease fittings. If the shaft bearings on your machine have grease fittings, lubricate the bearings after every 80 to 100 hours of operation.

   a. WITH ELECTRIC POWER DISCONNECTED AND LOCKED OUT, and trays, pan, and upper case cover removed, remove lower front and rear case covers.

   b. Apply a small amount of any good-quality bearing grease.

   c. Reassemble in reverse order.

6. Motor Bearings: Lubricate annually.

   a. Remove trays, pan, and upper case cover.

   b. Remove lower front and rear case covers.

   c. Find and remove the oil plugs at each end of the motor.

   d. Insert a few drops of oil.

   e. Replace plugs.

   f. Reassemble in reverse order.

7. Idler Pulley Bearings:
   These sealed bearings (#62) do not require lubrication.

**Belts:** The Drive Belt (#22) should fit snugly. If the belt is too tight, it will soon wear out, causing bearings to wear and resulting in noisy operation. A loose belt may cause the unit to run too slowly or to slip. Keep the drive pulley (#21) and motor pulley (#60) aligned so that the drive belt is straight.

The Timing Belt (#16) should fit tightly.

### Access to Belts:

1. DISCONNECT AND LOCK OUT ELECTRIC POWER.

2. Remove and set aside trays and pan.

3. Remove all case covers.

4. Drive Belt:
   Check tension by pressing on the span of the belt. If properly adjusted, the belt should be deflected 1/64th of the value of the distance between the pulleys. To adjust or remove, loosen the motor mounting bolts (#61); and the motor will slide up, loosening the belt tension.

   a. To adjust, move the motor up or down until the belt tension is correct. Retighten the nuts.

   b. Or remove the loosened belt if it is worn, and install a new one. Obtain the correct tension by moving the motor up or down. Retighten the nuts.

   c. Continue or reassemble.

5. Timing Belt:
   Check tension by pressing on the span of the belt. The belt should be tight. To adjust or remove the timing belt, loosen the two idler bracket mounting screws (#45). Loosen the nut on the adjusting screw (#46).

   a. To tighten: Turn in the adjusting screw to pull the bracket (#17) down and increase tension on the belt. Retighten the nut to hold the bracket in position. Reassemble.

   b. To replace: Loosen the adjusting screw to permit the idler bracket to move upward, loosening the tension on the timing belt so that you can remove it. Before reinstalling belt,

(1) Rotate drive shaft (#20) until the connecting rod (#50) is at its highest position.

(2) Rotate counterweight shafts (#12, #13) until counterweights are at their lowest position.

(3) Fit the belt around the left counterweight shaft pulley, around the timing pulley (#49), above the right counterweight shaft pulley, and around the idler pulley (#19).

(4) Tighten the idler bracket adjusting screw until the timing belt is tight, making certain that you do not change the position of the shafts. Lock the idler bracket in position with the nut. Tighten the bracket mounting screws.

(5) Reassemble.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

**Bearing Replacement:**

1. Guide Bearing Assemblies:
   The Porta-Screen® has three guide bearing assemblies: each has a housing and guide bushing. The two upper guide bearings (#34) are mounted to the top frame crossbar. The lower guide bearing (#59) is mounted to the underside of the vibrating unit.

   If you notice side-to-side movement of the vibrating unit during operation, inspect the guide bearings and replace them if necessary. We recommend replacement of all three assemblies at the same time.

   a. DISCONNECT AND LOCK OUT ELECTRIC POWER.

   b. Remove and set aside trays and pan.

   c. Remove top frame screws (#2), and lift off top frame crossbar (#1).

   d. Upper:
      (1) Remove mounting screws (#35) to detach bearing housing (#34).
      (2) Replace with new bearing housing assembly.

   e. Lower:
      (1) Remove all case covers.
      (2) Remove the connecting rod mounting bolt (#24).
      (3) Lift the entire vibrating unit assembly up and out of the Porta-Screen® frame.
      (4) Remove mounting screws (#56) to detach bearing housing unit (#59).
      (5) Replace with new bearing housing assembly.

   f. Reassemble in reverse order.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

2. Connecting Rod & Drive Shaft Bearings:
   The connecting rod (#50) can be replaced as an assembly, or you can press out and replace its bearing and bushing (#52).

   The drive shaft (#20) has front and rear bearings (#47). We recommend replacement of both front and rear bearings as a set.

   a. DISCONNECT AND LOCK OUT ELECTRIC POWER.

   b. Remove and set aside trays and pan.

   c. Remove top frame screws (#2).

   d. Lift off top frame crossbar (#1).

   e. Remove all case covers.

   f. Remove the connecting rod mounting bolt (#24).

   g. Lift the entire vibrating unit assembly up and out of the Porta-Screen® frame.

   h. Loosen the motor mounting bolts to release tension on the drive belt, and remove the drive belt from its pulleys.

   i. Loosen the setscrew in the drive pulley (#21), and slide the pulley off the drive shaft.

   j. Loosen the setscrew in the rear drive shaft bearing.

   k. Loosen the idler bracket mounting and adjusting screws (#45, 46) to release tension on the timing belt.

   l. Remove the timing belt (#16).

   m. Loosen the setscrew in the drive shaft pulley (#49), and slide the pulley off the drive shaft.

   n. Remove the mounting screws from the front drive shaft bearing (#47).

   o. Hold onto the top of the connecting rod (#50) while you pull the drive shaft out from the front of the machine with the front bearing attached.

   p. Remove the connecting rod (#50).

   q. Install new connecting rod assembly or press new bushing and bearing into existing connecting rod.

   r. Replace drive shaft bearings if needed.

   s. Continue or reassemble in reverse order. When replacing timing belt, refer to timing belt instructions and be sure that counterweights are aligned properly.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

3. Counterweight Shaft Bearings:
   Each of the two counterweight shafts (#12, 13) has a front and a rear bearing (#41). We recommend replacement of both bearings on a shaft. If you have disassembled the Porta-Screen® to replace the connecting rod and/or drive shaft bearings, skip to step h. Otherwise, disassemble as follows:

   a. DISCONNECT AND LOCK OUT ELECTRIC POWER.

   b. Remove and set aside tray and pan.

   c. Remove top frame screws (#2).

   d. Lift off top frame crossbar (#1).

   e. Remove all case covers.

   f. Remove the connecting rod mounting bolt (#24).

   g. Lift the entire vibrating unit assembly up and out of the Porta-Screen® frame.

   h. Loosen the idler bracket mounting and adjusting (#45, 46) to release tension on the timing belt.

   i. Remove the timing belt (#16).

   j. Loosen the bolts on the rear counterweight clamp bracket (#43), and remove the counterweight from the shaft.
   k. Loosen the setscrew which holds the rear bearing to the counterweight shaft.

   l. Remove the mounting screws (#42) which hold the front counterweight shaft bearing (#41) to the main frame.

   m. Pull the counterweight shaft from the front of the machine with its front counterweight, pulley, and front bearing all attached.

   n. Reinstall parts as needed.

   o. Reassemble in reverse order. When replacing timing belt, refer to timing belt instructions and be sure that the counterweights are aligned properly.

DO NOT PLUG IN THE PORTA-SCREEN® UNTIL YOU ARE READY TO USE IT.

4. Wire Cloth:
   Check condition of wire cloth both before and after operation. Test results can be only as accurate as the size of wire cloth openings. Always replace with testing grade wire cloth only.

   Testing grade wire cloth is a precision-made material and should be treated with care. The ASTM E-11 specification permits only very slight variations in average opening and wire diameter. Abrasion due to normal use and/or improper cleaning and handling can cause the wire cloth to be out of specification to a considerable degree before it appears worn. Check it frequently to be sure that it conforms to your test specifications.

   Wire cloth life can be extended by establishing proper procedures for handling, cleaning, and storage of trays. The Porta-Pan Accessory is helpful in the repetitive sequence of emptying trays, cleaning wire cloth, and weighing sample fractions.

   Wire cloth may eventually sag, reducing its effective screening area. Wire sizes 2" to No. 14 are rigid and self-supporting. Trays for No. 16 through No. 80 wire cloth contain three wire cloth support strips. No. 100 and finer trays have supporting backup cloth to minimize wear and distortion. When you replace No. 16 and finer wire cloth, always use support strips or backup cloth as indicated.

## 5.0 Parts List

| | PARTS | NO. REQUIRED |
|---|---|---|
| | ***Outer Case & Frame Parts*** | |
| 1 | Top frame cross bar | 1 |
| 2 | Top frame screw & lock washer | 4 |
| 31 | Bullseye level with cushion washer | 1 |
| 36 | Bullseye level adjusting screws | 3 |
| 27 | Leg lock tab | 3 |
| 33 | Leg lock tab spring | 3 |
| 65,28 | Leveling leg (65), with adjusting screw pad, nut & washer | 3 |
| 29 | Main frame | 1 |
| 30 | Vibrating unit assembly | |
| | Upper case cover | 2 |
| 11A | Lower case cover, front | 1 |
| | Lower case cover, rear | 1 |
| | ***Upper Guide Bearing Assembly Parts*** | |
| 34 | Upper guide bearing housing with guide bushing | 2 |
| 35 | Upper guide bearing mounting screw & lock washer | 4 |
| 4 | Upper guide bearing pin & set screw | 2 |
| | ***Clamping Assembly Parts, Right & Left*** | |
| 5A | Clamp lever with mounting bracket 6F left side | 1 |
| 5B | Clamp lever with mounting bracket 6F right side | 1 |
| 38 | Clamp lever handle grip | 2 |
| 6R | Rear clamp lever mounting bracket | 2 |
| 39 | Clamp lever mounting bracket screw & lock washer | 8 |
| 7 | Clamp tension rod | 4 |
| 40 | Clamp tension rod retainer clip, screw and lock washer | 4 |
| 8 | Clamp bar | 1 |
| 9 | Clamp adjusting nut and spacer | 4 |
| | ***Counterweight Assembly Parts*** | |
| 12 | Left counterweight shaft (short) | 1 |
| 13 | Right counterweight shaft (long) | 1 |
| 41 | Counterweight shaft bearing | 4 |
| 42 | Counterweight shaft bearing mounting screw & lock washer | 8 |
| 14 | Counterweight | 4 |
| 43 | Counterweight clamp bracket | 4 |
| 44 | Counterweight clamp bracket bolt & lock washer | 8 |
| 15 | Counterweight shaft pulley & set screw | 2 |
| 16 | Timing belt | 1 |
| 17 | Idler bracket | 1 |
| 45 | Idler bracket mounting screw with lock & flat washers | 2 |
| 46 | Idler bracket adjusting screw with locking nut | 1 |
| 18 | Idler pulley mounting screw & lock washer | 1 |
| 19/62 | Idler pulley with bearing set | 1 |
| | ***Drive Shaft Assembly Parts*** | |
| 20 | Drive shaft with eccentric, set screw, and roll pin | 1 |
| 47 | Drive shaft bearing | 2 |
| 42 | Drive shaft bearing mounting screw & lock washer | 4 |
| 49 | Timing pulley & set screw | 1 |
| 21 | Drive pulley with set screw | 1 |
| 22 | Drive belt | 1 |

| | PARTS | NO. REQUIRED |
|---|---|---|
| | ***Connecting Rod Assembly Parts*** | |
| 50 | Connecting rod with grease fitting | 1 |
| 51 | Connecting rod rubber bushing | 1 |
| 52 | Connecting rod bearing with inner race | 1 |
| — | (Connecting rod assembly - Parts 50, 51, 52, assembled) | (1) |
| 24 | Connecting rod mounting bolt with lock nut | 1 |
| 54 | Connecting rod mounting bolt spacer | 2 |
| | ***Lower Guide Bearing Assembly Parts*** | |
| 59 | Lower guide bearing housing with guide bushing | 1 |
| 56 | Lower guide bearing mounting screw & lock washer | 2 |
| 26 | Lower guide bearing pin | 1 |
| 64 | Lower guide bearing pin clamp bolt with lock nut | 1 |
| | ***Electric & Drive Parts*** | |
| 63 | Motor, 1/4 hp, 115V, 60Hz, 1Ph, 1725 RPM | 1 |
| 60 | Motor Pulley & set screw | 1 |
| 61 | Motor mounting bolt with lock & flat washer | 4 |
| — | Electric cord assembly, motor-to-timer | 1 |
| — | Electric cord assembly, with ground plug | 1 |
| — | Electric cord grip grommet | 1 |
| | Timer, Digital (EDA) | 1 |
| | Timer, Digital (Artisan) | 1 |

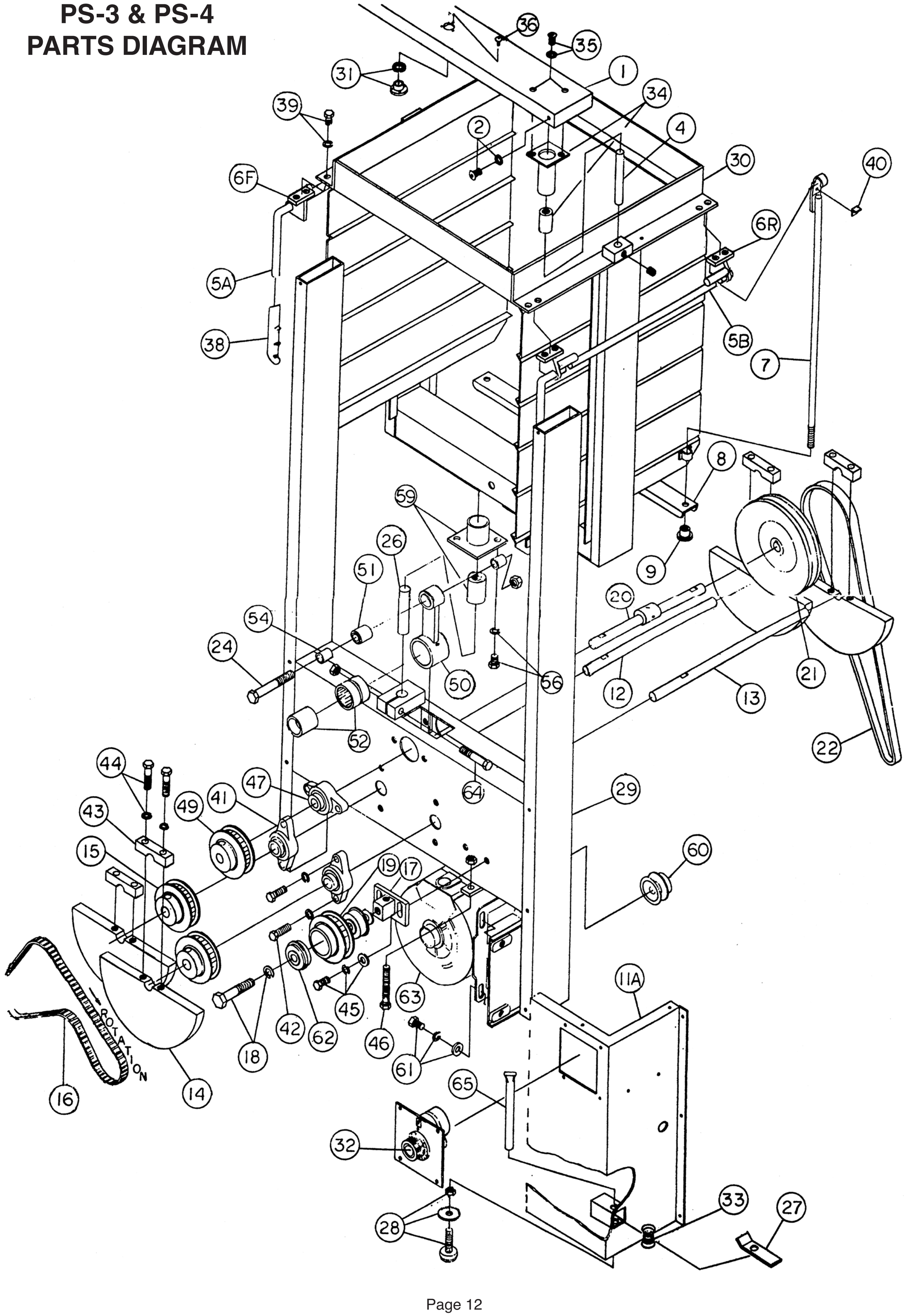
## Replacement Trays and Wire Cloth

| | **Model** | |
|---|---|---|
| Porta-Screen® Tray, complete with wire cloth | PSA-300 | 2" to No. 4 inclusive |
| | PSA-301 | No. 5 to No. 14 inclusive |
| | PSA-302 | No. 16 to No. 80 inclusive with wire cloth supports |
| | PSA-302 | No. 100, with backup cloth |
| | PSA-306 | No. 200, with backup cloth |
| | PSA-310 | Dustpan tray |

| | **Model** | |
|---|---|---|
| Replacement Wire Cloth, complete with metal shields & resilient gasket backing | PSA-325 | 2" to No. 4 inclusive |
| | PSA-326A | No. 5 to No. 14 inclusive |
| | PSA-326B | No. 16 to No. 100 inclusive |
| | PSA-327 | No. 200 |
| | PSA-225 | Backup cloth (use with No. 100 to No. 200) |

| | **Model** | |
|---|---|---|
| Screen Tray Parts | PSA-336 | Tray, complete, but without wire cloth, supports, or backup cloth |
| | | Tray side clamp (4 required per tray) |
| | | Tray bolts & nuts (12 required per tray) |
| | | Wire cloth support (3 required per tray) |

# PS-3 & PS-4
# PARTS DIAGRAM



## 6.0 Accessories

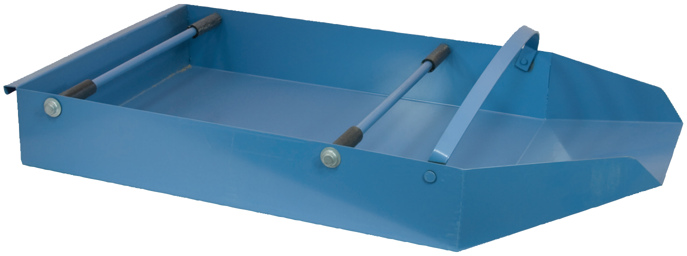
Porta-Screen® has Foot-Tab leveling.

Porta-Screen® Tray cloth has metal shields to eliminate partial openings.

**PSA-114 Porta Wheels** may be attached for added mobility. Ball-bearing wheel assemblies with rubber tires are predrilled for quick attachment to frame of Porta-Screen®.

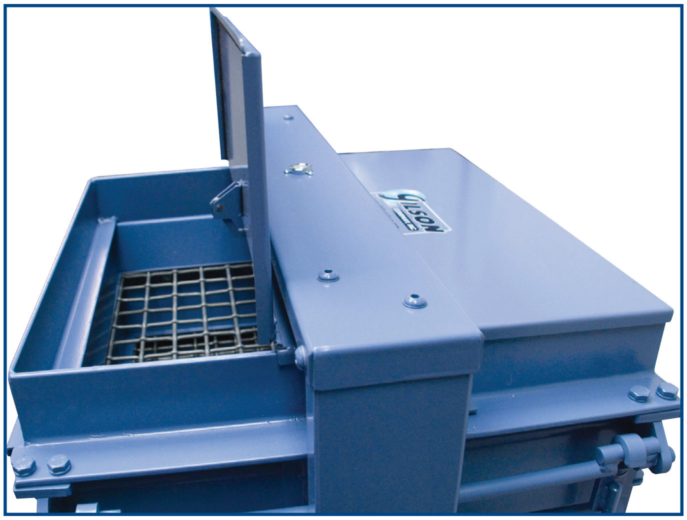
PSA-114

**PSA-367 Porta-Pan** is helpful in emptying and cleaning trays and in weighing operations. This 17x30x4in (432x762x102mm), WxLxD chute-end pan is sized to fit inverted trays and hold entire samples for cumulative weighing. Handling is easy with the top swing-away handle and end handle grip.



PSA-367

**PSA-312 Porta Cover** bolts to the top flange to enclose the sample chamber. It has a latch, and is hinged to open for introduction of samples.



PSA-312 on PS-3

AECOM

Project Operating Procedure

---

# Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

Procedure Number: PPG 017

Revision No.: 1

Revision Date: June 2010

Henry Chow

POP Author: Henry Chow

Date: June 29, 2010

Frank R. Tringale J

Program Manager: Frank R. Tringale

Date: June 29, 2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

# Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

POP No.: PPG 017
Revision: 0
Date: June 2010
Page i of i

---

## Contents

Project Operating Procedure

# Operation of the TSI Model 8520 DustTrak™ Aerosol Monitor

POP No.: PPG 017
Revision: 1
Date: June 2010
Page 1 of 11

---

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) defines the procedures for monitoring particulate matter (PM) using a totally portable system.

**1.2** This POP is to be utilized to conduct the work identified in the title of this POP. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, as well as personal protective equipment (PPE) requirements, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager Interferences.

## 3.0 Interfaces

**3.1** The following may cause errors in data that could cause erroneous operation of this system:

- If the analyzers are in need of maintenance or repair;
- If environmental conditions are beyond the limits specified in the instrument manual;
- Excessive ambient moisture either because of high humidity or precipitation will interfere with the proper operation of either instrument; and
- Operation of the system in portable mode without a fully charged battery can interfere with the proper measurement of PM data.

## 4.0 Equipment and Materials

**4.1** The following equipment and materials are required for operation of the PAM station:

- Trimpot screw driver;
- Flow meter with a measurement range of 0-3 LPM;
- Zero particulate filter; and
- Operator manuals for TSI model 8520 DustTrak™ aerosol monitor.

## 5.0 Procedures

**5.1** ON/OFF key

Press the ON/OFF key to power the DustTrak monitor. The DustTrak monitor immediately begins an internal self-check, while illuminating the display digits and symbols. If a problem is detected, the display shows the message “SERVICE” along with a number indicating that the DustTrak monitor requires service. Refer to Chapter 5: “Troubleshooting,” of the manual for information regarding service numbers. If the “SERVICE” message appears, the DustTrak monitor will pause until any key is pressed. (**NOTE**: when the cause of the service message is resolved, the message must be reset according to instructions specified in the user manual, if not, the message will re-appear again each time the DustTrak is powered on.)

**5.2** Manually Setting the Real-Time Clock

To set the time and date with the keypad, you must press and hold the SAMPLE key while the DustTrak monitor displays the current time. Hold the SAMPLE key until the monitor “beeps”. You will have an opportunity to view and/or change the year, month, and calendar day, hours, and minutes in sequence.

Use the up and down arrow keys (↓ ↑) to change a setting. Use the SAMPLE key to store each setting and advance to the next one. (**NOTE**: it is imperative to set the correct time and date when operating in the data logging mode.)

**5.3** SAMPLE Key

Press the SAMPLE key to start/stop data sampling. The word “SAMPLE” appears in the upper right corner of the display while the DustTrak monitor is in sample mode. When sampling is stopped, the DustTrak monitor automatically scrolls through statistics for the sampling period that just ended. (**NOTE**: Data sampling must be stopped in order to establish communication with TrakPro software to download logged data.)

**5.4** TIME CONSTANT Key

Momentarily press and release the TIME CONSTANT key to view the current time-constant. To change the time-constant, press and hold the key down. The available time-constant choices will scroll on the display. When the desired value is displayed, immediately release the key. Select 10 seconds as the time constant for standard operation.

**5.5** SAMPLING MODE Key

The SAMPLING MODE key allows you to select among the four (4) sampling modes: Survey, LOG 1, LOG 2, and LOG 3. Each time you press the SAMPLING MODE key, the DustTrak monitor sequences to the next mode. When the DustTrak monitor is in Survey mode, the current measurement will be shown on the display. When one of the LOG modes is selected, the LOG mode number, (i.e., LOG 1, LOG 2, or LOG 3) will be displayed along with the percentage of free memory available.

### **5.6** Survey Mode

When the DustTrak monitor is first turned on, it will always be in Survey mode. Survey mode allows you to make real-time measurements of aerosol concentrations, and to obtain statistics for that sample. The statistics include the average, minimum, and maximum values, as well as the elapsed time for that sample. Individual data points are not recorded in internal memory (this can be done in any of the LOG modes). Each new sample taken in Survey mode clears the previous sample data from memory. Data taken in Survey mode remains in memory until another sample is made, or until samples are taken in one of the LOG modes. Turning the DustTrak monitor off will ***not*** erase data.

Use the SAMPLE key to start and stop a sample

### **5.7** LOG Modes

There are three (3) LOG modes: LOG 1, LOG 2, and LOG 3. When one of these modes is selected using the SAMPLING MODE key, the LOG mode number will be listed at the top of the display. The LOG modes allow you to record aerosol concentration data points in the internal memory for later retrieval and analysis using the TraKPro software provided with the instrument. Use the SAMPLE key to start and stop recording. The word “RECORDING” appears at the top of the display when recording is in progress. The frequency that data is recorded can be set for LOG 1 mode with the LOGGING INTERVAL key. (**NOTE**: the logging interval is also the data averaging time used by the DustTrak and only block average can be generated.) Use TraKPro software for LOG 2 and LOG 3 modes. (**NOTE**: LOG2 and 3 are for timed or scheduled on/off sampling.)

Data recorded using one of the LOG modes can only be erased by using the CLEAR MEMORY key. Turning the DustTrak monitor off ***will not*** erase data. Recording another sample (by turning sampling off and on again) with one of the LOG modes without clearing memory first will cause new data to be added to the existing data in the memory and these new data will be identified with a new TEST number.

### **5.8** LOGGING INTERVAL key

This key sets the frequency and averaging period for LOG1 mode. Use SAMPLE MODE key to set the monitor to LOG1 mode, press and hold the LOGGING INTERVAL key, release this key when the desired interval is displayed. (**NOTE**: Only TraKPro software can be used to set interval for LOG 2 and 3.)

### **5.9** CLEAR MEMORY Key

Use the CLEAR MEMORY key to erase stored data. The CLEAR MEMORY key ***will not*** respond unless the DustTrak monitor is in one of the three LOG modes. (**NOTE**: before clearing the memory, you should first download the data to a computer through the TraKPro software.

***There is only one block of memory in the DustTrak monitor. Clearing the memory for one LOG mode clears memory for all LOG modes.***

To clear the memory, press and hold the CLEAR MEMORY key until the countdown reaches zero, then release quickly. This prevents the data from being accidentally erased. Releasing the key too soon or too late prevents memory from being cleared. (**NOTE**: the DustTrak monitor has memory capacity of 31,000 data points, if the data average interval is set to 15-minutes, it could store data up to a total of 322 days. After the memory is cleared 100% memory should be displayed.

### **5.10** The Arrow Keys ↑ ↓

The two arrow keys are used to adjust the readings when calibrating the DustTrak monitor and for adjusting the time and date for the internal real-time clock.

### **5.11** CALIBRATE Key

Use the CALIBRATE key to put the DustTrak monitor into calibration mode. See Chapter 4, “Maintenance” and Step 5.1.12 below for details on how to perform zero calibration of the monitor.

### **5.12** Display/Keypad Lockout Switch

Recording data over extended time periods often requires leaving the DustTrak monitor unattended. To reduce the risk of having an unauthorized person either intentionally or inadvertently interrupt the measurements, you can lock the display and keypad. The lockout switch is on the backside of the DustTrak monitor between the data port and the external power socket. It is a small slide switch and is recessed so that a pointed device must be used to move it.

- With the switch in the right side position (nearest the power socket), the keypad and display functions will work normally.

- With the switch in the left side position (closest to the data port), the display and keypad will go into lockout mode.

There are two ways to use the lockout switch.

1. Lock the keypad after recording starts, or

2. Put the switch into the lockout position prior to when recording starts.

The second method will enable you to operate each function normally *until* the SAMPLE key is pressed in one of the LOG modes. At that time the keypad automatically locks. When the display and keypad are locked, the display shows the words “RECORDING LOG X ” where “X” is the current LOG mode number.

**5.13** Zero Checking/Re-Zeroing/Calibration

To calibrate or perform a zero check on the DustTrak, use the following steps:

1. Put the DustTrak monitor in Survey mode;

2. Connect zero particulate filter (supplied by DustTrak manufacturer) on monitor sample inlet. (See Figure 4–1 of the manual for an illustration on how to make the connection);

3. Set the time-constant to 10 seconds, if necessary. Press and hold the TIME CONSTANT key until “10” is displayed, then release;

4. Wait 10–60 seconds for displayed values to settle to zero;

5. If the displayed value is between -0.001 and +0.001 mg/m$^3$, the DustTrak monitor does not need adjustment. If the displayed value exceeds this limit, follow steps 6 to 8 below to re-zero the instrument;

6. Press and hold the CALIBRATE key and wait for the displayed countdown to reach 0, then immediately release the key. The message “CALIBRATE ZERO” is displayed. If it is not displayed, try again;

7. Press the SAMPLE key and wait for the 60-second countdown. When the countdown is completed, the current calibration constant will be displayed; and

8. Press the CALIBRATE key again to return to survey mode. The re-zeroing process is now completed.

**5.14** Verification/Adjustment of sampling flow rate

The standard sampling flow rate for the DustTrak 8520 is 1.7 LPM and should be verified and adjusted initially and on a regular basis. The particle size cut-off is based on this flow rate for each size cut-off nozzles and cyclone.

Connect the flowmeter (supplied by manufacturer) to the monitor sample inlet, hold the flowmeter in a vertical position (as illustrated on Figure 4-4 of the manual) and verify the flowmeter ball height (middle of the ball) is at 1.7 LPM. If necessary, adjust the flow adjustment trimpot with a small screw driver until the flow rate is at 1.7 LPM. The flow adjustment trimpot is located at the back panel of the DustTrak monitor.

**5.15** Maintenance

(See Chapter 4 of the Operation Manual for recommended maintenance schedule and detailed maintenance procedures)

**5.16** Standard Startup Procedure for DustTrak 8520

Standard Startup procedure is as follows for the DustTrak:

5.16.1 Instrument set up

- Power up - press ON/OFF key
    - DustTrak should begins self-check sequence ,and display all digits and symbols;
    - Verify no SERVICE messages; and
    - Verify adequate battery life remaining and no battery symbol is displayed.

- Verify internal clock - adjust clock if necessary either manually or through the use of TRAKPRO Software

- Verify flow rate @ 1.7 LPM_– connect rotameter to inlet nozzle, check and verify ball high (mid-ball) at 1.7 LPM, adjust flow pot if necessary

- Verify time constant (recommended to use 10 seconds)

- Verify or Select/sampling particle size inlet. The selections are as follow:
    - 4.0 um: install BLACK nozzle and CYCLONE;
    - 10 um: install BLACK nozzle;
    - 2.5 um: install BLUE 2.5 um nozzle with impactor plate and O-ring; and
    - 1.0 um: install BLUE 1.0 um nozzle with impactor plate and O-ring.

- Zero checking/re-zeroing **-** perform this procedure:
    - Daily from cold start;
    - Ambient temperature change exceeds more than 8C;
    - Maintenance is performed; and
    - DustTrak is moved from high aerosol concentration to a low concentration location.

- Put DustTrak in SURVEY mode (press SAMPLE key if need to).

- Connect filter to inlet nozzle.

- Press and hold TIME CONSTANT key to verify display is in 10 sec (00:10:00).

- Wait 10-60 second sampling, readings should be approaching zero.

- If stable reading is between +/- 0.001 mg/m$^3$, no zeroing will be needed.

- If reading exceeds this limit, press and hold CALIBRATE key until count down to 0 and release key immediately, "CALIBRATE ZERO" message should be displayed, if not try again.

- Press SAMPLE key to initiate the 60 seconds countdown. Current calibration factor should be displayed after the countdown.

- Press CALIBRATE key to return DustTrak to survey mode and zeroing is completed.

5.16.2 Set DustTrak in one of the four SAMPLING MODEs

- Survey mode – default mode after power up : to display real-time readings ( no internal logging) – this mode is use mostly for analog output to connect to an external data logger.

- LOG 1 – sample and record average readings in internal memory
  - ➢ Press SAMPLE MODE until LOG1 is displayed;
  - ➢ Press LOGGING INTERVAL to verify averaging period (e.g., 15 minute);
  - ➢ Or press and hold key until the desired interval is displayed, release key immediately; and
  - ➢ Press SAMPLE key to start sampling. In additional to readings, **LOG1 Recording and Sample** message will also be displayed, this verifies that sampling is in progress and data averages will be stored in internal memory.

**NOTE**: each time when SAMPLE key is pressed to stop and start a new sampling event, a new test ID will be created for the current sampling event).

- LOG2 and LOG3 – user selectable auto start/stop operation and average readings recorded in internal memory.

5.16.3 Enable Alarm (only through the use of TraKPro software)

- Start up TraKPro.
  - ➢ Select Instrument Setup, select Parameters, Alarm Setpoint;
  - ➢ Check Alarm Enabled box;
  - ➢ Enter an alarm limit (e.g., 0.150 mg/m$^3$);
  - ➢ Press send button to program the DustTrak;
  - ➢ When alarm is triggered, internal beeper will be on once/second and AL message will be flashing on display; and
  - ➢ Alarm will be turned off when reading falls below 5% of limit.

5.16.4 If LOG1 mode is used, verify and/or select the LOGGING INTERVAL. Verify adequate memory is available.

5.16.5 Verify no battery warning is displayed. Press SAMPLE key to start the sampling session. (**NOTE**: SAMPLE should be displayed on the top right hand corner of the display panel).

**5.17** Use of TraKPro Software

TraKPro is a companion software designed to assist in the operation of DustTrak 8520. TraKPro provides a number of operation features that cannot be initiated through the keypad.. These features include the following:

- Logging Interval for LOG2 and 3;
- Enable/disable data alarm and setting/modifying alarm threshold;
- Setting up analog output range;
- Downloading and exporting logged data; and
- Generating data reports.

5.17.1 Follow the procedure described in Chapter 2 “Setting up TraKPro Data Analysis Software” to connect the monitor to a Personal Computer (PC).

**NOTE**: Sampling must be stopped manually (press the SAMPLE key) in order to establish communications between the monitor and PC.

5.17.2 Follow the procedures described in Chapter 3 “Analog Output”; “Alarm Output Specifications and Programming the Alarm Set Point”; and “Programming Advanced Modes: LOG2 and LOG3” to configure the monitor as needed.

**NOTE**: DustTrak 8520 will alarm only on instantaneous readings.

5.17.3 Downloading and Exporting logged data

1. Open TraKPro Software.
2. Click on File in the TraKPro task bar.
3. Select Receive.
4. On the sub-menu “Logged data Test(s) to receive”, sampling events stored in monitor (identify by Test ID number, Test date and time) will be listed on a menu. You either Select ALL or highlight the test ID to select the data you want to transfer from the DustTrak to the PC, and then click Receive…
5. After the data transfer is complete, a confirmed window “Logged Test(s)” will open with more detailed information on the selected test ID. By highlighting the Notes at the end of each test ID, the operator can add specific comments associated with each test ID (i.e., test location or site code before it is saved).

6. Click File, select Save As, select a file destination, specify a file name, and click Save. The data will be saved with a TPK extension (the TrakPro native file).
7. To export data as text file that can be used with MS Excel, click File, select Export, and select Export Test Data. At this point a window will come up listing the test IDs, start date, and time.

**NOTE**: The default Data Delimiter is Comma.

**M**odify the selection as needed, highlight the monitoring event(s) to convert, click Export, specify a file destination, specify file name, and click Save. A text file with a .TXT extension will be created and saved.

**NOTE**: a standard file naming convention is recommended, at a minimum the name should contain information to identify the site location and date of sampling, an example is as follows:

**NNNN mmddyy** where:

NNNN = site code or location
mm = month
dd = day
yy = year

## 6.0 Quality assurance / quality control

**6.1** Calibrations must always leave the analyzer operating within ± 5.0% of the reference calibrator at each calibration input.

**6.2** As soon as possible following calibration, the completed data form is to be submitted to the project manager or designee for review. Standards are reviewed for traceability and completeness. Data and strip chart readings (where applicable) are to be reviewed for agreement and completeness

## 7.0 Data and records management

**7.1** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.2** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

7.2.1 The field documentation (PAM Station Checklist) is included at the end of this POP.

**7.3** Completed calibration data sheets are subject to senior review in accordance with AECOM senior review policy (SOP 1003, Senior Review). Calculations, standard conditions, correction factors, project identification, and other data will be reviewed for accuracy, completeness and conformance to the relevant AECOM operational SOP and the project QA Plan.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

8.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.2** Responsibilities

8.2.1 The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

8.2.2 The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

ENSR 1003, Senior Review.

ENSR SOP 1011, Preparation and Control of Standard Operating Procedures

TSI model 8520 DustTrak™ aerosol monitor

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 1 | June 2010 | Minor edits re typos |

AECOM

AECOM
2 Technology Park Drive
Westford, Massachusetts 01886

978.589.3000 tel
978.589.3100 fax

# Routine Operations Check List

Portable Air Monitoring Stations

Week of (Monday date): ______________________ Site: ______________________

| Activity | Technician's Results | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|
| Daily Start-Up | Mon | Tue | Wed | Thu | Fri | Sat | Sun | |
| 1. Time of Calibration | | | | | | | | |
| 2. Technician's Initials | | | | | | | | |
| 3. Perform zero check of RAE. Record results. | | | | | | | | |
| 4. Perform span check of RAE. Record results. (Re-span if > +/- 0.5 ppm) | | | | | | | | |
| 5. Perform zero check of DustTrak. Record initial results. (Re-zero if > +/- 1.0 ug/m$^3$) | | | | | | | | |
| 6. Perform flow check of DustTrak. Record initial results. (Acceptable flow 1.5 – 1.9 lpm) | | | | | | | | |
| 7. Record combined battery voltage (Target 12V, if less than 11.3V batteries must be changed). | | | | | | | | |
| 8. Record top battery voltage (Target 6.5V) | | | | | | | | |
| 9. Check water drop out jar and empty as necessary. | | | | | | | | |
| Weekly | | | | | | | | |
| 1. Check DustTrak filter following rain events for moisture. If filter is wet, then replace with new filter. | | | | | | | | |
| Monthly | | | | | | | | |
| 1. Replace sample line filters on RAE PID. | | | | | | | | |
| 2. Perform an upscale response check of DustTrak particulate monitor, using a smoke generator. Record upscale response and time of check. | | | | | | | | |
| Comments: | | | | | | | | |

AECOM

Standard Operating Procedure

---

# Calibration/Operation/Maintenance of MiniVol™ Tactical Air Sampler (TAS)

## Procedure Number: PPG 018

Based on Procedure Number: 2000-226

Revision No.: 1

Revision Date: June 29, 2010

SOP Contributors: Tony Sacco

Henry Chow

Henry Chow, Technical Team Leader

Date: June 2010

Frank R. Tringale Jr

Frank R. Tringale Project Manager

Date: June 2010

## Contents

Standard Operating Procedure

# Calibration/Operation/Maintenance of MiniVol™ Tactical Air Sampler (TAS)

---

## 1.0 Scope and applicability

**1.1** This Standard Operating Procedure (SOP) provides the guidance for the use of the MiniVol™ Tactical Air Sampler (TAS), to provide a standardized procedure for the collection of particulates or vapors.

**1.2** This sampler may be used to collect particulate matter on various types of filer media or gases/vapors in Tedlar™bags. General sampler calibration procedures are given in ENSR SOP 2000-106.

**1.3** This SOP is to be utilized to conduct the work identified in the title of this SOP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this SOP are not applicable to the project, there is the option to either adapt this SOP or to develop a site-specific SOP to more closely match the requirements of the project. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

## 2.0 Health and safety considerations

**2.1** The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, as well as personal protective equipment (PPE) requirements, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

**3.1** Physical disturbance of the sample during collection can result in significant loss of sample. Care must be taken to minimize disturbance of samples during collection to ensure that intact discrete samples are obtained and that the samples are representative of the intended interval.

**3.2** Communication with the laboratory in the project planning stages is critical to address the potential issues that may arise.

## 4.0 Equipment and materials

A standard MiniVol™ TAS comes packed in an all weather carrying case containing the following:

- 1 MiniVol™ TAS Pump Module
- 2 Filter Holder Assemblies
- 2 Size Selective Impactors
- 2 Battery Packs and a Battery Charger

- 1 All Weather Carrying Case
- 1 Universal Mounting Bracket or Light Weight Tripod

During particulate matter sampling, the following consumables are needed for proper operation of the MiniVol™TAS:

- Impactor grease - Glisseal® Ht, Apiezon® M Grease, etc.
- 47 mm filters - pure quartz, pure Teflon®, Teflon®-coated glass, etc.
- Petrislides™ - for storage and transport of the filters.
- A microbalance accurate to one microgram is needed to weigh the filters.
- Operation Manual.
- ENSR SOP 2000-106 Ambient Monitoring Transfer Standard Calibration.

# 5.0 Procedures

## 5.1 Charging batteries

1. Connect the charging plug of the battery charger to the charging jack on the battery pack.

2. Plug the charger into an AC outlet.

3. The LED on the top of the battery charger will light indicating the status of the battery being charged.

When this light is green the battery is charged. A fully discharged battery requires about 5 hours to be completely recharged.

**Battery Charger LED Status Modes**

**LED Status Battery Status**

- Green Battery Fully Charged
- Red Battery Partially Charged
- Flashing Red Battery Fully Discharged

## 5.2 Turning the sampler On/Off

The ON/AUTO/OFF button on the Programmable Timer allows the operator to manually turn the sampler on or off (or to place it in the "Auto" mode in which it is controlled by programmed on/off sequences). As the ON/AUTO/OFF button is pressed, a bar at the lower edge of the LCD display moves horizontally over the words "On", "Auto" and "Off" which are printed on the timer case. With the battery pack inserted into the sampler, press the ON/AUTO/OFF button until the bar is above the "ON" legend. The red power indicator (to the right of the ON/AUTO/OFF button) should light and the pump motor should start. If the timer display does not respond, press the small black reset button located next to the red power led. While the sampler is running press the ON/AUTO/OFF button, until the bar indicator is over the “OFF” legend. The power indicator light will go off and the pump will stop running.

**5.3** Programming the timer

The Programmable Timer can be set to run up to six on/off cycles within a 24 hour period, as well as to run for separate time periods on separate days within a 7-day period. To set the timer, first set the real-time clock to establish the correct time frame in which the cycles are to run. Next, enter the on/off times at which the programmed cycles are to begin and end. Finally, set the timer to "Auto" mode.

**5.4** Setting the real-time clock

1. DAY SET: Hold down the CLOCK button and press the WEEK button until the correct day appears at the top of the display.

2. TIME SET (Hour): Hold down the CLOCK button and press the HOUR button until the display indicates the correct hour. You may have to cycle through the hours twice to obtain the proper AM or PM (on the left side of the display). Seconds will automatically reset to zero.

3. TIME SET (Minutes): Hold down the CLOCK button and press the MIN button until the display indicates the correct minutes. Seconds will automatically reset to zero.

**5.5** Setting the On/Off times

1. Press the **PROG** button once. **1ON** will appear near the lower left corner of the display indicating that the Power-on time for the first cycle is ready to be programmed.

2. Press the **HOUR** and **MIN** buttons to enter the power-on time for the first cycle.

3. Press the **WEEK** button to select the desired day. The days appear along the top of the display. Continuously pressing the **WEEK** button will sequentially display "Mo Tu We Th Fr Sa Su", "Mo", "Tu", "We", "Th", "Fr", "Sa", "Su", "Mo Tu We Th Fr", "Sa Su" and finally back to "Mo Tu We Th Fr Sa Su".

   **NOTE: When more than one day is displayed, these days will all have the same power-on time.**

4. After you have entered the power-on time and date for the first cycle, press the **PROG** button. **1OFF** now appears on the display to indicate that the power-off time for the first cycle is ready to be programmed. Repeat steps 2 and 3 to enter the desired power-off time.

   **NOTE: The power-off time does not have to occur on the same day as the on time. In this way, sampling may start on one day and end on the next day**.

5. Press the **PROG** button again. **2ON** appears on the display to indicate that the second power-on time is ready to be programmed. Repeat steps 2 through 4 to enter the remaining power-on/power-off times (up to 6 on/off times).

6. Press the **PROG** button to step through the times you entered to make sure they are correct. Press the **RST/RCL** button to disable (ReSeT) or reactivate (ReCalL) any time entries. When you disable a particular power-on/off entry, four dashes will appear instead of the time. When you reactivate an entry, it will return to the values that were set before you performed a reset.

   **NOTE: Be sure to clear or reset all unwanted time entries prior to sampling in the AUTO mode. Both ON and OFF entries need to be disabled for the unwanted programs to be inactive.**

8. Press the **CLOCK** button to return to the real-time clock display.

9. Press the **ON/AUTO/OFF** button until the bar is positioned above the desired setting (see below).

### 5.5.1 Setting the time to “ON,” “AUTO,” and “OFF” modes

The **ON/AUTO/OFF** button is used to manually turn the sampler on or off, or to place it in the "Auto" mode. A bar on the lower edge of the LCD display moves from "Off" to "Auto" to "On" as the button is pressed. In the "Auto" mode the sampler is controlled by the programmed on/off sequences.

To manually turn the sampler ON, press the ON/AUTO/OFF button until the bar on the lower edge of the display is above the "ON" legend. The pump will start and the power indicator will light.

To manually turn the sampler OFF, press the ON/AUTO/OFF button until the bar is above the "OFF" legend.

To set the timer to "AUTO" mode, in which the sampler will be automatically controlled by programmed sequences, first turn the sampler OFF. Then press the ON/AUTO/OFF button until the bar is above the "AUTO" legend.

## 5.6 Checking for leaks

To check for leaks, remove the impactor/filter holder assembly from the inlet tube. Make sure that the inlet tube is fully extended and the compression fitting is tight. Cover the air inlet tube with the palm of the hand while the pump is running. The ball in the flowmeter should drop to zero and remain there without movement.

**NOTE: If the "Low Flow" indicator LED activates and the sampler shuts down after 15-20 seconds, push the reset button twice to reactivate the sampler. If the ball does not drop to zero, a leak exists somewhere in the hoses and/or fittings between the inlet and the flowmeter.**

Leaks on the inlet side of the pump are especially critical, since flow measurement will not accurately reflect the amount of air passing through the filter. The sampler will be measuring air passing through the filter, plus whatever air may be entering through the leak.

If there is a leak use the following procedures to isolate the leak. After each procedure check the sampler for leaks before moving to the next step:

- Verify that the inlet tube is extended and the compression fitting is tight.
- Remove the four faceplate thumbscrews and the sampler mount thumbscrew to access the sampler pump and plumbing.
- Verify that all push-on hose fittings are secure.
- Check for cracks in the flowmeter inlet and outlet.
- Check for cracks in the pulse dampener.
- Check and tighten all compression fittings.

### **5.7** Particulate matter sampling

Sampling procedures for TSP, $PM_{10}$, and $PM_{2.5}$ are identical except for the configuration of the impactor/filter holder assembly.

#### **5.7.1** Preparing the sampler

**TSP** - Remove the impactor from the filter holder assembly prior to sampling. Since the impactor will not be used, greasing and cleaning of the impactor's target disk need not be done.

. **$PM_{10}$** - Use a $PM_{10}$ impactor in the filter holder assembly. Greasing and cleaning of the impactor's target disk should be performed initially and after every fifth sample (or more often if heavy loading is observed).

**$PM_{2.5}$** - Use a $PM_{2.5}$ impactor in the filter holder assembly and a $PM_{10}$ impactor in a multiple impactor adapter mounted on the filter holder assembly tube. Greasing and cleaning of the impactors' target disks should be performed initially and after every fifth sample (or more often if heavy loading is observed).

To remove impactor, use your thumb to simply push the impactor out of its tube from bottom to top. When correctly installed, the impactor's top is flush with the surrounding filter holder assembly tube or multiple impactor adapter tube.

Before transporting the MiniVol™ TAS to the field, perform a laboratory check to determine if it is operational.

- Turn the sampler on and observe the motor performance.
- Perform a leak check. Investigate and correct any malfunctions before proceeding.
- Perform a single-point flow rate check using a calibrated orifice, soap-bubble meter or other flow measuring device of known accuracy and compare to the curve established during calibration. The flow should be within ±10% of 5 LPM at current conditions. If the unit fails to operate in this range, check the sampler for obvious leaks and malfunctions. The sampler must be repaired or recalibrated if the flow criteria are not met.

### **5.7.2** Flow rate

The particle size cut point of the impactor is a function of the velocity with which the air stream passes through the impactor and impacts on the target. The impactor is designed to have the correct cut point at an air flow rate of 5 LPM at ambient conditions. Since the density of air and the behavior of the flowmeter are functions of the ambient air temperature and atmospheric pressure, a flow rate set point must be calculated for each different sampling project.

The sampler air flow calibration curves that are supplied with each sampler contain the necessary information needed to determine the flowmeter set point for a particular ambient condition.

Flowmeter calibration

The sampler should be recalibrated once a year and/or if the flowmeter is replaced (see ENSR SOP 2000-106 Ambient Monitoring Transfer Standard Calibration.

### **5.7.3** Particulate matter sampling procedure

After the sampler has been assembled (refer to sections 4.7-4.14 of the MinVol ™ manual), adjusted, verified to be in proper working order, and a filter loaded in the Filter Assembly, the sampler is ready to collect air samples.

1. Carefully transport the sampler to the field site. Verify that the sampler, when finally installed will be positioned with the intake upward in an unobstructed area at least 30 cm from any obstacle to airflow.
2. Place the sampler on a firm level surface.
3. Loosen the inlet tube compression nut and extend the inlet tube to the maximum height and re-tighten the nut. Check for leaks.
4. Remove the clean Impactor/Filter Holder Assembly from the plastic transport bag or case. Attach the assembly to the top of the sampler inlet tube.
5. Record the following information on the PM Field Data Sheet: Site ID, number of the filter, the battery ID, sampler ID, ambient temperature and pressure, flowmeter

reading, and elapsed time meter reading. (a copy of the data sheet may be downloaded from the Airmetrics website, www.airmetrics.com).

6. Open the sampler case and obtain the beginning flow rate, press the **ON/AUTO/OFF** button to start the pump. On the LCD display, the horizontal bar should move to "ON".
7. If the flowmeter, which should be in the vertical position, indicates zero or a very low reading, check for restrictions.
8. Using the Flow Rate Adjustment control, set the flowmeter within specifications for the project temperature and pressure conditions. Take the reading of the flowmeter from the center of the ball.
9. Press the **ON/AUTO/OFF** button twice to stop the pump.
10. Press the **ON/AUTO/OFF** button to set the timer to "Auto" mode.

    **NOTE: The Sampler MUST be in “Auto” mode before the operator leaves if the sampler is to run at a pre-programmed time.**
11. Close the sampler case.

### 5.7.4 Particulate matter sample retrieval

As soon as possible after the end of the sampling period, the operator should return to the monitoring site to retrieve the exposed filter. There is a potential for filter damage or changes in sample mass due to particle loss, passive deposition, or volatilization increases if the filter is left in the sampler for extended periods of time after the sampling activity has ceased. On the previously referenced Field Data Sheet record the ambient temperature (Ta), barometric pressure (Pa), flowmeter reading and elapsed time.

**NOTE: Ta and Pa readings may be estimated on site or may be obtained from a nearby US National Weather Service Forecast Office or airport weather station. Barometric pressure readings obtained from airports must be at station pressure (not corrected to sea level), and they may have to be corrected for differences between the elevation of the monitoring site and that of the airport. If Ta and Pa readings are not available, seasonal average temperature ($T_{avg}$) and barometric pressure ($P_{avg}$) may be substituted. Care must be taken that the actual conditions at the site can be reasonably represented by such averages. It is therefore recommended that seasonal values represent actual values within 20°C and 40 mmHg.**

1. Open the sampler case and check the sampler for any error conditions. Repair as needed.
2. Verify correct time and day of week on time LCD.
3. Record elapsed time as shown on the Elapsed Time Totalizer.
4. Obtain ending flow rate:
    - Press the **ON/AUTO/OFF** button to start the pump.

- With the flowmeter in a vertical position, record the flow rate to the nearest 0.25 LPM (read at center of ball).
- Press the **ON/AUTO/OFF** button twice to stop the pump.

5. Exchange a new impactor/filter holder assembly for the exposed filter holder assembly. Perform a crosscheck of the exposed filter number with the filter number recorded on the Field Data Sheet for the run just completed. Also, check the filter number against the site number.
6. Change the battery pack.
7. Obtain beginning flow rate (see above, step 4).
8. Make sure the timer is set for the desired period and in the **"AUTO"** mode.

### **5.7.5** Exposed filter

1. In the laboratory, unscrew the filter holder and remove the filter cassette.
2. Locate the Petrislide™ with the filter number which matches the number on the side of the filter holder assembly. This is the original Petrislide™ in which the filter came.
3. Use the cassette separator (P/N 600-007) to remove the top half of the filter cassette.
4. Using forceps carefully remove the exposed filter from the filter cassette and place it into its original Petrislide™ with the exposed side of the filter facing up, replacing the Petrislide™ lid when finished.

   **NOTE: Be sure to replace the filter support screen in the filter cassette assembly.**
5. Remove the old ID tag from the filter holder assembly base and discard.

   **NOTE: Recheck this number to be sure it matches the number on the Petrislide™.**

### **5.7.6** Maintenance

Ideally, records reflecting the history of maintenance (including all replacement parts, supplies, costs, expenditures) should be kept for each MiniVol™ TAS.

Check sheets should be used to record preventative and/or corrective maintenance activities and the subsequent sampler calibration curve.

The sampler is comprised of four basic components that require maintenance:

- impactor/filter holder assembly,
- flow control system,
- timer, and
- battery pack.

Section 6 of the MiniVol™ TAS Operation Manual details the recommended maintenance procedures.

## 6.0 Quality assurance / quality control

**6.1** Quality control requirements for the MiniVol™ TAS are dependent on project-specific objectives. The Quality Assurance Project Plan (QAPP) will provide requirements for sample preservation and holding times, container types, sample labeling, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, MS/MSDs, and field duplicate samples.

**6.2** Siting Requirements

Siting recommendations in the operational manual conform to the U. S. Environmental Protection Agency requirements as stated in the U. S. Code of Federal Regulations (40 CFR part 58, Appendix E). When operating the sampler in locations under another jurisdiction, the operator should follow the appropriate guidelines.

The MiniVol™ TAS should be positioned with the intake upward and should be located in an unobstructed area at least 30 cm from any obstacle to air flow. Accessibility to the unit under all weather conditions, along with safety and security of the monitoring personnel and equipment, should be prime considerations.

Completed calibration data sheets are subject to senior review in accordance with AECOM's senior review policy. Calculations, standard conditions, correction factors, project identification, and other data will be reviewed for accuracy, completeness and conformance to the relevant AECOM operational SOP and the project QA Plan.

## 7.0 Data and records management

**7.1** Forms must be completed and delivered to the project manager for review. A copy of these forms must be maintained on site. All columns on these forms must be completed or marked N/A if they do not apply.

**7.2** All activities performed in shelter must be documented in the field station log including date, the time in and out, technician’s initials and employee number, activities performed, time the instrument is taken off-line, time the instrument is put back on-line, calibration results as well as any other circumstances which may arise during the site visit.

**7.3** Unanticipated changes to the procedures or materials described in this SOP (deviations) will be appropriately documented in the project records.

**7.4** Records associated with the activities described in this SOP will be maintained according to the document management policy for the project.

# 8.0 Personnel qualifications and training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

**8.1.2** Field technicians must have been trained to operate, maintain and calibrate this sampler and must be familiar with procedures for proper documentation of test data.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this SOP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this SOP and any project-specific work plans.

**8.2.3** The Project Manager is responsible for determining the methods that are appropriate to achieve the project objectives, and for supplying the necessary resources to meet those objectives.

**8.2.4** The field sampling team leader or task manager is responsible for ensuring that this procedure is followed in collecting the samples.

# 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

AECOM Project Procedure PP-9-0, Senior Review Procedure.

AECOM SOP 1011, Preparation and Control of Standard Operating Procedures.

ENSR SOP 2000-106, Ambient Monitoring Transfer Standard Calibration.

ENSR SOP 1007, Chain of Custody Procedures.

Revision history

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | NA |

Standard Operating Procedure

# Sample Collection of Airborne Hexavalent Chromium using Airmetrics MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2

**Procedure Number: PPG 019**

Based on Procedure Number: 2000-126

Revision No.: 0

Revision Date: May 2010

SOP Contributors:

Henry Chow

Date: 5/28/10

Henry Chow, SOP Team Leader

Leo J. Gendron

Date: 05/28/10

Leo Gendron, AM Dept. Manager

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________ .
Initials: ________ Date: ________

Standard Operating Procedure

# Sample Collection of Airborne Hexavalent Chromium using Airmetrics MinVol Tactical Air Sampler and OSHA Method ID 215 Version 2

SOP No.: PPG 019
Revision: 0
Date: May 2010
Page i of i

## Contents

Standard Operating Procedure

# Sample Collection of Airborne Hexavalent Chromium using Airmetric MiniVol Tactical Air Sampler and OSHA Method ID 215 Version 2

## 1.0 Scope and applicability

This Standard Operating Procedure (SOP) defines the collection procedures of airborne hexavalent chromium in ambient air and/or work places using OSHA Method ID 215 Version 2 on a polyvinyl chloride (PVC) filter. Ambient air is drawn through a polystyrene cassette preloaded with a PVC filter and stainless steel back-up screen at a measured flow rate through the use of the Air Metric MiniVol Tactical Air Sampler (TAS). After sampling, the filters are extracted in an alkaline digestion solution and analyzed colorimetrically in the laboratory using the procedures described in OSHA Method ID-215 Version 2.

**1.1** This SOP is to be utilized to conduct the field sampling tasks identified in the title of this SOP. In the event the Project Manager or Project Team Members determine that the protocols and procedures listed in this SOP are not applicable to the project, there is the option to either adapt this SOP or to develop a site-specific SOP to more closely match the requirements of the project. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

## 2.0 Health and safety considerations

**2.1** The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

**3.1** The two known interferences in ambient sampling could be low humidity and low concentration that might affect the ability of PVC filter to retain hexavalent chromium (Cr (VI)).

## 4.0 Equipment and materials

- Air Metrics MiniVol TAS (Tactical Air Sampler or equivalent) with related apparatus and Manufacturer's instruction manual
- Air Metric (or equivalent) NIST traceable flow standard kit for calibrating the MiniVol TAS Sampler
- Cr(VI) Field Sampling Event Data Sheets

- Chain-of-custody forms
- Two-piece polystyrene filter cassettes with back-up screen
- Cassettes shipping plastic mailer
- 47 mm PVC filters
- Teflon coated forceps
- Small Shipping cooler
- Blue Ice
- Ziploc bag
- Small Bubble wrap

# 5.0 Procedures

## 5.1 PVC Filter Cassette Assembly Preparation

**5.1.1** Using the Teflon coated forceps, place a 47 mm PVC filter on the stainless steel screen in the outlet side of the two-piece cassettes

**5.1.2** Replace the inlet side of the cassette and then compress the two pieces together to form the cassette assembly

**5.1.3** Verify that the PVC filter is facing the inlet of the cassette assembly

**5.1.4** Place the assembled filter cassette in a clean cassette holder (plastic mailer) to seal the filter cassette

**5.1.5** Assembling of the filter cassette may be performed in the laboratory or the field.

## 5.2 Flow Calibration of the MiniVol TAS

The sample flow rate specified in OSHA Method ID 215 Version 2 is 2 liters per minute (LPM) and the total sample volume required is approximately 960 liters.

**5.2.1** In order to simulate the pressure drop that will be encountered during actual sampling, the PVC filter cassette assembly prepared in section 5.1 should be used in the flow calibration. It is advisable to dedicate a "dummy" cassette assembly for the purpose of calibrations and flow checks.

**5.2.2** Load the “dummy “ cassette assembly in the MinVol TAS filter holder . Remove the weather cap and insert the Air Metric flow calibration kit adaptor and connect the port of the adaptor to the digital manometer with suitable flexible tubing.

---

**5.2.3** The MiniVol TAS consists of an active constant flow device which compensates for changes in pressure drop across the sample train. The use of a dummy filter cassette assembly in-line during calibration and flow check serves as a verification that the pressure drop over the filter cassette assembly is not too great for the pump and is an exact duplication of conditions the pump will experience during sampling.

**5.2.4** For the operating procedures of the MiniVOl TAS and the Air Metric calibration kit, refer to the manufacturer instruction manual as well as its SOP

**5.2.5** Turn ON the MinVol TAS and digital manometer of the flow standard, and let it running and warm-up for at least 2-3 minutes, verify the ball height on the rotameter is at approximately 2 LPM, adjust the flow control circuit on the TAS until the ball height is at 2 LPM if necessary

**5.2.6** Measure the approximate flow rate through the calibration system train. Adjust the flow on the MiniVol TAS until the desired flow rate close to 3.5 LPM is achieved. Ensure to allow 10 to 15 seconds after each adjustment for the flow control mechanism to respond before activating the flow standard to take any flow measurement. Record the digital manometer reading of the adapter and the equivalent rotameter reading (midpoint of the ball) on the calibration data sheet. Record the ambient temperature and pressure, the standard pressure and temperature

**5.2.7** Repeat 5.2.7 for target flow rate of 3.0, 3.5. 4.0, 4.5 and 5.0 LPM

**5.2.8** Calculate the actual flow from each manometer reading from the equation provided with the calibration kit ( adaptor) for each ball height. Determine the relationship by linear regression or on a graph between the actual measured flow rates ( on Y axis) and the square root of equivalent rotameter reading( on X axis) corrected to actual temperature and pressure

**5.2.9** Determine the equivalent ball height (corrected to seasonal temperature and pressure ) of the rotameter for the sampling flow of 2 LPM

**5.2.10** When the calibration has been completed, remove the dummy filter cassette assembly and save it for future calibrations.

**5.3** Calibrate each MiniVol TAS following step 5.2 of this SOP.

**5.4** Record all calibration data on a Calibration Data Sheet including serial numbers as well as the calibrated flow rates, ball heights, temperature and pressure as well as flow rate vs. ball height relationship associated with each MiniVol TAS,

**5.5** Determine and record the seasonal, operation ball height as in step 5.2.10 for each MiniVol TAS.

**5.6** Install the MiniVol TAS consisting of a pre-loaded PVC filter cassette assembly at the sampling location. The height of the sample inlet should be approximately 2 meters from the ground. .

**5.7** Record all initial pertinent data on the Cr (VI) Field Sampling Event Data Sheet including sample location name, date of sampling, filter and cassette ID #, MiniVol TAS serial #, seasonal rotameter ball height, and start time on the elapsed timer.

**5.8** At the start of the sampling event, turn the MiniVol TAS on and begin sampling. Record the initial reading on the elapsed timer. Verify the ball height on the rotameter has settled steadily on the pre-determined seasonal reading ( from step 5.5)., adjust the ball height as necessary **Note:** The MiniVol TAS might take a few seconds to regulate the flow to the target value

**5.9** If possible, check each MiniVol TAS at approximately one-hour intervals to assure proper operation.

**5.10** After the sampling event is completed, record the final rotameter ball height, turn off the TAS then record the "End Time" on the elapsed timer on the Cr (VI) Field Sampling Event Data Sheet

**5.11** Remove the exposed filter cassette from the MiniVol TAS inlet/filter holder and place it in a clean plastic cassette mailer. After all samples have been collected they will be transported to a "clean area" for transfer to the sample shipping container for overnight shipping and delivery to the analytical laboratory. **Note :** All Cr (VI) field samples with the chain-of-custody form will be shipped overnight to arrive at the analytical laboratory within 24 hours of sampling. All samples will be logged, with the accompanying information.

**5.12** Once chain-of-custody documentation is completed and all entries verified, the samples will be prepared for overnight shipment. Sample cassette /plastic mailer assemblies should be placed in a clean Ziploc® bag and the bag should be packed with small bubble wrap snugly in a clean shipping container or cooler to prevent movement of the samples during shipment.

**5.13** To preserve the samples during transit, Blue ices will be placed inside the shipping cooler as standard practice.

**5.14** After packing, the container or cooler lid will be sealed along its entire length with wide tape.

**5.15** **Field Blank** -One field blank per sampling day will also be submitted from the same lot number as the sample filters. Field blanks will be subjected to the exact handling as the samples, except that no air is drawn through the filter cassette assembly. The handling includes loading, sealing and transporting in the field and shipping to the laboratory.

# 6.0 Sample Analysis

6.1 All filter samples including blanks and quality control samples must be analyzed within 8 days of collection. Samples must be prepared using an alkaline digestion as described in OSHA Method ID-215. The digestate is then analyzed using OSHA Method ID-215. Results are reported as total ug Cr(VI)/filter.

6.2 Final results may be reported as $\mu g/m^3$ using the following equation:

$$Cr(VI),\ \mu g/\ m^3 = Cr\ (VI)\ on\ filter\ \mu g/m^3\ air\ sampled$$

# 7.0 Quality assurance / quality control

**7.1** Field Blanks: The purpose of field blanks is to facilitate the detection of contamination that may have occurred between the initial filter manufacturing process and field handling. To accomplish this a field blank is collected by dedicating a filter cassette through the entire process of filter loading, cassette sealing, labeling, transporting to the field site, set-up, and labeling/packaging/transporting to the lab, without passing any sample air through it. In general, at least one field blank from the same lot number as the samples should be collected and analyzed per day of sampling. Details of the blank collection procedure should be described in the sample collection records.

**7.2** Chromic Acid cleaning solutions must not be used in any field or laboratory operations.

# 8.0 Data and records management

**8.1** All data, notes, comments will be documented on the Cr(VI) Sampling Event Data Sheet and in the Site Log Book as described in this procedure. All laboratory data must be recorded in a bound notebook. All documentation must be reproducible. Use black ink whenever possible, and write legibly. All records shall be placed in the project/task file immediately following sample collection.

**8.2** Unanticipated changes to the procedures or materials described in this SOP (deviations) will be appropriately documented in the project records.

**8.3** Records associated with the activities described in this SOP will be maintained according to the document management policy for the project.

# 9.0 Personnel qualifications and training

**9.1** Qualifications and training

**9.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

**9.1.2** The individual must have prior knowledge and training of operating the Air Metric Calibration kit flow standard and the Air Metrics MiniVol TAS.

**9.2** Responsibilities

**9.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this SOP.

**9.2.2** The individual performing the work is responsible for implementing the procedures as described in this SOP and any project-specific work plans.

**9.2.3** The on-site field technician or operator is responsible for the operation and documentation of the sample collection apparatus, as well as preparation of samples for shipment to the laboratory.

## 10.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

OSHA Method ID 215 Version 2 for Hexavalent Chromium Analysis. Revised April 2006. Method Development Team, Industrial Hygiene Chemistry Division, Sandy UT

AECOM SOP 1011, Preparation and Control of Standard Operating Procedures.

AECOM SOP 2000-226 Calibration/Operation/Maintenance of MiniVol TAS

## 11.0 Revision history

| Revision | Date | Changes |
|---|---|---|
| 0 | May 2010 | NA |
| | | |

## Cr(VI) Field Sampling Event Data Sheet

**Network Name ________________ Date __________________ Operator _____________**

**Site Temperature °C: begin________ End _______Atmospheric Pressure __________mmHg**

**Seasonal Temperature °C = ____________ Seasonal Pressure ____________mm Hg**

| Location (ID) | Filter ID | MiniVol TAS S/N | MiniVol Initial Flow Rate (LPM$_1$) | MinVol Post-Sampling flow Rate (LPM$_2$) | Average sampling Flow Rate Ave(LPM) | Start Time ( min ) | End Time (min) | Elapsed Time ( min ) | Total Sampling Volume (Liters) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Note :** **Ave(LPM) = $(LPM_1 + LPM_2)/2$**

**Total Sampling Volume (Liters) = Ave(LPM) x Elapsed time (min)**

**Specs for Total Volume : between 912 - 1008 liters**

**Comments :**

Example of a Sampling Event Data Sheet

# Operation and Calibration of a Portable Hydrogen Sulfide Monitor

Procedure Number: PPG 020

Revision No.: 0

Revision Date: May 2010

Mary

POP Author

Date: May 2010

Project Manager

Date: May 2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

## Contents

Project Operating Procedure

POP No.: PPG 020
Revision: 0
Date: May 2010

# Operation and Calibration of a Portable Hydrogen Sulfide Monitor

## 1.0 Project Scope and applicability

### 1.1 Purpose and Applicability

This document describes the procedures that will be followed by field staff for operation and calibration of a portable hydrogen sulfide ($H_2S$) monitor. The monitor is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of hydrogen sulfide in sampling environments.

The instrumentation routinely used by AECOM personnel is the Jerome 631-X Hydrogen Sulfide Analyzer manufactured by Arizona Instrument Company. Personnel responsible for using this monitor should first read and thoroughly familiarize themselves with the instrument instruction manual.

### 1.2 Principle of Operation

The Jerome 631-X Hydrogen Sulfide Analyzer is designed for rapid detection of hydrogen sulfide vapor in ambient air. A thin gold film undergoes an increase in electrical resistance in the presence of hydrogen sulfide proportional to the mass of hydrogen sulfide present in the sample. When the SAMPLE button is pressed, an internal pump pulls ambient air over the gold film sensor for a measured period; the gold film absorbs the hydrogen sulfide and the increase in electrical resistance is converted to and displayed as parts per million (ppm) $H_2S$. During normal sampling the ambient air sample is diluted in the flow system at a ratio of 100:1. If low levels of hydrogen sulfide are expected, undiluted air samples can be drawn across the gold film sensor.

The instrument’s microprocessor automatically re-zeroes the digital meter at the start of each sample cycle and freezes the meter reading until the next sample cycle is activated, thus eliminating drift between samples. During the sample mode cycle, the LCD display indicates the percentage of sensor saturation. Depending on concentration a series of 50 to 500 samples may be taken before the sensor reaches saturation. When the display indicates the sensor is near saturation a 10-minute heat cycle is required to remove the accumulated hydrogen sulfide from the sensor.

### 1.3 Specifications

Refer to the specific manufacturer’s instructions for the technical specifications. This analyzer has a range of 0.003 ppm to 50 ppm $H_2S$. Response time is 12 – 52 seconds.

## 2.0 Health and safety considerations

The health and safety considerations for the site, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

This instrument is designed for vapor use only. The probe or instrument intake should not be exposed to any liquid, dust, or other foreign material.

## 3.0 Interferences

The instrument should be at the same temperature as its environment before sampling. A Zero Air Filter removes mercury vapor, mercaptans, and hydrogen sulfide from the air sample; when this filter is installed the readings should be at or near zero. Since air cooler than the instrument can cause low readings and warmer air can result in higher readings the Zero Air Filter should be used to equilibrate the instrument to ambient air temperature. Continuous sampling with clean air will not cause saturation of the gold filter but will allow the instrument to equilibrate more rapidly.

The Zero Air Filter can also be used to identify contamination within the instrument. If the readings do not reduce to near zero with the filter installed, contamination should be suspected.

The gold film sensors do not respond to the following compounds:

- Hydrocarbons
- CO, $CO_2$, and $SO_2$
- Water vapor (water vapor condensation on the gold film can cause irreparable harm to the sensor and must be avoided)

The following compounds *may* cause the gold film to respond:

- Chlorine
- Ammonia
- $NO_2$
- Most mercaptans (organic sulfur compounds or thiols)

## 4.0 Equipment and materials

- Jerome 631-X Hydrogen Sulfide Analyzer
- Probe
- Tubing Adapter
- Trimmer Tool
- Zero Air Filter
- Line Cord
- Functional Test Module
- Manufacturer’s instructions

- Field data sheets or logbook/pen

## 5.0 Procedures

### 5.1 Preliminary Steps

Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

### 5.2 Calibration

To ensure the input to the instrument contains no hydrogen sulfide or mercaptans, use a Zero Air Filter. This filter cleans the air sample and should produce sample readings of less than 0.003 ppm. With the Zero Air Filter in place, sample the air continuously until the readings stabilize.

Perform a sensor regeneration and re-zero the instrument prior to each day’s use or after 30 days of storage or inactivity. Press the ON switch and the REGEN button. The instrument will begin a 10 minute regeneration cycle indicated by .H.H.H flashing on the display. **Do not interrupt this cycle**. When regeneration is complete wait 30 minutes to allow the instrument to cool then zero the sensor by pressing the ZERO button and turning the zero adjust screw under the instrument handle until the display reads 0.

The gold film sensor is inherently stable and does not require frequent calibration. It has been factory calibrated against NIST traceable permeation tubes. Calibration must be performed at the factory or an authorized calibration/repair facility. While the actual frequency depends upon the application and use, the recommended interval between calibrations is every 12 months. The Functional Test Module (FTM) provides a field check of the functionality of the instrument but does not calibrate the instrument. The FTM uses a permeation tube containing hydrogen sulfide; the flow rate and temperature of the release of hydrogen sulfide is factory calibrated to provide a specified concentration to the instrument. If the concentration falls within the expected range for the FTM being used the instrument is functioning properly; if the level is not within the expected range then the instrument must be returned for service. This calibration check is used as part of a routine maintenance routine.

### 5.3 Operation

Turn on the unit and allow it to warm up (minimum of 1 minute). The digital display should read 000. Recharge or replace the battery pack if the LO BAT indicator remains on.

Use the Zero Air Filter to equilibrate the instrument to ambient air temperature; sample continuously until the readings stabilize.

Perform sensor regeneration, wait a minimum of 30 minutes and then zero the instrument.

Press the SAMPLE button to begin sampling; during the sampling cycle the digital display will show bars to indicate the degree of sensor saturation. At the end of the sampling cycle the hydrogen sulfide concentration is displayed in ppm; record the value. This value will remain in the display until the next sample is taken; the digital meter automatically zeroes at the start of each sample.

When sampling is completed for the day, perform sensor regeneration. Under no circumstances should hydrogen sulfide be allowed to remain on the sensor overnight.

At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 5.2) except that no adjustment will be made to the instrument. Record the information in the field records.

When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

### **5.4** Routine Maintenance

Perform sensor regeneration daily. Do not allow hydrogen sulfide to remain on the gold film sensor overnight. This analyzer has a range of 0.003 ppm to 50 ppm $H_2S$. Periodically check Tygon® tubing within the instrument; kinks and crimps can restrict airflow during regeneration cycle and permanently damage the sensor.

All routine maintenance should be performed in a non-hazardous environment.

### **5.5** Troubleshooting Tips

A display of .8.8.8 indicates the sensor is saturated and must be regenerated.

Changes in temperature may cause the display to show .L.L.L when taking the initial sample. Refer to the operating manual for directions on zero adjustment.

The display shows H at conclusion of sensor regeneration when zero is pressed. Check tubing for crimps and repeat regeneration cycle. If the problem is not resolved the fritware filter, intake filter disk, scrubber filters and Tygon® tubing.

High or erratic results may indicate that the internal filters are clogged. This can happen when sampling in dusty or humid areas.

A low response or erratic readings, particularly after an extended period of non-use may indicate the need for a second regeneration cycle. Wait 30 minutes before performing the second regeneration cycle.

## 6.0 Quality assurance / quality control

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.

Calibration of the $H_2S$ monitor will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The FTM will be used as part of a routine maintenance program to verify instrument functionality. Readings which are outside the stated acceptance range for the FTM used will require that the monitor be returned to the factory for calibration.

Checks of the instrument response (Section 5.2) should be conducted periodically and documented in the field records.

## 7.0 Data and records management

Safety and survey monitoring with the hydrogen sulfide monitor will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number.
- Instrument manufacturer, model, and identification number.
- Operator's signature.
- Date and time of operation.
- Calibration check at beginning and end of day (meter readings before adjustment).
- Span setting after calibration adjustment.
- Meter readings (monitoring data obtained).
- Instances of erratic or questionable meter readings and corrective actions taken.
- Instrument checks and response verifications.

## 8.0 Personnel qualifications and training

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this POP and the project plan.

The field operator is responsible for verifying that the hydrogen sulfide monitor is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this POP and the project plan.

## 9.0 References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | May 2010 | Original POP |

# Field and Laboratory Measurement of pH

**Manager's Signature:**

| | |
|---|---|
| **SOP #:** | 7121 |
| **Effective Date:** | 12/29/2009 |
| **Revision #:** | 2 |
| **Method Reference:** | 2550 B |

## 1.0 SCOPE AND APPLICATION

### 1.1 Purpose and Applicability

This Standard Operating Procedure (SOP) provides basic instructions for routine calibration and operation of the Oakton pH/CON 300 meter. This SOP is designed specifically for the measurement of pH in accordance with Standard Method 4500-H B which address electrometric pH measurements of drinking, surface, and saline waters, domestic and industrial wastes, and acid rain.

### 1.2 Quality Assurance Planning Considerations

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the laboratory Quality Assurance Quality Control (QA/QC) Manual and may include duplicate or replicate measurements or confirmatory analyses.

## 2.0 RESPONSIBILITIES

2.1 The analyst is responsible for verifying that the pH meter is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this SOP and the project plan.

2.2 The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project plan.

## 3.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Oakton Portable Waterproof pH/Conductivity/temperature meter 9with Auto temperature correction) (model 300)
- Oakton pH/CON 300 instruction manual

- Deionized water
- Clean glass or plastic beakers or cups
- 4.0, 7.0, and 10.0 buffer solutions
- Magnetic stirrer and Teflon-coated stirring bar
- Lint-free tissues
- Mild detergent and/or 10% hydrochloric acid (for use if samples contain oily material or particulate matter)
- Calibration sheets
- Laboratory/field data sheets or logbook.

## 4.0 SUMMARY OF METHOD

The pH of a sample is determined electrometrically using either a glass electrode and a reference potential or a combination electrode.

## 5.0 SAMPLE HANDLING, PRESERVATION, AND GENERAL MEASUREMENT PROCEDURES

5.1.1 To achieve accurate pH measurements, samples shall be analyzed within 15 minutes of collection. Sample should be collected in plastic or glass containers.

5.1.2 After measuring a sample containing oily material or particulate matter, the electrode must be cleaned by carefully wiping with a lint-free cloth, or washing gently in a mild detergent, followed by a deionized water rinse. If this does not suffice, an additional rinse with 10% hydrochloric acid (followed by de-ionized water) may be needed.

5.1.3 As temperature can affect the pH measurements obtained, both the pH and the temperature of the sample must be recorded.

5.1.4 Calibration must include a three point calibration that bracket the expected pH of the samples to be measured.

5.1.5 Primary standard buffer salts available from NIST can be purchased and are necessary for situations where extreme accuracy is required. Secondary standard buffers may be purchased as a solution from commercial vendors and are recommended for routine use. Buffers should not be used after their expiration dates as provided by the manufacturer. If the manufacturer does not supply an expiration date or if the buffers are prepared from pH powder pillows, etc., an expiration date of one year from purchase or preparation should be used. All standards must be labeled with manufacturer, lot number, receipt date, opened date, and expiration date.

5.1.6 When the meter is being used in the field, move the probe in a way that creates sufficient sample movement across the sensor; this insures homogeneity of the sample and suspension of solids. If sufficient movement has occurred, the readings will not drift (<0.1 pH units). Rinse the electrode with deionized water between samples and wipe gently with a lint-free tissue.

5.1.7 Fluctuating readings may indicate more frequent instrument calibrations are necessary.

5.2 Calibration and Measurement Procedures

5.2.1 The pH meter must be calibrated daily before any analyses are performed. The instrument serial # should be noted in the log book. The meter should be checked every 3 hours against one of the buffers, and the value recorded. If the measurement is off by more than 0.2, the instrument needs to be re-calibrated.

5.2.2 A duplicate pH reading must be made for every twenty (20) samples measured in the field for any given parameter. The duplicate results must be reported with its corresponding sample results. Duplicate results must be within 0.10 standard units of the original analysis result.

5.2.3 Connect the electrode to the meter. Choose either 7.0 and 10.0 (high range) or 4.0 and 7.0 (low range) buffers, whichever will bracket the expected sample range. Place the buffer in a clean beaker. If the pH is being measured in a laboratory, place the beaker on the magnetic stirrer and place the stirring bar in the beaker. Measure and record the temperatures of the buffers using a calibrated thermometer or automatic temperature compensation (ATC).

5.2.4 Place the electrode into the 10.0 buffer or into the 7.0 buffer. (The calibration procedure described here begins with the buffer of the highest pH selected. The instrument manufacturer’s calibration instructions may suggest starting with the buffer of the lowest pH selected).

5.2.5 Adjust the instrument calibration according to the Oakton instruction manual. Discard the buffer and rinse the beaker and stirring bar thoroughly with de-ionized water.

5.2.6 Refill the beaker with the 7.0 buffer or the 4.0 buffer. Rinse the electrode, gently wipe it with a lint-free tissue, and place it in the selected buffer solution. If the pH is being measured in a laboratory, place the beaker on the magnetic stirrer and place the stirring bar in the beaker. Continue adjusting the instrument calibration according to the manufacturer's instructions. Record the electrode slope (if provided by the instrument) on the calibration sheet (an acceptable slope is between 92 and 102 percent). Measure and record the temperature of the buffer using a calibrated thermometer or ATC. Discard the buffer and rinse the beaker and stirring bar thoroughly with deionized water.

5.2.7 After calibration, the instrument shall be checked against the calibration buffers. Calibration is valid if buffers read within 0.10 standard units of their certified values.

5.2.8 An additional check may be performed, if required by the project plan, by placing the electrode into an additional buffer solution. This buffer should be from a different source than the buffers used for the initial calibration. This buffer should read within +0.2 pH units of the buffer's true pH value if after three hours of use.

5.2.9 Verify the calibration every 20 samples and after the last sample of the day with a buffer solution prepared from a different source than that used for initial calibration. Recalibrate the instrument if the check value varies more than 0.2 pH units from the true value.

5.2.10 The electrode will be rinsed with deionized water and wiped gently with a lint-free tissue between sample analysis.

5.2.11 Recalibrate the instrument if the buffers do not bracket the pH of the samples.

5.2.12 The meter must be re-calibrated following any maintenance activities and prior to the next use.

### 5.3 Troubleshooting Information

If there are any performance problems with the pH meter which result in inability to achieve the acceptance criteria presented in Section 5.0, consult the appropriate section of the meter instruction manual for the checkout and self-test procedures. If the problem persists, consult the manufacturer's customer service department immediately for further instructions.

### 5.4 Maintenance

5.4.1 Instrument maintenance should be performed according to the procedures and frequencies required by the manufacturer.

5.4.2 The electrode must be stored and maintained according to the manufacturer's instructions.

5.4.3 If an instrument with ATC is being used, the device should be checked on a quarterly basis for accuracy with an NIST thermometer.

## 6.0 QUALITY CONTROL

6.1 Duplicate measurements of a single sample will be performed of at least 1 per every 20 samples. Duplicate measurements should agree within +0.1 pH units.

6.2 The temperature readout of the meter will be checked quarterly against an NIST-traceable thermometer. If the difference is greater than 0.2□C, the instrument manufacturer will be consulted for instructions. Temperature measurements will be compensated for any difference with the reference thermometer.

## 7.0 REPORTING

7.1 All pH meter calibration, temperature check, and maintenance information will be recorded on a daily calibration sheet. pH data may be recorded on the appropriate laboratory or field data sheets or logbooks.

7.2 Calibration documentation must be maintained in a thorough and consistent manner. At a minimum, the following information must be recorded:

- Date and time of calibration

- Signature or initials of person performing the measurement
- Instrument identification number/model
- Expiration dates and batch numbers for all buffer solutions
- Reading for pH 7.0 buffer before and after meter adjustment
- Reading for pH 4.0 or 10.0 buffer before and after meter adjustment
- Readings for all continuing calibration checks
- Temperature of buffers (corrected for any difference with reference thermometer), including units
- Slope reading (if provided by instrument)
- Comments

7.3 Documentation for recorded data must include a minimum of the following:

- Date and time of analysis
- Signature or initials of person performing the measurement
- Instrument identification number/model
- Sample identification/station location
- Temperature (corrected for any difference with reference thermometer) and pH of sample (including units and duplicate measurements)
- Comments
- All calibration records (logs) must be retained for five years.

## 8.0 TRAINING/QUALIFICATIONS

To properly perform pH measurements, the analyst must be familiar with the calibration and measurement techniques stated in this SOP. The analyst must also be experienced in the operation of the meter.

Certain state certification programs require that pH measurements in the field be taken by, or in the presence of, personnel that are qualified under the certification program.

## 9.0 REFERENCES

APHA-AWWA-WPCF. Standard Methods for the Examination of Water and Wastewater, 20th Edition. 1999.

AECOM

Project Operating Procedure

---

# Field and Laboratory Measurement of Dissolved Oxygen

**Procedure Number: PPG 022**

Reference SOP #: 7124 Revision No.: 3

Method Reference: 2550 B

Revision Date: June 2010

POP Author Date: 6/21/2010

Kathleen Woolley

QA Reviewer Date: 6/21/2010

Annual review of this POP has been performed
and the POP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

# Project Operating Procedure

# Decontamination of Field Equipment

POP No.: PPG 022
Revision: 0
Date: June 2010

## Contents

# Project Operating Procedure

# Decontamination of Field Equipment

## 1.0 Purpose and applicability

This Standard Operating Procedure (SOP) provides basic instructions for routine measurement of Dissolved Oxygen (DO) using Oakton Portable Waterproof Dissolved Oxygen Meter (Model 35641). It is noted that this instrument is a combination DO/temperature meter.

This SOP, which has been prepared pursuant to the requirement of NJAC7:18-8, addresses DO measurement only.

This SOP applies when performing “analyze immediately” DO measurements on regulatory samples, in accordance with Standard Method SM 4500 O G, for DO measurement in drinking, surface and saline waters, and domestic and industrial wastewaters.

## 2.0 Summary of method

Dissolved oxygen levels in natural and waste waters depend on the physical, chemical, and biochemical activities in the water body.

This meter uses a galvanic probe. It consists of a cell that contains electrolyte and that is enclosed by a selective membranes, and two metallic electrodes. The membrane is practically impermeable to water and ionic dissolved matter, but is permeable to oxygen and a few other gasses.

The cathode consumes the oxygen passed through the membrane, and produces an electric current in the probe; this current is proportional to the partial pressure of oxygen in the sample.

## 3.0 Responsibilities

The analyst is responsible for verifying that the DO meter is in proper operating condition prior to use, and for operating the meter in accordance with manufacturers’ instructions. The analyst is also responsible for implementing and documenting the calibration and measurement procedures in accordance with the manufacturers’ instructions, this SOP and the project plan.

The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources and guidance necessary to perform the measurements in accordance with this SOP and the project plan.

## 4.0 Required materials

The following materials are necessary for this procedure:

- Oakton Portable Waterproof DO meter (Model 35641)
- Oakton instruction manual
- Deionized Water

- Field logbook
- Lint free cloth

## 5.0 Sample handling and general measurement procedures

To achieve accurate temperature measurements, samples must be analyzed within 15 minutes of collection. Samples should be collected in glass or plastic containers.

Since the cathode consumes the oxygen in the sample, it is essential that the fluid flow past the sensor to maintain accurate readings. Therefore, when the meter is being used in the field, if necessary, move the probe in a way that creates sufficient sample movement across the sensor. This insures homogeneity of the sample. If sufficient movement has occurred, the readings will not drift. Rinse the electrode with deionized water between samples and wipe gently with a lint free cloth.

The solubility of oxygen in water varies with barometric peruse and temperatures, and decreases as salinity increases. For the most accurate DO readings, you need to compensate for these factors. This meter automatically compensates for temperature readings. It also allows you to enter a salinity correction factor and the barometric pressure to correct this variability. A pressure vs. altitude table is included in the equipment instruction booklet. Consult manufacturer's instructions if it becomes necessary to adjust the instrument from factory default settings for salinity and/or barometric pressure.

After measuring a sample containing oily material or particulate matter, the electrode may need to be cleaned using a deionized water rinse and/or by carefully wiping with a damp lint-free cloth.

## 6.0 Calibration and measurement procedures

The DO meter must be calibrated daily before any analyses are performed. The meter shall be calibrated in accordance with the manufacturer's instructions. The instrument serial number should be noted in the field book.

A duplicate DO reading must be made for every twenty samples measured in the field. The duplicate result must be reported with its corresponding sample result. Duplicate results must be within 10% of the original analysis result and recorded in the field book.

The electrode will be rinsed with deionized water and wiped gently with a lint-free tissue between sample analyses.

The meter must be re-calibrated following any maintenance activities and prior to the next daily use.

The built-in temperature sensor included in the probe is factory calibrated. Calibrate your sensor only if you suspect drift that may have occurred over a long period of time or if you have a replacement probe. Calibration is performed using a NIST traceable thermometer, in accidence with manufacturer's instruction.

The instrument will be calibrated for DO measurement precision weekly when in use using the Winkler Method.

## 7.0 Troubleshooting information

If there are any performance problems with the DO meter which result in inability to achieve the acceptance criteria presented in Section 6 (+/- 10%), consult the appropriate section of the meter instruction manual for the troubleshooting procedures. If the problem persists, consult the manufacturer’s customer service department immediately for further instructions.

## 8.0 Probe care

The probe is a galvanic measuring element which produces an output proportional to the oxygen present in the medium in which it is placed. The galvanis probe design lets you take measurements immediately- without the typical 15 minute wit of other dissolved probes.

The probe consists two parts:

- An upper part consisting of an anode, a cathode, and cable; and
- A lower part consisting of a membrane cap, membrane, and electrolyte.

Under typical operating control conditions, the probe should last for several years. Proper care and maintenance will help you receiver the maximum probe life and ensure more accurate readings. Since any deposits on the membrane surface act as a barrier to oxygen diffusing through the membrane, the membrane must be cleaned at regular intervals to assure maximum reliability. After using the probe, rinse the probe in clean water and wipe it with a soft cloth or paper to avoid any hardening of deposits. If growth develops on the probe, use a disinfecting chemical to clean.

NOTE: Although the membrane is strong and not easily damaged, wipe it gently while cleaning it. If the membrane is damaged or torn, the probe will no longer function. There are no special probe storage requirements.

## 9.0 Quality control

A duplicate measurement of a single sample will be performed of at least 1 per every20 samples. Duplicate DO measurements should agree within +/- 10%. Duplicate temperature measurements should agree within 1.0 degree Fahrenheit.

The instrument will be calibrated quarterly when in use using the Winkler method. The temperature probe will be calibrated against an NIST traceable thermometer. Calibration records will be maintained by AECOM’s Laboratory Manager. Records will be kept on the file for at least 5 years.

## 10.0 Reporting

All daily DO meter calibration and maintenance information, as well as DO data, will be recorded on the appropriate laboratory or field data sheets or field logbook.

At a minimum, the following information must be recorded:

Date and time of calibration
Instrument identification number/model
Signature or initials of person performing the measurement

Documentation for recorded data must include a minimum of the following:

Data and time of analysis
Signature or initials of person performing the measurement
Instrument identification number/model
Sample identification/ station location
Temperature and DO readings
Comments

## 11.0 Training/qualifications

To properly perform temperature measurements, the analyst must be familiar with the calibration and measurement techniques stated in this SOP. The analyst must also be experienced in the operation of the meter.

Certain state certification programs require that temperature measurements in the field be taken by, or in the presence of, personnel that are qualified under the certification program.

## 12.0 References

APHA-AWWA-WPCF. Standard Methods for the Examination of Water and Wastewater, 20th Edition. 1999.

Operating Instructions – Oakton DO Meter – 300 Series.

## 13.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 3 | June 2010 | Revised POP |

# Field and Laboratory Measurement of Temperature

| | |
|---|---|
| **Manager's Signature:** | |
| **SOP #:** | 7123 |
| **Effective Date:** | 12/29/2009 |
| **Revision #:** | 2 |
| **Method Reference:** | 2550 B |

## 1.0 SCOPE AND APPLICATION

### **1.1** Purpose and Applicability

This Standard Operating Procedure (SOP) provides basic instructions for routine measurement of temperature using the Oakton pH/CON 300 meter. It is noted that this instrument is a combination pH/temperature meter. This SOP addresses temperature measurement only (other capabilities are outlined in the appropriate SOP). This SOP is designed specifically for the measurement of temperature in accordance with Standard Method 2550 B which address thermometric temperature measurement of drinking, surface, and saline waters, and domestic and industrial wastes.

### **1.2** Quality Assurance Planning Considerations

The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the laboratory Quality Assurance Quality Control (QA/QC) Manual and may include duplicate or replicate measurements or confirmatory analyses.

## 2.0 RESPONSIBILITIES

**2.1** The analyst is responsible for verifying that the Oakton pH/CON 300 meter is in proper operating condition prior to use and for implementing the calibration and measurement procedures in accordance with this SOP and the project plan.

**2.2** The project manager is responsible for ensuring that project-specific requirements are communicated to the project team and for providing the materials, resources, and guidance necessary to perform the measurements in accordance with this SOP and the project plan.

## 3.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Oakton Portable Waterproof ph/Conductivity/Temperature meter (model 300)
- Oakton pH/CON 300 meter instruction manual
- National Institute of Standards and Technology (NIST)-traceable thermometer
- Laboratory or field data sheets or logbooks
- Clear glass or plastic containers

## 4.0 SUMMARY OF METHOD

The temperature of a sample is determined electrometrically using a temperature sensor. The Oakton pH/CON 300 meter displays temperature in the range of -10.0 to 110 $^{o}$C simultaneously with sample results. The meter can display measurement values to tenths (0.0), hundredths (0.00) or thousandths (0.000). The default is hundredths. The meter can display temperature in $^{o}$C or $^{o}$F.

## 5.0 SAMPLE HANDLING, PRESERVATION, AND GENERAL MEASUREMENT PROCEDURES

To achieve accurate temperature measurements, samples shall be analyzed within 15 minutes of collection. Samples should be collected in glass or plastic containers.

### **5.1** Calibration and Measurement Procedures

**5.1.1** The Oakton pH/CON 300 meter will, at a minimum, be checked quarterly as described in Section 5.0. The device will be checked against an NIST-traceable thermometer and the necessary compensation made for the difference in temperature 0.5 $^{o}$C or greater

**5.1.2** Immerse the Oakton pH/CON 300 meter into the sample.

**5.1.3** Swirl and take a reading when the value stabilizes.

**5.1.4** Record the temperature reading to the nearest 0.1$^{o}$.

**5.1.5** The Oakton pH/CON 300 meter will be deployed in accordance with the manufacturer's instruction manual. For water-column profiling operations (if applicable) the sensor readings will be recorded manually in a designated field logbook or continuously through the use of a computer. An internal data-logger will be used for recording sensor measurements during moored deployment of a sensor. The frequency of data recording will be specified in the project plan. The location, date, and time of sensor deployment, along with depth (of measurement or mooring) will be recorded in conjunction with the temperature sensor data. Additional documentation requirements are listed in Section 6.2.

**5.1.6** Temperature data may be post-calibrated using any of a variety of calibration data including, but not limited to, field calibration points, manufacturer calibration data, and analytical results from samples collected during field deployment of the sensors. The decision criteria for post calibration, and the technique used, will be specified in the project plan, and will be consistent with the manufacturer's recommendations.

### **5.2** Troubleshooting Information

If there are any performance problems with the Oakton pH/CON 300 meter, consult the appropriate section of the meter instruction manual for the checkout and self-test procedures. If the problem persists, consult the Oakton customer service department immediately for further instructions. If performance problems exist with the probe, repair or replace the temperature sensor.

### **5.3** Maintenance

Instrument maintenance for meter-type temperature measuring devices should be performed according to the procedures and frequencies specified by Oakton.

## 6.0 QUALITY CONTROL

**6.1** The Oakton pH/CON 300 meter will, at a minimum, be checked against an NIST-traceable thermometer at the frequency stated in section 5.1.1 (quarterly). This verification procedure will be performed as follows:

- Immerse the temperature sensor and the NIST-traceable thermometer into a sample.
- Allow the readings to stabilize.
- Record the readings and document the difference.
- Label the temperature sensor with the correction value/adjustment and the date the accuracy check was performed. A correction factor is required only when the difference between the NIST thermometer and the probe equals or exceeds 0.5 $^{o}$C.
- Compensate for the difference when sample measurements are taken.
- Record the thermometer IDs, the temperature from the NIST-traceable thermometer, the temperature from the thermometer being verified, the time, date and the initials of the analyst, and any required correction factor.

**6.2** A duplicate measurement must be made for every twenty (20) samples measured in the field for temperature measurements. It is noted that duplicate measurements should agree within ±0.5°C or approximately ±1.0°F.

## 7.0 REPORTING

**7.1** Records for checking the accuracy of the Oakton pH/CON 300 meter (where applicable) will include:

- Date
- Temperature probe checked
- Reference thermometer number
- Readings for reference thermometer and temperature probe being checked
- Adjustment made for difference in readings
- Initials of analyst

**7.2** Documentation for recorded data must include a minimum of the following:

- Date and time of analysis
- Signature or initials of person performing the measurement
- Thermometer ID number or instrument identification number/model
- Sample identification/station location
- Temperature of sample (including units and duplicate measurements) compensated for any difference with the reference thermometer if applicable
- Comments
- Records will be kept on file for at least 5-years.

## 8.0 TRAINING/QUALIFICATIONS

To properly perform temperature measurements, the analyst must be familiar with the calibration and measurement techniques stated in this SOP. The analyst must also be experienced in the operation of the meter.

Certain state certification programs require that temperature measurements in the field be taken by, or in the presence of, personnel that are qualified under the certification program.

## 9.0 REFERENCES

APHA-AWWA-WPCF. Standard Methods for the Examination of Water and Wastewater, 20th Edition. 1999.

AECOM

**STANDARD OPERATING PROCEDURE**

| | |
|---|---|
| **NUMBER:** | DRAFT |
| **REVISION:** | 01 |
| **ISSUED:** | May 26, 2010 |
| **PAGE:** | 1 of 11 |

# CALIBRATION AND OPERATION OF THE LAMOTTE 2020 TURBIDIMETER

**Prepared by:** ______________________________ **Date:** ____________
Andrew J. Mosuly // Supervisor/Technical Director

**Reviewed by:** ______________________________ **Date:** ____________
Erin Murphy Govern // Quality Assurance Officer

**Approved by:** ______________________________ **Date:** ____________
Anne M. Salazar // Manager

## TABLE OF CONTENTS

Attachment A

Attachment B

## 1.0 Scope and Application

This procedure is applicable to the field measurement of turbidity in groundwater, drinking water, or surface water using the LaMotte 2020 turbidimeter. Turbidity is an expression of the optical property that causes light to be scattered or absorbed rather than transmitted in straight lines through a sample (the higher the intensity of scattered light, the higher the turbidity). Turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic material, and microscopic organisms. Turbidity should not be confused with color, since a darkly colored water can still be clear and not turbid.

## 2.0 Summary of Method

The LaMotte 2020 turbidimeter is a portable, microprocessor controlled Nephelometer. The LaMotte 2020 turbidimeter measures scattered light in the sample at 90 degrees from the light source. A reference beam passes through the sample and is measured at 180 degrees from the light source. The ratio of these two readings is electronically converted to a turbidity measurement in nephelometric turbidity units (NTU). The light source for the LaMotte 2020 turbidimeter is a tungsten incandescent light bulb operated at 2,800 degrees Kelvin, and the light is detected by two silicon photo diodes (one at 90 degrees from the light source and one at 180 degrees from the light source). The multi-detector optical configuration assures long term stability and minimizes stray light and color interferences. All readings are determined by the process of signal averaging over a five second period, minimizing fluctuations in readings attributed to large particles and enabling rapid, repeatable measurements. A picture of the LaMotte 2020 turbidimeter is presented as Figure 2-1. A diagram illustrating how the LaMotte 2020 turbidimeter measures turbidity is presented as Figure 2-2.

The LaMotte 2020 turbidimeter is pre-calibrated by the manufacturer to a range of 0 to 1,100 NTU with AMCO™ primary standards. Recalibration of the LaMotte 2020 is not required by the user. However, a procedure to standardize the calibration is performed to obtain the most accurate readings over a narrow range using two AMCO™ standards of 1.00 NTU and 10.0 NTU, which are supplied with the LaMotte 2020.

For operation of the LaMotte 2020 turbidimeter, a sample is collected into the LaMotte 2020 turbidity vial. The vial is placed into the LaMotte 2020 sample chamber, the sample chamber is closed, and the READ button is pressed. A walking dash “—“ is displayed while the LaMotte 2020 turbidimeter analyzes the sample. After five seconds, the turbidity in NTU is displayed.

## 3.0 Health and Safety Warnings

3.1 Refer to the site-specific heath and safety plan for cautions and health and safety procedures associated with the samples to be analyzed.

3.2 Caution should be taken when working with all chemicals. Refer to the Material Safety Data Sheets (MSDSs) for the chemicals to be used. The MSDSs are located in the site-specific health and safety plan.

**Figure 2-1. The LaMotte 2020 Turbidimeter**

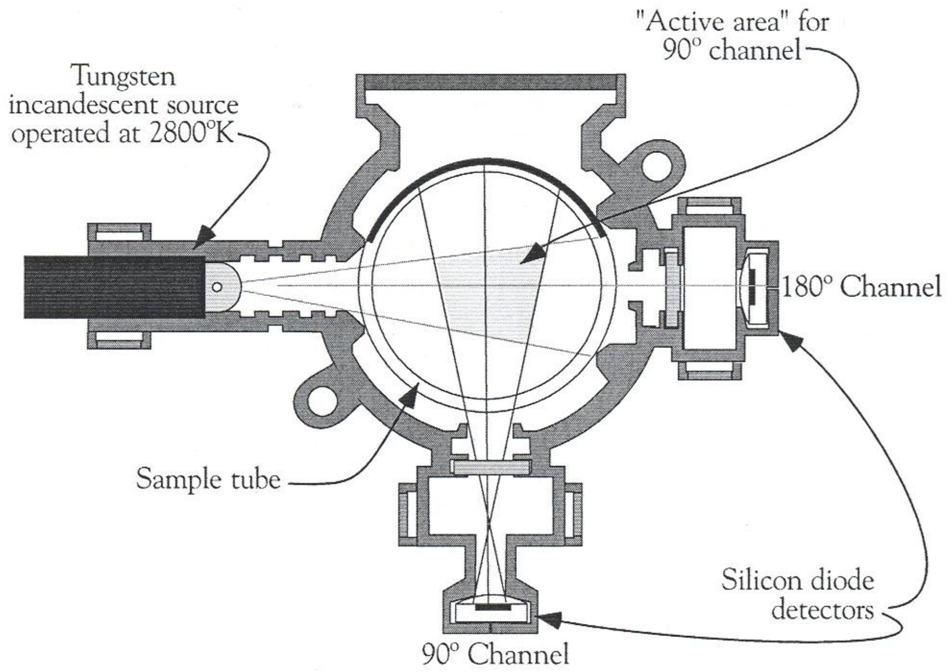


**Figure 2-2. How the LaMotte 2020 measures turbidity**

3.3 The LaMotte 2020 turbidimeter should not be stored or used in a wet or corrosive environment. Care should be taken to prevent water from wet turbidity tubes from entering the turbidimeter light chamber. NEVER PUT WET TURBIDITY TUBES IN THE TURBIDIMETER.

3.4 If operating the LaMotte 2020 turbidimeter in an environment where the temperature is less than or equal to 0° C, be sure to remove the turbidity standards from the LaMotte 2020 turbidimeter case, as the standards will freeze and crack the turbidity vials if exposed to temperatures less than or equal to 0° C.

## 4.0 Interferences

4.1 The presence of floating debris, coarse sediments, or air bubbles will cause high readings.

4.2 The presence of light absorbing materials (such as activated carbon) will cause low readings.

4.3 Excessive color in a sample will absorb light and cause high readings. If the turbidity readings appear to be biased high due to excessive color in the sample, use professional judgment when interpreting the turbidity results. This should be noted on the monitoring well worksheet or the field logbook.

4.4 Extreme care should be taken when handling the turbidity standards or the turbidity vial, as surface scratches or finger smudges will cause analytical errors. Handle these items by the top only.

4.5 Do not shake or freeze samples or turbidity standards.

4.6 Do not operate the LaMotte 2020 turbidimeter near electric motors. The electric field created by electric motors can affect turbidity readings on the LaMotte 2020 turbidimeter.

4.7 The LaMotte 2020 turbidimeter should be placed on a surface free from vibration. Vibrations can cause high turbidity readings on the LaMotte 2020 turbidimeter.

## 5.0 Personnel Qualifications

All field samplers are required to take the 40-hour OSHA Hazardous Waste Operations training course and annual 8-hour refresher training prior to engaging in any field collection activities. Prior to the implementation of this SOP, all field samplers will be instructed by a person experienced with the LaMotte 2020 turbidimeter and this SOP. All field samplers must demonstrate to the field team leader and/or Project Chemist the proper procedures for calibration and operation of the LaMotte 2020 turbidimeter prior to sample analysis.

## 6.0 Equipment and Supplies

- Copy of the Health and Safety Plan and Sampling and Analysis Plan
- LaMotte 2020 turbidimeter
- LaMotte 2020 turbidimeter turbidity tubes
- AMCO™ 1.00 NTU and 10.0 NTU turbidity standards
- Kimwipes® Absorbent Wipes
- Backup 9-volt battery
- Deionized, ultra-filtered (DIUF) water
- Turbidity free water
- ¾” circular stickers
- thermometer

## 7.0 Procedure

### 7.1 Setting the Operating Mode

The LaMotte 2020 turbidity meter has two operating modes: standard operating mode and EPA mode. The standard operating mode displays the measured turbidity to the full resolution of the instrument. The EPA mode displays the measured turbidity rounded to the reporting requirements of the EPA and Standard Methods compliance monitoring programs. Operating in EPA mode eliminates the need for the user to manually round off turbidity results according to EPA specifications. The EPA requires these reporting requirements because it recognizes the inherent accuracy limitations of turbidity measurements within the specified ranges.

The LaMotte 2020 turbidity meter can only be switched from one mode to the other while turning the instrument on from the off state. The LaMotte 2020 turbidity meter will remain in which ever mode it was last used, even if the meter has been turned off. To switch from one mode to the other, perform the following procedure:

7.1.1 Turn off the LaMotte 2020 turbidimeter if it is on.

7.1.2 Press the **CAL** button and hold it down while pressing the **READ** button to turn the LaMotte 2020 turbidimeter on.

7.1.3 The LaMotte 2020 turbidimeter will come on in the opposite mode than it was in previously. If the LaMotte 2020 is in EPA mode, an up arrow (▲) will be visible in the upper left hand corner of the instrument display.

## 7.2 Calibration of the Turbidity Tubes

If the LaMotte 2020 is supplied by a rental agency (e.g. U.S. Environmental, Pine Environmental), calibration of the turbidity tubes is usually not needed, as this procedure is performed by the rental agency and the turbidity tube with the lowest reading is usually supplied with the turbidimeter. If the LaMotte 2020 turbidimeter is purchased, or if this step was not performed by the rental agency and more than one turbidity vial is provided with the LaMotte 2020, perform the following procedure.

7.2.1 Record the ambient temperature.

7.2.2 Allow the calibration standards to equilibrate to ambient temperature.

7.2.3 Fill each turbidity tube with DIUF water.

7.2.4 Analyze and record the turbidity reading for each turbidity tube according to the procedures presented in Section 7.4.

7.2.5 Mark the tube with the lowest turbidity reading by placing a ¾" circular sticker on the top of the lid of the tube and writing an "R" on the sticker for reference tube.

7.2.6 Follow the calibration procedures presented in Section 7.3, using the reference turbidity tube and the 1.00 NTU or 10.0 NTU AMCO™ standard.

7.2.7 Fill the remaining turbidity tubes with the same AMCO™ standard as in the reference turbidity tube.

7.2.8 Analyze and record the turbidity reading for each tube according to the procedures presented in Section 7.3.

7.2.9 The difference between the true value of the AMCO™ standard (1.00 NTU or 10.0 NTU) and the value produced when the turbidity tube with the AMCO™ standard is analyzed is the correction factor for that tube. Place a ¾' circular sticker on the top of the lid of the turbidity tube and write the correction factor on the sticker. This correction factor should be used when comparing results from different tubes.

In most cases, comparison of results from different tubes is not necessary, and only steps 7.2.1 through 7.2.3 need to be performed in order to determine which turbidity tube produces the lowest reading.

## 7.3 Calibration of the LaMotte 2020 Turbidimeter

7.3.1 Record the ambient temperature.

7.3.2 Allow the calibration standards to equilibrate to ambient temperature.

7.3.3 Select the AMCO™ standards (1.00 NTU or 10.0 NTU) in the range of the samples to be tested. In most cases this will be the 10.0 NTU standard.

7.3.4 Fill the reference turbidity tube (see section 7.2) with the standard, cap the reference turbidity tube, and wipe the reference turbidity tube with a Kimwipe®. **NOTE:** If the LaMotte 2020 Turbidimeter is provided by a rental agency, the rental agency will most likely supply the two AMCO™ standards in capped turbidity tubes that are dedicated to each standard. Therefore, pouring of the AMCO™ standard into the reference turbidity tube is not necessary.

7.3.5 Open the lid on the LaMotte 2020 turbidimeter. Align the indexing arrow on the turbidity tube with the indexing arrow just below the sample chamber on the LaMotte 2020 turbidimeter (see Figure 7-1), and insert the turbidity tube into the sample chamber.

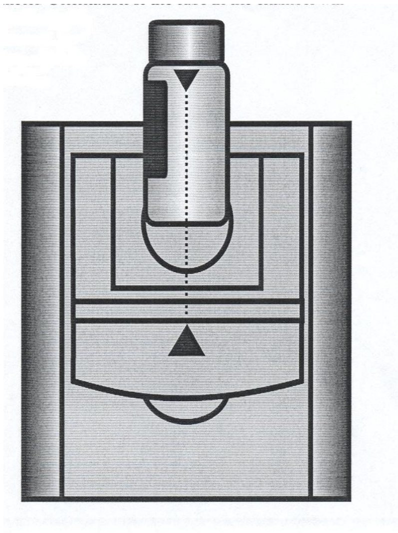


**Figure 7-1 Aligning the Index Arrows on the Turbidity Tube and the LaMotte 2020 Turbidimeter**

7.3.6 Close the lid on the LaMotte 2020 turbidimeter and press the **READ** button. The turbidity in NTU will be displayed in five seconds. If the displayed value is within +/- 5% of the true value of the AMCO™ standard, record the reading on the turbidity calibration log sheet, and indicate in the comments column of the turbidity calibration log sheet that the reading was obtained through a calibration check, and the LaMotte 2020 turbidimeter did not require calibration. If the displayed value is not within +/- 5%of the true value of the AMCO™ standard, continue with the calibration procedure.

7.3.7 Push the **CAL** button for five seconds until **CAL** is displayed on the LaMotte 2020 turbidimeter, and release the **CAL** button. The display will flash the reading obtained in step 7.3.6.

7.3.8 Adjust the display with the ▲ or ▼ buttons until the true value of the AMCO™ standard is displayed on the LaMotte 2020 turbidimeter.

7.3.9 Push the **CAL** button again to memorize the calibration. The LaMotte 2020 turbidimeter display will stop flashing, indicating that calibration is complete. Press the **READ** button again to verify that the calibration is acceptable. If the reading is not within +/- 5% of the true value of the AMCO™ standard, the LaMotte 2020 turbidimeter must be recalibrated by repeating steps 7.3.1 through 7.3.9.

7.3.10 Once an acceptable calibration check has been performed, record the reading on the turbidity calibration log sheet, and indicate in the comments column of the turbidity calibration log sheet that the reading was a calibration check obtained following calibration.

7.3.11 Repeat the calibration check using a second standard to bracket the expected values. For low-flow groundwater sampling, deionized ultra-filtered water (0.00 NTU) should be used unless elevated turbidity is expected. Repeat steps 7.3.4 and 7.3.6. The value should be within ± 0.10 NTU. If criteria are not met, check the cleanliness of the tube, check the standard for air bubbles, and repeat the check. If the error cannot be corrected, recalibrate, or use another meter.

7.4 Sample Analysis

7.4.1 Rinse an empty turbidity tube with a portion of the sample, and shake out the excess sample water.

7.4.2 Fill the reference turbidity tube to the neck. The turbidity tube should be filled in a manner such that the sample water is entering the turbidity tube down the side of the turbidity tube to avoid creating bubbles.

7.4.4 Cap the turbidity tube and wipe the turbidity tube dry with a clean Kimwipe®.

7.4.5 Gently mix the sample by inverting the turbidity tube. Be careful not to introduce any bubbles into the turbidity vial.

7.4.6 Open the lid on the LaMotte 2020 turbidimeter. Align the indexing arrow on the turbidity tube with the indexing arrow just below the sample chamber on the LaMotte 2020 turbidimeter (see Figure 7-1), and insert the turbidity tube into the sample chamber.

7.4.7 Close the lid on the LaMotte 2020 turbidimeter and press the **READ** button. The turbidity in NTU will be displayed in five seconds.

7.4.8 Use a graduated cylinder and turbidity free water to dilute any sample that is over 1,100 NTU, such that the reading falls within the LaMotte 2020 turbidimeter's calibrated range (0 to 1,100 NTU). Calculate final turbidity according to the following formula:

*Turbidity (NTU) = sample_reading x dilution_factor*

Record the results on the monitoring well worksheet or the field logbook.

7.4.9 The LaMotte 2020 turbidimeter will turn off automatically two minutes after the last button push. To turn the LaMotte 2020 turbidimeter off manually, press and hold the **READ** button for at least one second. Release the **READ** button when "0FF" is displayed.

## 8.0 Data and Records Management

All calibration/calibration check information must be documented on the turbidity calibration log sheet. An example turbidity calibration log sheet is presented in Attachment A. All sample data and relevant information (e.g. sample collection method used) must be documented on field data sheets (e.g. groundwater monitoring worksheets, surface water sampling worksheets) or within site log books with permanent ink. Data recorded will include the following:

- Instrument make, model, and serial number
- Date, time, and results of instrument calibration and calibration checks
- Deviations from the procedure as written
- Readings obtained, including any dilutions

## 9.0 Quality Control and Quality Assurance

9.1 The LaMotte 2020 turbidimeter will be calibrated at the start of each day of sample analysis according to the procedures described in Section 7.3. If a parameter is measured that lies outside of the range bracketed by the instrument calibration standards, the instrument must either be recalibrated using standards that bracket the value or a calibration check using a standard that brackets the value must be performed. If the standards are not available to bracket the result, the data must be qualified.

9.2 Readings measured by instruments that are subsequently found to be outside of criteria during the calibration check shall be documented on the sampling worksheet used to document the sample collection.

9.3 If the LaMotte 2020 turbidimeter is being used in fieldwork (e.g. groundwater sampling or surface water sampling), the calibration will be checked each day prior to calibration, immediately after calibration (if calibration is required as described in Section 7.3), and at the end of each day using the same AMCO™ standard as was used for calibration. The reading must be within +/- 5% of the true value (± 0.10 NTU for the zero standard). If this criteria is not met, the source of the problem must be identified and corrected, or another turbidimeter must be used.

9.4 If the LaMotte 2020 turbidimeter is being used in a field laboratory setting (e.g. pilot groundwater treatability study), the calibration will be checked each day prior to calibration, immediately after calibration (if calibration is required as described in Section 7.3), at the midpoint of each day, and at the end of each day using the same AMCO™ standard as was used for calibration. The reading must be within +/- 5% of the true value. If this criteria is not met, the source of the problem must be identified and corrected, or another turbidimeter must be used.

## 10.0 Troubleshooting and Maintenance

The LaMotte 2020 turbidimeter is not designed for field service with the exception of battery replacement. See the Instructions Manual presented in Attachment B for detailed descriptions of troubleshooting and maintenance procedures. Some common troubleshooting and maintenance procedures are presented below.

10.1 "BAT" is displayed – The battery is low and needs to be changed.

10.1.1 Open the battery compartment lid on the bottom of the LaMotte 2020 turbidimeter

10.1.2 Remove the 9-volt battery from the battery compartment, disconnect and remove the 9-volt battery from the polarized plug

10.1.3 Carefully connect a new 9-volt battery to the polarized plug and insert it into the battery compartment.

10.1.4 Close the battery compartment lid.

10.2 "ER1" is displayed – The battery is very low and needs to be changed immediately. **Operating the LaMotte 2020 turbidimeter with a very low battery could result in permanent erasure of the factory calibration. Change the battery according to the procedures outlined in steps 10.1.1 through 10.1.4 immediately.**

10.3 "ER2" is displayed – The sample result is above the calibration range (>1,100 NTU). Dilute the sample with turbidity free water and reanalyze.

10.4 "ER3" is displayed – The tungsten incandescent light bulb is misaligned or burnt out. Call LaMotte for procedures on returning the instrument to the manufacturer.

## 11.0 References

LaMotte Company, 2004. *LaMotte 2020 Turbidimeter Instruction Manual,* August.

U.S. Environmental Protection Agency Region I (U.S. EPA-NE). 2010. *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductivity, oxidation/reduction potential [ORP], and turbidity), Revision Number 2*. January 19.

Attachment A

# Attachment B

AECOM

**STANDARD OPERATING PROCEDURE**

| | |
|---|---|
| **NUMBER:** | DRAFT |
| **REVISION:** | 01 |
| **ISSUED:** | May 26, 2010 |
| **PAGE:** | 1 of 20 |

# CALIBRATION AND OPERATION OF YSI 6-SERIES WATER QUALITY METER FOR TEMPERATURE, PH, DISSOLVED OXYGEN, CONDUCTIVITY AND OXIDATION REDUCTION POTENTIAL

**Prepared by:** ______________________ **Date:** __________
Andrew J. Mosuly // Supervisor/Technical Director

**Reviewed by:** ______________________ **Date:** __________
Erin Murphy Govern // Quality Assurance Officer

**Approved by:** ______________________ **Date:** __________
Anne M. Salazar // Manager

## TABLE OF CONTENTS

## 1.0 Scope and Application

The purpose of this standard operating procedure (SOP) is provide a framework for calibrating sondes used to measure water quality parameters for ground water and surface water. Water quality parameters include temperature, pH, dissolved oxygen, conductivity/specific conductance, and oxidation reduction potential. Turbidity must not be measured using the portable water quality meters since the method used by the YSI and other models for turbidity measurement may not be approved for use by EPA, and because the flow-through cell acts as a sediment trap. A separate meter which uses EPA Method 180.1 or Standard Method 3130 B to measure turbidity must be used.

This SOP is written specifically for the YSI model 6-Series Sondes (which include the 600R, 600XL, 600XLM, 6820, 6920 and 6600 models), and the YSI 650 MDS (Multi parameter Display System) display/logger. Note that the YSI 6820 is the equipment model typically used. The general calibration processes discussed herein are applicable to other manufactures sondes and displays/loggers. Consult the manufacturer’s instruction manuals for specific procedures.

## 2.0 Summary of Method

This SOP describes the process for calibration using YSI Model 6-Series Sondes for water quality field measurements.

## 3.0 Health and Safety Warnings

3.1 All proper personal protection clothing and equipment is to be worn.

3.2 The standard solutions for calibrating conductivity contain iodine, potassium chloride and propanol. When using the standards, avoid inhalation, skin contact, eye contact or ingestion. If skin contact occurs, remove contaminated clothing immediately. Wash the affected areas thoroughly with large amounts of water. If inhalation, eye contact or ingestion occurs, consult the Material Data Safety Sheets (MSDS) for prompt action, and in all cases seek medical attention immediately.

3.3 All standard solutions for calibration pH contain the following chemicals:

- pH 4 Solutions: potassium hydrogen phthalate, formaldehyde, water
- pH 7 Solutions: sodium phosphate (dibasic), potassium phosphate (monobasic), water
- pH 10 Solutions: potassium borate (tetra), potassium carbonate, potassium hydroxide, sodium diethylenediamine tetraacetate, water

Avoid inhalation, skin contact, eye contact and ingestion. If skin contact occurs remove contaminated clothing immediately. Wash the affected areas thoroughly with large amounts of water. If inhalation, eye contact or ingestion occurs, consult the MSDS for prompt action, and in all cases seek medical attention immediately.

3.4 Standard solutions for calibration of oxidation reduction potential (ORP) contain the following chemicals:

- potassium ferrocyanide trihydrate

- potassium ferrocyanide
- potassium chloride

Avoid inhalation, skin contact, eye contact, and ingestion. Avoid combining with the pH buffers and with any acids since cyanide may be released. Isolate the ORP solution. Do not dispose with other calibration solutions. If skin contact occurs, wash affected areas thoroughly with large amounts of water. Consult the Health and Safety Plan, and the MSDSs therein.

3.5 Standard solutions for calibration of dissolved oxygen contain sodium sulfite, cobalt chloride, manganese sulfate, alkali-iodide-azide, sulfuric acid, starch solution and sodium thiosulfate. Avoid inhalation, skin contact, eye contact, and ingestion. If skin contact occurs, wash affected areas thoroughly with large amounts of water. Consult the Health and Safety Plan, and the MSDSs therein.

## 4.0 Interferences

4.1 Each of the parameters measured with this procedure is subject to various interferences including cross-contamination, turbidity, aeration, and temperature fluctuations. Care must be taken to ensure that the instrument remains in a stable, controlled environment throughout the calibration and monitoring process; and that the conditions under which the samples are analyzed are the same as those under which calibration is conducted.

4.2 There must be no air bubbles lodged between the probe and probe guard.

4.3 All standards should be stored according to manufacturers' instructions.

## 5.0 Personnel Qualifications

5.1 All field samplers are required to take the 40-hour OSHA health and safety training course and annual 8-hour refresher courses prior to engaging in any field collection activities.

5.2 Prior to implementation of this procedure, the field sampler will be instructed by a person experienced with these procedures and will demonstrate to the field team leader the proper set-up, calibration, operation, and routine maintenance of the hand-held equipment, as well as an understanding of this procedure.

## 6.0 Equipment and Supplies

- Copy of the instrument manual and instrument specifications
- Copy of the project Health and Safety Plan and Sampling and Analysis Plan
- Thermometer (with NIST trace)
- pH Buffers of 4, 7, and 10
- Conductivity standards (concentration dependent upon expected field conditions)
- Zobell ORP calibration standard
- Zero Dissolved Oxygen Solution
- Deionized Ultra-Filtered (DIUF) Water

- YSI Sonde with attached pH, Conductivity, Dissolved Oxygen, and ORP probes with clear flow-through cell
- YSI 650 MDS Multiparameter Display System
- Sonde communications cable
- Winkler DO Kit
- Ring stand or similar capable of holding the sonde and flow-through cell upright during low-flow groundwater sampling
- Kimwipes or equivalent
- Gallon-size plastic freezer bags (e.g. Ziploc) to protect the MDS and the top of the Sonde from rain

## 7.0 Procedure

All instrument probes must be calibrated before they are used to measure environmental samples, and the calibration should be checked at the end of the sampling day or if any anomalous readings are obtained. All results should be recorded on the YSI Water Quality Calibration Log Sheet, presented in Attachment 1.

### 7.1 Set-up

7.1.1 Before performing any calibration procedure the sonde and display/logger must warm-up for at least 15 minutes.

7.1.2 During the warm-up period, set the sonde up on a ring stand.

7.1.3 Prior to calibration, all instrument probes on the sonde must be cleaned according to the manufacturer’s instructions. Failure to perform this step can lead to erratic measurements. The probes must also be cleaned by rinsing with deionized water before and after immersing the probe in a calibration solution.

7.1.4 Check the calibration solutions for expiration dates and do not use expired standards.

7.1.5 The temperature of the standards should be as close to the temperature of the samples to be measured as is practical.

7.1.6 For each of the calibration solutions, provide enough volume so that the probe and the temperature sensor are sufficiently covered. Specific detail on the volume required for each sonde and calibration solution is provided on pages 2-29 and 2-30 of the YSI 6-Series Instrument Manual.

7.1.7 Check the display/logger to determine the battery level in the display/logger to see if new batteries are necessary.

7.1.8 Set up instrument display so that the following items are displayed:

- DO (%)
- ORP (mV)

- DO (mg/L)
- Cond. (µs/cm)
- Sp. Cond. (µs/cm)
- pH (Standard Units [S.U.])
- Temperature (°C)

## 7.2 Temperature

For instrument probes that rely on the temperature sensor (pH, dissolved oxygen/specific conductance, and ORP), the sonde temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST). This accuracy check should be performed at least quarterly, and the date and results of the check kept with the instrument. Temperature checks will be checked by the rental company for rented units, and by the M&E equipment manager for M&E-owned units. Prior to mobilizing, obtain the date and results of the check from the equipment room manager or check the outside of the case for rental units. If the check has not been performed within the past three months, do not use the instrument. Document the date, results, and company that performed the check on the calibration log sheet or in the field logbook. In the event that verification is required, the procedure is presented below:

7.2.1 Fill a container with water and adjust the water temperature to a temperature below the temperature of the samples to be measured.

7.2.2 Place a thermometer that is traceable to the NIST into the water and wait for both temperature readings to stabilize.

7.2.3 Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer within the accuracy of the sensor (+/- 0.2°C). If the measurements do not agree, the instrument may not be working correctly and the manufacturer should be contacted.

7.2.4 Repeat the procedure using a container of water that has a temperature above that anticipated for the samples to be measured.

## 7.3 Dissolved Oxygen

Dissolved oxygen (DO) content in water is measured using a membrane electrode. The DO probe's membrane and electrolyte solution should be inspected for any damage or air bubbles prior to calibration. If air bubbles, nicks, or damage are present, replace the membrane according to manufacturer's suggestions. After changing the membrane, it is preferable to wait 12 hours before use to allow the membrane to equilibrate. If this is not possible, note this in the calibration log. YSI 6-Series DO probe be must calibrated using the calibration cup provided with the sonde. Calibration of the DO probe requires inputting the current barometric pressure. The YSI 650 display/logger has a barometer within the unit and automatically provides this during the calibration procedure. The barometric pressure for all units onsite should be checked for agreement between units, or checked using the onsite barometer. Other display/loggers do not supply the barometric pressure, and this must be obtained from an onsite barometer. Do not use barometric pressure obtained from meteorology reports as these are usually corrected to mean sea level.

Calibration is performed using 100% saturated air, and checked immediately after with a solution with zero dissolved oxygen. The calibration check at the end of the day uses both 100% saturated air and the zero dissolved oxygen solution. In addition, on a weekly basis when the meter is in use, compare DO concentrations measured by the probe to those measured using the Winkler method.

7.3.1 DO Calibration

7.3.1.1 Gently dry the temperature sensor and remove any water droplets from the DO probe's sensor membrane according to the manufacturer's instructions. Note that the evaporation of moisture on the temperature sensor or DO probe may influence the readings during calibration.

7.3.1.2 Place a small amount of water (<1/8") in the bottom of the calibration cup. Engage only one thread of the calibration cap onto the sonde so that the DO probe is readily vented to the atmosphere. Take care to avoid touching the oxygen membrane with the calibration cups and flow-cell. The DO probe and thermistor must not be in contact with the water. Keep the instrument in run mode and wait approximately 15 minutes for the air in the calibration cup to become water-saturated (100% humidity at atmospheric pressure) and the temperature to equilibrate. Set up the remaining instruments and solutions in the meantime.

7.3.1.3 When the temperature has stabilized, go to Calibrate mode - **Calibrate DO%**

7.3.1.4 Record the temperature on the calibration log. Check the barometric pressure reading on the YSI versus the barometer and other YSIs present. Enter the barometric pressure if correction is necessary. Record the barometric pressure on the calibration log. (Note: barometric pressures presented in meteorological reports are generally corrected to mean sea level. These are not useful for calibrating the sonde, which requires uncorrected barometric pressure).

7.3.1.5 When the DO% and temperature readings have stabilized for at least one minute, press **enter**. Record the number that appears on the screen. Record also the DO mg/L value.

7.3.1.6 Check the oxygen solubility at that pressure and temperature on Table 1 and record under "Std temp/pressure correction." The instrument DO reading should be comparable with the value on the table (within ±0.2 mg/L). If not, recalibrate, or replace DO membrane.

7.3.1.7 Make up the zero DO solution by filling the calibration cap with DI water, adding approximately 1 gram of sodium sulfite to supersaturate the solution. Add a few crystals of the cobalt chloride (purple salt) and stir. There should be solids on the bottom of the cap. Screw the cap tightly onto the YSI. Water should leak out to indicate that there is no air around the probes. An open disposable sample cup may be used in place of the calibration cap, however if check criteria are not met, the procedure must be repeated using the calibration cap as described.

7.3.1.8 Immediately after calibration, if the DO is ≤ 0.50 mg/L and ≥ 0.00 mg/L, record the value on the calibration log. If the number stabilizes at a value > 0.50 mg/L, or reads negative, and an open cup was used, repeat the procedure with the closed calibration cup. If an open cup was not used, change the DO membrane and repeat the calibration and check.

7.3.1.9 Remove the cap, and rinse the probes well with DI water. Blot the probes dry, carefully avoiding the DO membrane.

7.3.2 DO End-of-Day Check

7.3.2.1 Perform the calibration check using the 100% saturated standard.

7.3.2.1.1.1 Follow Steps 7.3.1.1 and 7.3.1.2.

7.3.2.1.1.2 Allow the DO% and temperature readings to stabilized for at least one minute. Record the number that appears on the screen. Record also the DO mg/L value.

7.3.2.1.1.3 Check the oxygen solubility at that pressure and temperature on the attached table and record under "Std temp/pressure correction." The instrument DO reading should be comparable with the value on the table (within ±0.5 mg/L).

7.3.2.2 Perform the calibration check using the zero dissolved oxygen standard.

7.3.2.2.1.1 Follow Step 7.3.1.7.

7.3.2.2.1.2 The DO should be ≤ 0.5 mg/L, but not negative. If the DO is above criteria, make up a new zero DO standard and used a closed calibration cap if an open cup was used. Repeat the calibration check. If criteria are still not met, note the failed criteria and the readings that are impacted.

7.3.3 Winkler Method

7.3.3.1 Fill a 300-mL glass stoppered BOD bottle with sample water. Remember no bubbles.

7.3.3.2 Immediately add 2mL of manganese sulfate to the collection bottle by inserting the calibrated pipette just below the surface of the liquid. (If the reagent is added above the sample surface, you will introduce oxygen into the sample.) Squeeze the pipette slowly so no bubbles are introduced via the pipette.

7.3.3.3 Add 2 mL of alkali-iodide-azide reagent in the same manner.

7.3.3.4 topper the bottle with care to be sure no air is introduced. Mix the sample by inverting several times. Check for air bubbles; discard the sample and start over if any are seen. If oxygen is present, a brownish-orange cloud of precipitate or floc will appear. When this floc has settle to the bottom, mix the sample by turning it upside down several times and let it settle again.

7.3.3.5 Add 2 mL of concentrated sulfuric acid via a pipette held just above the surface of the sample. Carefully stopper and invert several times to dissolve the floc. At this point, the sample is "fixed" and can be stored for up to 8 hours if kept in a cool, dark place. As an added precaution, squirt distilled water along the stopper, and cap the bottle with aluminum foil and a rubber band during the storage period.

7.3.3.6 In a glass flask, titrate 201 mL of the sample with sodium thiosulfate to a pale straw color. Titrate by slowly dropping titrant solution from a calibrated pipette into the flask and continually stirring or swirling the sample water.

7.3.3.7 Add 2 mL of starch solution so a blue color forms.

7.3.3.8 Continue slowly titrating until the sample turns clear. As this experiment reaches the endpoint, it will take only one drop of the titrant to eliminate the blue color. Be especially careful that each drop is fully mixed into the sample before adding the next. It is sometimes helpful to hold the flask up to a white sheet of paper to check for absence of the blue color.

7.3.3.9 The concentration of dissolved oxygen in the sample is equivalent to the number of milliliters of titrant used. Each milliliter of sodium thiosulfate added in steps 6 and 8 equals 1 mg/L dissolved oxygen.

## 7.4 pH

The pH of a sample is determined electrometrically using a glass electrode. Choose the appropriate standards that will bracket the expected values at the sampling locations. A two or three-point calibration can be performed. Typically, a three-point calibration using standards pH 4, pH 7, and pH 10 will be required. A calibration check is performed immediately after calibration using the pH 7 standard and a criterion of ±0.05 S.U. A calibration check is also performed at the end of the day using the pH 7 standard and a criteria of 0.2 S.U..

### 7.4.1 pH Calibration

7.4.1.1 Allow the buffered samples to equilibrate to the ambient temperature.

7.4.1.2 Remove the calibration cap and clean all of the probes on the sonde with deionized water. Begin with pH 7. Wipe with Kimwipe and immerse all the probes except the DO probe in the 7 pH solution. Place enough pH 7 solution in the calibration cup to immerse the pH probe, reference junction, and thermistor. Return to **calibration mode**.

7.4.1.3 Scroll to pH on the calibration menu. Select **3-pt calibration**.

7.4.1.4 Enter the pH value based on the solution temperature when prompted for the first value, and press **enter**. The pH value adjusted for temperature is presented on the label of the buffer solution.

7.4.1.5 When value is stable for approximately 30 seconds, press **enter**, and record the number that appears on the screen. The display will indicate that the calibration has been accepted and will prompt the analyst to enter a second pH value.

7.4.1.6 Remove probes from solution. Rinse with DI water, wipe carefully, and put all probes in solution pH 4. Make sure that there is enough pH 4 buffer to immerse the pH probe, reference junction, and thermistor.

7.4.1.7 Enter the pH value based on the solution temperature when prompted for the second pH solution, press **enter**.

7.4.1.8 Allow at least one minute for temperature equilibration. When value is stable for at least 30 seconds, press **enter**, and record the number that appears on the screen.

7.4.1.9 Repeat steps 5, 6, and 7 for the pH 10 solution.

7.4.1.10 Press **enter** or **esc** to go to calibration menu.

7.4.1.11 Go to the run mode to perform a calibration check of the pH 7 solution. Rinse the probe and immerse in pH 7 solution. The reading should be within ± 0.05 pH units of the pH value adjusted for temperature. If not, recalibrate. Record the reading.

7.4.2 pH End-of-Day Check

7.4.2.1 Go to the run mode to perform a calibration check of the pH 7 solution.

7.4.2.2 Rinse the probe and immerse in pH 7 solution. Record the reading. The reading should be within ± 0.2 pH units of the pH value adjusted for temperature.

7.4.2.3 If not, record on the measurements impacted that the pH calibration check criterion was not met.

7.5 Conductivity

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25°C. Note that the pH buffers are highly conductive and will adversely impact calibration of conductivity. Thoroughly rinse the probes after performing pH calibration, and then pre-rinse the probe with the conductivity solution to be used.

EPA recommends that conductivity be calibrated using standards that bracket the range of concentrations expected. Conductivities in groundwater frequently range below 1,000 µS/cm; however YSI does not recommend calibration with standards below 1,000 µS/cm because interference with the instrument from outside electrical noise (RF) may be a factor. Since the calibration for conductivity is a 1-point calibration, and expected conductivities will generally be less than 1,000 µS/cm, calibrate with the 1,000 µS/cm standard, and perform a check with a lower conductivity solution to bracket the range (e.g. 100 µS/cm). If an alternative check concentration is required to bracket the expected concentrations of site samples, the alternative concentration will be specified in the site-specific QAPP.

7.5.1 Conductivity Calibration

7.5.1.1 Allow the calibration standards to equilibrate to the ambient temperature.

7.5.1.2 Carefully rinse the probes in DIUF, then in the first conductivity solution to be used.

7.5.1.3 Immerse all probes except the DO probe completely in the conductivity calibration solution. Make sure that the thermistor is immersed, and the conductivity cell is immersed past the vent hole. Gently tap the side of the calibration cup to dislodge any air bubbles trapped inside the cell.

7.5.1.4 Scroll to **conductivity** on the screen, then select **specific conductance**. Select calibrate to **µS/cm**. Enter the conductivity value for the standard at 25ºC in µS/cm, which is the same as the specific conductance for the standard

7.5.1.5 Press **enter** and wait for the readings to stabilize. Press **enter**. Record the readings for specific conductivity in the calibration log. Do not exit conductivity.

7.5.1.6 **Do not** indicate “accept” when the calibration indicates “Out of Range.” Possible causes are incorrect entry, low level of solution, bubbles, or a bad probe. Attempt to recalibrate. If the problem persists, use another instrument. Return the instrument to the vendor or equipment room.

7.5.1.7 Perform a check of the calibration. Remove the probes from the solution. Rinse with the next conductivity solution. Immerse all probes except DO in the conductivity calibration solution. Allow the number to stabilize and record the values for specific conductivity in the calibration log. If the specific conductivity result is not within 5% of the value on the bottle, recalibrate. Remove probes from solution and rinse with DI water. Wipe dry.

7.5.2 Conductivity End-of-Day Check

7.5.2.1 Rinse the probes with the conductivity solution. Immerse all the probes except the DO probes in the conductivity calibration solution.

7.5.2.2 Allow the number to stabilize and record the values for conductivity and specific conductivity in the calibration log. If the specific conductivity result is not within 5% of the value on the bottle, note on the measurements obtained that the conductivity calibration check criteria were not met.

7.5.2.3 Remove the probes from solution and rinse with DI water. Wipe dry.

7.6 Oxidation Reduction Potential

ORP will be checked for accuracy, and will only be field calibrated if the calibration check fails criteria.

7.6.1 ORP Calibration

7.6.1.1 Switch to **run mode**. Gently mix the ORP solution and open the packet. Put all but the DO probe in the ORP solution. Allow to stabilize and record reading. If reading is not within ±10mV of the actual value corrected for temperature (see Table 2), proceed to 7.6.1.2.

7.6.1.2 Go to Calibration mode. Scroll to ORP and press **enter**. Enter ORP value (**corrected for temperature** - see above) and press **enter**. When the number is stable for 20 seconds, press **enter** and record the number. If instrument says "Out of Range," do not accept the value: Use a different instrument. If a different instrument is not available, record the number and note that it is not within limits.

7.6.2 ORP End-of-Day Check

7.6.2.1 Switch to **run mode**.

7.6.2.2 Gently mix the ORP solution and open the packet. Put all but the DO probe in the ORP solution.

7.6.2.3 Allow to stabilize and record reading. If reading is not within ±10mV of the actual value corrected for temperature (see table below), note on the measurements affected that the criterion for ORP check was not met.

7.7 Close up Instrument (After calibration and prior to mobilizing to the sampling location)

7.7.1 Replace clean cap over probes.

7.7.2 Select MDS Menu mode. Reset the parameters to the field sampling parameters:

- Time (24hr) – correct as needed
- pH (S.U.)
- specific conductivity (µs/cm)
- ORP (mV)
- Temperature (°C)
- DO (mg/L)

7.7.3 Shut off computer, and return to case

## 8.0 Data and Records Management

8.1 Calibration logsheets shall be used to document the details of instrument calibration and calibration checks.

8.2 The site logbook should be used to note when instrument calibration and instrument calibration checks were conducted, and should reference the calibration logsheets for details.

## 9.0 Quality Control and Quality Assurance

9.1 Quality Control Criteria are summarized in Table 2.

9.1.1 If a parameter is measured that lies outside of the range bracketed by the instrument calibration standards, the instrument must either be recalibrated using standards that bracket the value or a calibration check using a standard that brackets the value must be performed. If the standards are not available to bracket the result, the data must be qualified.

9.1.2 Readings measured by instruments that are subsequently found to be outside of criteria during the calibration check shall be documented on the sampling worksheet used to document the sample collection.

9.2 Pollution Prevention

9.2.1 Containers used to calibrate the probes shall be sized to use the smallest amount of standard possible but still accommodate all probes which need to be in the calibration solution such that they are adequately covered.

9.2.2 Conductivity and pH calibration solutions may be reused at the end of the day with caution if properly stored. However, a calibration check that reuses standard but does not meet criteria should be re-checked with fresh standard, and calibration should be conducted with fresh standards.

9.3 Waste Management

Unused calibration standards should be returned to the equipment room manager for proper disposal. Do not combine ORP standards with other standards since cyanide could be released.

## 10.0 References

State of Washington Department of Ecology. 2010. How to Measure Dissolved Oxygen. http://www.ecy.wa.gov/programs/wq/plants/management/joysmanual/4oxygen.html May 25.

U.S. Environmental Protection Agency Region I (U.S. EPA-NE). 2010. *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductivity, oxidation/reduction potential [ORP], and turbidity), Revision Number 2*. January 19.

U.S. Environmental Protection Agency Region I (U.S. EPA-NE). 2002. *Standard Operating Procedure for Calibration and Field Measurement Procedures for the YSI Model 6-Series Sondes (Including: Temperature, pH, Specific Conductance, Turbidity, and Dissolved Oxygen), Revision I*. May 31.

U.S. Environmental Protection Agency Region I (U.S. EPA-NE). 2006. *Final QA Bulletin: Calibration of Dissolved Oxygen Meters, Revision 0*. February.

YSI, Inc. (YSI). 2010. 6-Series Multiparameter Water Quality Sondes: User Manual, www.ysi.com . May 25.

YSI, Inc. (YSI). 2002. *YSI Calibration Procedures: Profiling and Logging,* www.water-monitor.com . Dec 22.

**Table 1: Oxygen Solubility at Indicated Pressure (Source: 2010 EPA SOP for Calibration of Field Instruments)**

**Table 2: ORP Check Standard Readings (Source: YSI 3682 Zobell Solution Instructions)**

| Temperature, °C | 231 mV Standard Solution |
|---|---|
| -5 | 270.0 |
| 0 | 263.5 |
| 1 | 262.2 |
| 2 | 260.9 |
| 3 | 259.6 |
| 4 | 258.3 |
| 5 | 257.0 |
| 6 | 255.7 |
| 7 | 254.4 |
| 8 | 253.1 |
| 9 | 251.8 |
| 10 | 250.5 |
| 11 | 249.2 |
| 12 | 247.99 |
| 13 | 246.6 |
| 14 | 245.3 |
| 15 | 244.0 |
| 16 | 242.7 |
| 17 | 242.4 |
| 18 | 240.1 |
| 19 | 238.8 |
| 20 | 237.5 |
| 21 | 236.2 |
| 22 | 234.9 |
| 23 | 233.6 |
| 24 | 232.3 |
| **25** | **231.0** |
| 30 | 224.5 |

**Table 3: pH Values Adjusted for Temperature**
**For Use Only with**
**pH4 -- Fisher #SB-101-500**
**pH7 – Fisher #SB-107-500**
**pH10 – Fisher #SB-115-500**

**(Source: Fisher Scientific Standard Labels)**

| Temperature (° C) | pH 4 (S.U.) | pH 7 (S.U.) | pH 10 (S.U.) |
|---|---|---|---|
| 0 | 4.01 | 7.13 | 10.34 |
| 5 | 3.99 | 7.10 | 10.26 |
| 10 | 4.00 | 7.07 | 10.19 |
| 15 | 3.99 | 7.05 | 10.12 |
| 20 | 4.00 | 7.02 | 10.06 |
| 25 | 4.00 | 7.00 | 10.00 |
| 30 | 4.01 | 6.99 | 9.94 |
| 35 | 4.02 | 6.98 | 9.90 |

**Table 4: Quality Control Criteria**

| | **Beginning of Activities** | | | | **End-of-Day** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Calibration** | | **Calibration Check** | | **Calibration Check** | | | |
| **Parameter** | **Standard** | **Criteria** | **Standard** | **Criteria** | **1st Standard** | **Criteria** | **2nd Standard** | **Criteria** |
| Temperature | NIST Thermometer | ± 0.2 °C | NA | NA | NA | NA | NA | NA |
| Dissolved Oxygen | 100 % Saturated | ± 0.2 mg/L | 0.0 mg/L | ≤ 0.5 mg/L, but ≥ 0.0 | 100% Sat | ± 0.5 mg/L | 0.0 mg/L | ≤ 0.5 mg/L, but ≥ 0.0 |
| pH | Bracket anticipated (pH 7, 4, 10) | NA | pH 7<br>Temp. adjusted value | ± 0.05 pH | pH 7<br>Temp. adjusted value | ± 0.2 pH | NA | NA |
| Specific Conductance | Bracket anticipated (≤ 1,000 µS/cm) | NA | Bracket anticipated | ± 5% | Same as for calibration | ± 5% | NA | NA |
| Oxidation-Reduction Potential | Only if check fails: 231 mV Zobell solution | NA | 231 mV Zobell solution | ± 10mV | 231 mV Zobell solution | ± 10mV | NA | NA |

## Attachment: YSI Water Quality Calibration Log

**SOP NUMBER: 2600-150A**

# Operation/ Field Calibration of the Baseline BTX Model 1030A GC

**Date:** October 2004
**Revision Number:** 01
**Author:** Tony Sacco
**Discipline:** Air Toxics Monitoring

## 1.0 PURPOSE AND SCOPE

The purpose of this SOP is to provide a method for field personnel to operate and calibrate/ adjust the span response setting of the Baseline model 1030A gas chromatograph (GC) that is configured to speciate the BTX compounds benzene, toluene and the m, o, p-xylenes ( defined as Xylene).

This operation and calibration procedure assumes that the Model 1030A GC is installed in a real-time network where the analog output from each of the GC channels is sent to a Odessa Model 3260 data logger. The data logger converts the signals (0-10VDC) to engineering units. The engineering units are communicated to a desktop central computer by means of a telemetry system such as a spread spectrum or other wireless system

This SOP is intended for the use of individuals who have been trained in the task of calibration in general and in the calibration of this specific instrument, in particular.

## 2.0 RESPONSIBILITIES

**2.1** It is the responsibility of the project manager to make the proper training available to the qualified project field personnel.

**2.2** It is the responsibility of the project engineer to provide the training and guidance to field personnel prior to any field activity where this SOP is to be employed.

**2.3** It is the responsibility of the affected field personnel to read and understand this SOP and to also, read and understand the manufacturer's operation manual for the **Baseline, Model 1030A BTX Gas Chromatograph (GC)**.

## 3.0 REQUIRED MATERIALS

- Single pen strip chart recorder (0-10 VDC range) with the capability of a chart speed of 2 cm/min.
- Calibration gas mixture of benzene (approx. 1ppm), toluene (approx. 5 ppm), xylene (approx. 5 ppm).
- Electronic Calculator.
- Calibration form(s) (NJNG Calibration of Baseline GC).
- 10" adjustable wrench, 6" adjustable wrench.

- Laptop computer or data terminal (Optional).
- The manufacturer's operation manual for the Baseline, Model 1030A BTX Gas Chromatograph.

## 4.0 INSTRUMENT SPECIFICATIONS

- Dynamic Range: Benzene (0-2.00 ppm), Toluene (0-10.00 ppm), Xylene (0-10.00 ppm)
- Detection limits: 0.001 ppm, Benzene, Toluene, Xylene.
- Precision: 1% or 0.02 ppm
- Accuracy: +/- 1% of full scale
- Calibration: See section **6.0**
- Detector: PID 10.6 eV lamp
- Columns: packed
- Power: 115 VAC @ 60 Hz and 300 watts
- Operating conditions: 40-95 ºF (4-40 ºC); humidity, 10-85%, non-condensing.
- Carrier Gas: Helium containing <1ppm total hydrocarbons

## 5.0 CALIBRATION FREQUENCY

**5.1** A daily automatic span check is conducted for benzene, toluene and xylene. The span check is initiated through the data logger at each monitoring site and takes place during a time when there are no site activities.

**5.2** The site technician will conduct the following corrective actions on the basis of the nightly span checks results:

- **Routine QC Adjustment** ( section **6.0**)**–** if the span check error on any BTX channel is less than +/- 25% of full scale
- **QC Adjustment with Dynamic Calibration Verification** (section **7.0**) - if the span check error on any BTX channel is equal or greater than +/-25% of full scale

## 6.0 ROUTINE QC ADJUSTMENT

**6.1** Prior to going to the monitoring station that requires adjustment; fill out the top portion of the calibration data sheet "**Calibration of Baseline GC**". In order to determine the percent of Full Scale **(%FS)** that is expected for each of the compounds, use the following equation:

%FS = $\frac{cyl.\,ppm}{Span - ppm}$ (100)

Where:

%FS = the expected % of full scale that is expected for the compound

*Cyl. ppm* = the concentration of the compound in the calibration gas cylinder (ppm). (**Note:** This information should be noted on a paper tag or a label directly on the cylinder bottle installed in the monitoring station.)

*Span-ppm* = the full-scale range of the GC for the compound (ppm). (See list below)

The Span-ppm for the BTX compounds are:

**Benzene = 2 ppm,**
**Toluene = 10 ppm**
**Xylene = 10 ppm.**

**6.2** Locate the monitoring station, verify that the Monitor System Unit # matches the station (site) # on the calibration data sheet or on the daily span check report.

**6.3** Verify the GC is in **Standby** mode, switch the display to the BTX channel required adjustment

**6.4** Un-lock the corresponding BTX channel potentiometer (pot), turn the pot clockwise or counter-clockwise until the display is equal to the corresponding expected value in % full scale (**D**) as indicated on the calibration data sheet. Go to Step 6.5. But if the pot has run out of adjustment, a coarse adjustment should be performed as follow:

- **6.4.1** Adjust the pot to mid-scale ( 5.00), and then remove the cover of the GC chassis
- **6.4.2** Locate the integrated control/output PCB inside the chassis, this PCB is mounted on the panel in the middle left hand side of the chassis and on the same side as the sample pump.
- **6.4.3** Locate the 8 position DIP switches on the PCB. Record the current setting on calibration data sheet
- **6.4.4** Turn on the next combination of switches to increase the effective gain ( refer to page 20 of the operation manual for the effective gain setting) (ie. Switch 4 on = effective gain X5, switches 5&6 on = effective gain X8.33, etc.)

- **6.4.5** Repeat step **6.4** to fine tune the adjustment to the expected %of full scale.

**6.5** Lock the pot when the adjustment is complete and record the **After Cal** pot setting on the calibration data sheet

**6.6** Repeat step **6.4** and **6.5** for other BTX channels as necessary

**6.7** At the Main site, perform the following steps to activate the GC into speciation mode for analyzing the ambient sample and to reset the BTX integrated outputs to ambient condition.

- **6.7.1** At the conclusion of a polling cycle press the **ESC** key of the computer terminal of the desktop PC (when the screen flashes several times) and the screen will display the **Main Menu** list.
- **6.7.2** Select "**Communicate with DAU (SCADA)**" by using the arrow keys and move the cursor to appropriate box , Key in **X** and then press the **F1** key. Select the DAU # corresponding to the number on the shelter door of the GC that is to be calibrated (1-9) and press the **F1** key and then **F1** key again, the data logger responds with the specific DAU # indicating that it is in data collection mode and is logged in
- **6.7.3** In data collection mode, key-in **A**; the data logger will respond with a sub-menu consisting of a listing of action items; enter a **1** ( start seq), when data logger prompts again; enter a **3** to activate sequence 3 of the data logger set up. (note: sequence 3 was designed to accomplish step **6.7** to reset the BTX integrated outputs to ambient conditions)

**6.8** Press **ESC** and **ESC** again to bring the desktop PC back to displaying the data screen.

**6.9** Press **Alt M** for a Marco screen , select " **Change Display to BTX and PM10**" Verify that when sequence **3** is complete, all BTX outputs are near ambient concentration levels.

**6.10** Press **Alt M** again for the Macro screen; select "**Change Display to TVOC and PM10** " to return monitor to the normal data display screen.

## 7.0 QC ADJUSTMENT WITH DYNAMIC CALIBRATION VERIFICATION

**7.1** Repeat steps **6.1** through **6.6**

**7.2** At the Main site, perform the following steps to activate the daily calibration sequence for the GC to verify the field QC adjustment.

**7.3** At the conclusion of a polling cycle on the desktop PC (when the screen flashes several times) and from data display screen, press the **ESC** key at the computer terminal and the screen will display the **Main Menu** list.

**7.4** Select "**Communicate with DAU (SCADA)**" by using the arrow keys and move the cursor to related the appropriate box , Key in **X** and then press the **F1** key. Select the DAU # corresponding to the number on the shelter door of the of the GC is to be calibrated (1-9) and press the **F1** key and then the **F1** key again, the data logger responds with the specific DAU # indicating that it is in data collection mode and is login

**7.5** In data collection mode, Key-in **A**, data logger will respond with a sub-menu, enter a **1** (start seq), when data logger prompts again, enter a **1** to activate sequence 1 of the data logger set up. (note: sequence 1 was designed for the daily calibration of the GC)

**7.6** Press **ESC** and **ESC** again to bring the desktop PC back to displaying data screen.

**7.7** When daily calibration sequence **1** is complete (the calibration sequence should be completed within 25 minutes), press **ESC** to return to the **Main Menu**,

**7.8** Select" **Generate Quick Look Report**" on **Main Menu** then **F1,** select the specific DAU #, and then **F1**

**7.9** Verify the date of the daily calibration report to be generated and then select a **Single Day** report.

**7.10** Key-in **X** on "**Calibration Report to a Printer".**

**7.11** Check and verify the start time on the report is correct

**7.12** scale. The QC adjustment is complete.

**7.13** Verify that the calibration result of all BTX channels is within +/- 20 % of the full If the result is more than +/- 20 % of full scale on any BTX channel, the GC should be removed for services and replaced with a backup unit.

## 8.0 DYNAMIC CALIBRATION AFTER MAINTENANCE SERVICE

This calibration procedure should be performed after trouble-shooting or maintenance service ( e,g cleaning and/or replacing the UV lamp or PID detector. Refer to page 16 of the Operation Manual for detailed maintenance procedure) and is recommended to be conducted in a temperature controlled environment such as inside the trailer located at the Main site. The 1030A GC should be removed from the monitoring location and set up inside the trailer.

**8.1** After the performing any maintenance services, re-connect the Helium carrier gas and the calibration gas cylinder to the GC

**8.2** Turn GC power on, verify the carrier gas is on and that the analyzer is in **standby** mode. Allow the GC to warm up at minimum of 1-2 hours or until the temperature reaches its set point.

**8.3** install a strip chart recorded and connect the chart recorder input leads to Pin 2(+) and Pin 10(-) on connector 1 at the rear panel of the GC.( **Note**: polarity of the leads should be observed). Plug the recorder power cord into a power outlet. Confirm the recorder is getting power and the pen and chart advance is operating. The chart will move slowly at 2 centimeters per hour (one inch per hour). Set recorder signal input span to 0-10Vdc

**8.4** Repeat step **6.1** described above, determine the % full scale (D) for each BTX compound and fill out data sheet with required information

**8.4** Locate and press the **Auto** button on the GC followed by the **Clear** button on the lower right front panel of the Baseline GC.

**8.5** Put the 1030A GC **CAL** switch in the **ON** (up) position and confirm the recorder is attached and operating (responding to the GC). The display panel above the GC keypad will begin scrolling through the timing program similar to the program as indicated on Page 5 of the Model 1030A Analyzer Operation Manual. Observe that the RED **Stand-bye** lamp (located to the left of the display screen) goes out and that the GREEN **Analyze** lamp (located below the stand-bye lamp) comes on.

**7.6** Adjust the chart speed of the recorder to obtain a smooth chromatogram showing good separation of the BTX compounds. Allow the GC to complete at least 3 cycles or until the peak heights from two consecutive cycles for each of the BTX compounds have stabilized. The heights should be approximately the same when observing the strip chart.

**8.6** After the peak heights have stabilized, record the **%FS** data from the GC display screen on the calibration data sheet.

**8.7** Release **AUTO** and depress **CLEAR** to stop the analysis

**8.8** Adjust the calibration potentiometer (pots), which are located below the display screen, to the expected % full scale for each of the BTX compounds (benzene is **CH1,** toluene is **CH2**, and xylene is **CH3**).
**Note**: The selector switch below the display screen must be set to the appropriate channel before it can be adjusted

**8.9** Record **yes** in the column marked **Cal. Adj** on the calibration data form

**8.10** At the conclusion of the calibration record the final potentiometer settings in the spaces marked **After cal.** on the calibration data form. Be sure to lock the pot(s) at the conclusion of the calibration

**8.11** Place the **CAL** switch on the GC to the middle position, depress **AUTO** and then **CLEAR** to switch into speciation and allow the GC to go through two cycles without span gas to re-set the integrated output to ambient concentration.

**8.12** The GC is ready for monitoring service

.

## 9.0 DOCUMENTATION

Make certain to document all calibrations along with comments in the field station log. Return all equipment and tools to the proper locations.

## 10.0 QUALITY ASSURANCE

All calibration documentation will be reviewed by the project engineer. Quarterly audits of the GCs will be conducted by the project quality assurance officer.

ENSR INTERNATIONAL

## CALIBRATION OF BASELINE GC

**Site #_________ Monitor System Unit #_________ GC S/N___________ Date of Cal. ___________**

**Tech Name__________________________ Time of Calibration ________________**

**Span Pot Settings: Before Cal: CH1________ CH2________ CH3_________Coarse Setting________**

**After Cal: CH1________ CH2________ CH3_________Coarse Setting________**

**Cal. Gas Concentration : Benzene* ________ppm Toluene** _______ppm Xylene***_________ppm**

**Expected %FS _________(D) % FS ________(D) %FS ___________(D)**

**Down Channel Before Cal.: _Yes / No_ Time:______ Up Channel After Cal. _Yes / No_ Time:_______**

**(circle response Yes or No)**

## DATA

| | Benzene (O) %FS | Δ% FS | Toluene (O) %FS | Δ% FS | Xylene (O) %FS | Δ% FS | Cal. Adj. (Yes or No) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Δ% FS = 0 – D**

**(LIMIT FOR QC Adjustment with Dynamic Span Check Verification: +/- 20 % FS )**

**Output Voltage-ppm equivalent:**

***Benzene: 0-10VDC = 0-2.0 ppm**

****Toluene: 0-10VDC = 0-10 ppm**

***** Xylene: 0-10VDC = 0-10 ppm**

**Comments**

ENSR | AECOM

Standard Operating Procedure

# Changing the BTX Span Value(s) for an Air Monitoring System

Procedure Number: 2000-119

Revision No.: 0

Revision Date: May 2008

SOP Contributors: Larry Nigro

Tony Sacco, SOP Team Leader

Date: June 4, 2008

Joseph Curreri,
Stakeholder/Service Line Leader

Date: 6/4/08

Robert C. Weber,
President and Chief Executive Officer

Date: June 4, 2008

Annual review of this SOP has been performed and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Standard Operating Procedure

# Changing the BTX Span Value(s) for an Air Monitoring System

SOP No.: 2000-119
Revision: 0
Date: May 2008
Page i of i

---

## Contents

Standard Operating Procedure

# Changing the BTX Span Value(s) for an Air Monitoring System

SOP No.: 2000-119
Revision: 0
Date: May 2008

## 1.0 Scope and applicability

**1.1** This Standard Operating Procedure (SOP) defines methods by which technicians may change the values for the benzene, toluene and xylenes (BTX) span values for the gas chromatograph/photoionization detector (GC/PID) instruments installed at a fenceline air monitoring site.

**1.2** This SOP applies to those situations when a new cylinder of BTX is being installed at a monitor location. The method in this SOP is used to change the database so that the designated values for the BTX calibration reflect new span concentrations.

**1.3** This SOP is to be utilized to conduct the work identified in the title of this SOP. In the event the Project Manager or Project Team determines that the protocols and procedures listed in this SOP are not applicable to the project, there is the option to either adapt this SOP or to develop a site-specific SOP to more closely match the requirements of the project. Refer to SOP 1011, Preparation and Control of Standard Operating Procedures, for SOP modification and Project Operating Procedure (POP) development procedures.

## 2.0 Health and safety considerations

**2.1** The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the site specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the ENSR Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

- Employing calibration gases that have not been properly certified may cause data to be rejected.
- Calibration gases used outside of the operating range of the monitoring system may cause data to be rejected.
- Leaks in the GC/PID pneumatics may lead to erroneous data.

## 4.0 Equipment and materials

- BTX calibration cylinder.
- Calibration gas in the appropriate range for the monitoring program under test.
- A tool kit that includes several adjustable wrenches.

# 5.0 Procedures

**5.1** As soon as the pressure in any BTX calibration cylinder declines below 500 psig the field technician should inform the project engineer so that new calibration gas can be ordered. The cylinder pressure may be observed on the cylinder regulator pressure gage which is the gage that is closer to the cylinder. In order to read the pressure, the cylinder supply valve must be turned on.

**5.1.1** The BTX calibration cylinder should be replaced when the gas pressure falls below 100 psig.

**5.1.2** The procedure below should be followed in order to replace a BTX calibration cylinder.

1. Shut off the cylinder supply valve.
2. Shut off the regulator supply valve.
3. Use a 6” adjustable wrench to remove the fitting that connects the Teflon line to the GC.
4. Slowly bleed any pressure that may remain in the regulator by opening the regulator supply valve. Be sure to shut the valve after the regulator has been bled.
5. Use a 10” adjustable wrench to remove the regulator from the cylinder.

**NOTE: THE THREAD ON THE FITTING IS LEFTHAND. IN ORDER TO REMOVE IT THE FITTING MUST BE TURNED CLOCKWISE.**

6. Connect the regulator to the new BTX cylinder using a 10” adjustable wrench. The fitting must be turned **counterclockwise**.
7. Reconnect the fitting for the Teflon® line to the regulator. Make sure that the regulator output valve is shut.
8. Turn on the cylinder supply valve. The cylinder pressure gage should register approximately 2000 psig. If the gage registers less than 1500 psig, inform the project engineer. You may still use the cylinder.
9. Use Snoop liquid to identify whether there are any leaks at any of the thread connections. This will be obvious by the appearance of bubbles where the Snoop has been applied.
10. Turn on the regulator supply valve and set the pressure to approximately 20 psig.

**5.2** Once the new cylinder has been installed and leak checked, the new span values for the BTX compounds should be input to the computer at the main site.

**5.2.1** From the dual data screen key in **ESC**.

**5.2.2** Scroll down to the line that reads “Perform Operator Functions” and key in **F1**.

**5.2.3** Select the option that indicates “Change Expected Calibration Factors” and key in **F1**.

**5.2.4** Select the monitor number where the BTX calibration values are to be changed and key in **F1**.

**5.3** Select the parameter (benzene, toluene or xylene), key in **F1** and enter the new expected span value (the expected span values for each BTX compound is printed on the certification tag on the calibration cylinder).

**5.4** Key in **ESC** and repeat steps 5.2.2 - 5.2.5.

**5.5** When all the required span values have been modified, key in **ESC, ESC** to return to the dual data screen.

## 6.0 Quality assurance / quality control

**6.1** Calibrations should always leave the analyzer operating within ± 5.0% of the reference calibrator at all calibration inputs.

**6.2** As soon as possible following calibration, the completed data form is to be submitted to the project manager or designee for review in accordance with ENSR's Senior Review Policy PP-9-0. Standards are reviewed for traceability and completeness. DAS and strip chart readings are to be reviewed for agreement and completeness. Calculations, standard conditions, correction factors, project identification, and other data should be reviewed for accuracy, completeness and conformance to the relevant ENSR operational SOP and the project QA Plan.

## 7.0 Data and records management

**7.1** Unanticipated changes to the procedures or materials described in this SOP (deviations) will be appropriately documented in the project records.

**7.2** Records associated with the activities described in this SOP will be maintained according to the document management policy for the project.

## 8.0 Personnel qualifications and training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures should have read, and be familiar with, the requirements of this SOP.

**8.1.2** Technicians attempting the tasks in this SOP must be thoroughly trained to operate and calibrate the GC/PID being used.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this SOP.

**8.2.2** It is the responsibility of the project manager and project engineer to make this SOP available to field personnel and to ensure that the method described in this SOP is directly applicable to the task.

**8.2.3** It is the responsibility of the field technicians to read and follow this SOP at any time when a new BTX span cylinder is to be installed.

# 9.0 References

ENSR SOP 1011, Preparation and Control of Standard Operating Procedures.

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

# 10.0 Revision history

| Revision | Date | Changes |
|---|---|---|
| 0 | May 2008 | NA |

AECOM

Project Operating Procedure

---

# Standard Operating Procedure for the Niton XL3t 600 XRF

Procedure Number: PPG 028

Revision No.: 0

Revision Date: June 2010

Mary Donnell [illegible]

POP Author

Date: June 2010

Craig W. MacPhee

Project Manager

Date: June 2010

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

Project Operating Procedure

# Standard Operating Procedure for the Niton XL3t 600 XRF

POP No.: PPG 028
Revision: 0
Date: June 2010
Page i of i

---

## Contents

# Project Operating Procedure

# Standard Operating Procedure for the Niton XL3t 600 XRF

---

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) provides the proper techniques for safely operating the Niton XL 3t 600 X-Ray fluorescence (XRF) analyzer for field screening of metals, primarily chromium, in soil. The procedure will permit in-situ analysis of soil samples for field decision making and will be used for delineation purposes during the remedial investigation. This procedure is not intended for submission of data to regulatory agencies; confirmatory analysis must be performed by a certified laboratory using EPA total metals methods.

**1.2** This procedure is to be used in conjunction with the site specific Field Sampling Plan. This procedure is intended to provide the necessary information for setting up and analyzing soil samples with the XRF analyzer and performing associated quality control procedures.

**1.3** This procedure is to be used in conjunction with the Niton XL 3t 600 XRF User's Guide. This procedure will provide the basic information for set up of the instrument and analysis of soil samples. However, certain custom functions are not covered in this procedure and must be referenced from the instruction manual.

**1.4** The method sensitivity or lower limit of detection depends on a number of factors including physical and chemical matrix effects and interelement spectral interferences; in-situ analysis and testing of bagged samples are considered field screening procedures. More accurate measurements using XRF are highly dependent on sample homogeneity; samples must be prepared by sieving and potentially grinding to a uniform particle size in order to achieve the most accurate results.

**1.5** In-situ XRF results alone are not acceptable for determining that a sample is below cleanup levels. In these cases XRF must be performed on a prepared (homogenized) sample and confirmed using a certified laboratory.

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Health and Safety Plan (HASP). In the absence of a site-specific HASP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

**2.2** Due to the dust generation anticipated from this procedure, field personnel will be required to don Level C personal protective equipment (PPE) for this procedure. Refer to the job safety analysis (JSA) for this activity in the site-specific HASP for more detail.

**2.3** The XRF analyzer contains an x-ray tube; when the x-ray tube is turned on by the user and the shutter is open, as during a measurement, the analyzer emits a directed radiation beam. The instrument should never be pointed at anyone or at any body part. **Never** point the analyzer into the air and perform a test. **Never** hold a sample in your hand and perform a test.

**2.4** Each field analyst must undergo training in safe use of the instrumentation by a manufacturer's representative prior to use of the XRF equipment. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. All maintenance other than that specifically listed in the operating manual must be performed by the manufacturer.

**2.5** Those operating XRF equipment must be aware of, and comply with, state-specific licensing requirements for the use of XRF analyzers (N.J.A.C 7:28-54.1). A copy of the license should be present with the instrument at all times and available upon request in an audit.

**2.6** A copy of the United States Department of Transportation (US DOT) compliance statement has been provided with each Niton instrument; this document should be kept in the analyzer case at all times.

**2.7** The analyst must comply with all safety requirements listed in the instrument specific operating manual.

## 3.0 Interferences

**3.1** Physical matrix effects can result from variations in the physical character of the sample. This includes variations in particle size, uniformity, homogeneity and surface condition. As a minimum every effort should be made to thoroughly mix and homogenize samples before analysis. The most accurate data will be obtained if samples are sieved and ground to a uniform particle size prior to testing.

**3.2** Moisture content of soils and sediments can impact analytical accuracy particularly if the sample is water saturated; moisture levels of 5-20% generally have a minimal impact on accuracy. If field data are to be compared with laboratory generated results, samples should be dried using a convection or toaster oven; a microwave should not be used due to the potential for arcing if metal fragments are present in the sample. Studies have also shown poor agreement between laboratory confirmatory analysis and field XRF data when microwave drying is used.

**3.3** Inconsistent positioning of the sample in front of the probe window can produce errors since the x-ray signal decreases as the distance from the radioactive source increases. The best results are obtained when the sample has a flat, smooth surface and the probe window is in direct contact with the surface.

**3.4** Chemical matrix effects can occur in soils contaminated with metals and result from spectral interferences (peak overlaps) or as x-ray absorption and enhancement phenomena. Peak overlaps occur when certain x-ray lines from different elements are close in energy; the degree to which these peaks can be resolved is dependent upon the instrument detector. Elevated levels of vanadium have been documented as a potential interference for chromium. Absorption occurs when one element tends to absorb the x-rays of a second element reducing the detector's measurement of the intensity of the second element. Less common are interferences resulting from K/L, K/M, and L/M line overlaps; this interference can cause difficulty in detection of arsenic in the presence of high levels of lead.

**3.5** Ambient temperature changes can result in instrument drift. The analyst should review the instrument instructions for the optimal operating range of the instrument and assess the accuracy of instrument response through periodic analysis of blanks and QC check samples.

## 4.0 Equipment and Materials

**4.1** The following equipment and materials are required for sample analysis using this technique:

- Niton XL 3t 600 XRF
- Niton XL 3t 600 XRF User’s Guide, Version 6.5
- U.S. DOT Compliance Statement and any state required licenses
- Battery charger and spare battery
- National Institute of Standards and Testing (NIST) certified standard reference material(s) (SRMs) or similar standards from the U.S. Geological Survey (USGS) or commercial sources.
- Reference standards and samples provided by the instrument manufacturer
- Blank sample of clean quartz, Teflon, or silicon dioxide
- Trowel for smoothing soil surface or collecting sample
- Plastic bags for collection and homogenization of soil samples.
- Field logbook and pen
- Level C PPE
- Camera (optional)

## 5.0 Procedures

**5.1** Initial Setup

**5.1.1** Don the Level C PPE as instructed in the site-specific HASP.

**5.1.2** To turn on the analyzer depress the on/off/escape button on the control panel for 10 seconds; the start screen will appear and begin a 10 second countdown. When the log on screen appears, press anywhere on the screen to continue. Acknowledge the radiation warning by pressing “Yes” and enter the security code for the device.

**5.1.3** Confirm that the date/time display is correct. Refer to the Niton XL3t 600 User's Guide for specific instructions on navigation through the menu. If the instrument has been turned off for more than 30 minutes allow a 10 minute warm-up period before calibration. Select Calibrate and Test and press Clear/Enter to begin the self calibration; when the instrument beeps the calibration is complete and the instrument is ready for use.

**5.1.4** For the purposes of in-situ measurements, the instrument will be operated in the Standard Soil Mode. Select Standard Soil Mode from the Bulk Analysis Menu. Calibrate the instrument using the soil standards supplied by Niton immediately after the instrument completes self-calibration. The standards should be tested every 1- 2 hours during the analysis day and at the conclusion of testing for the day to ensure that no drift has occurred. All calibration procedures and the results of standard check samples must be recorded in the XRF logbook. Until control limits specific to the XRF unit being used are established control limits of ± 20% of the true value should be used.

**5.1.5** The Niton XL3T 600 offers six modes of operation for soil samples. It is expected that the Easy Trigger method will be used for in-situ measurements. Using this technique the measurement window is placed against the sample and the trigger is pulled once to initiate the analysis. The instrument constantly checks the backscatter measurements to determine if a sample is against the measurement window and will shut off any radiation directed through the window if it determines there is no sample present.

**5.1.6** The analyzer will display the results screen throughout the duration of the reading; once the reading is complete, the screen will display the final results of the measurement.

**5.2** Sample screening may be performed by holding the probe directly on the soil or on a bagged sample. Clean the measurement window between samples using a cotton swab.

**5.2.1** Remove any obviously non-representative materials such as leaves, vegetation, roots, or concrete from the sample; use caution that COPR related materials are not removed from the sample. Finer and more homogeneous material will yield more accurate results. Increased accuracy can be gained by loosening the soil and letting it dry in the sun prior to testing. The soil sample should not be saturated with water; the XRF technique will generally not produce reliable results if ponded water exists on the surface.

**5.2.2** Use a trowel to level the surface of the soil. Hold the XRF in one hand and place the instrument window flush against the surface of the sample to be tested. The four LED lights on the screen will flash to indicate the initiating preconditions have been met (see page 1-45 of the User's Guide); however as a safety precaution the x-ray tube will not turn on immediately and no reading will begin for approximately 0.5 seconds. Watch the display screen to determine when the test is complete; a typical test will take 30-60 seconds. To end the test simply release the trigger mechanism.

**5.2.3** If direct measurement of the sample is not possible, samples may be placed in plastic bags and analyzed without preparation. However, since the measurement is made through a plastic bag, test results can be 5-10% lower than those obtained by direct measurement. Place 50-100g of soil in a clean zipper locking bag (approximately 1-mil thick polyethylene bag is recommended) removing any obviously non-representative material. Mix the sample thoroughly by kneading the bag and flatten the bag of soil to form uniform layer of approximately 0.5 inch thickness. Place the XRF flat against the bag and take a measurement as described in Section 5.2.2. ***Do not hold the bag in your hand during testing.***

**5.3** Download the stored data and spectra to a computer or directly to a database; erase the stored data from the XRF once you have confirmed that all results have been successfully downloaded. ***Do not attempt to take measurements while downloading readings, this will generate an error requiring a system reset and may corrupt stored readings.***

**5.4** Routine maintenance procedures include cleaning and replacement of the measurement window.

**5.4.1** Keep the transparent measurement window covering the analysis window clean. Clean the measurement window gently with a cotton swab. Clean the body of the analyzer with a soft cloth. The touch screen may be cleaned using a lens cleaning solution with a soft cloth; water should not be used. Never use detergents or solvents on any portion of the analyzer or immerse the analyzer in water.

**5.4.2** If the measurement window becomes frayed, ripped, or contaminated with metal particulates, replace it with a new window. The User's Guide provides part numbers and instructions for replacement of the windows.

**5.4.3** All other maintenance must be performed by an authorized Niton service center. The instrument must be transported and stored in its padded carrying case when not in use.

## 6.0 Quality Assurance / Quality Control

**6.1** An energy calibration check should be run at the start of each day of sampling. This check confirms that the characteristic x-ray lines are stable and instrument drift is not occurring. This also provides a gain check if the ambient temperature fluctuates significantly. This test must be run at the start of each day, when the batteries are changed, when the instrument is shut down, and at the end of each day. This procedure should also be run any time the operator believes that drift is occurring during analysis.

**6.2** A blank consisting of silicon dioxide or a Teflon or quartz block must be run at the beginning and end of each day of analysis and after every 20 samples or every hour of operation during the day or at any time the analyst suspects contamination in the analytical system.

**6.3** An independent standard must be used to verify the accuracy of the instrument and confirm its stability and consistency for the analyte of interest. NIST, USGS or commercial standards may be used. The standard check must be performed at the beginning and end of each analysis day and after every 20 samples or hour of operation during the day. If the measured value falls outside the acceptance range the check sample must be reanalyzed; if it is still outside the acceptance range the instrument must be recalibrated and any samples analyzed since the previous acceptable calibration check must be reanalyzed.

**6.4** At least one sample in each set of 20 must be analyzed in duplicate to assess measurement precision. Relative percent difference for duplicates should be ≤ 30%.

**6.5** The field forms and field notes generated from this procedure will be reviewed by the sampling team leader, project manager, or designee. All quality control results must be downloaded to project computer files along with sample data. Any deviations from this SOP, problems encountered during the analysis and corrective actions taken must be documented in the field records.

## 7.0 Data and Records Management

**7.1** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.2** All data and spectral files must be backed up onto a computer on a regular basis. Any deviations from this POP or problems encountered during the analysis must be documented in a field log book which is dedicated to the XRF analyzer.

**7.3** Records associated with the activities described in this POP will be maintained according to the specific document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** Sampling personnel must be health and safety certified as specified by Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(e)(3)(i) to work on sites where hazardous materials may be present.

**8.1.3** Each person who performs this procedure will undergo training offered by the manufacturer such that the procedure is performed in a consistent manner and all safety procedures are followed.

**8.1.4** Individual states and countries have specific regulations and guidelines for the use of X-ray tube devices that produce ionizing radiation. For New Jersey site work, the licensing requirements outlined in N.J.A.C. 7:28-54.1 must be met prior to the start of site work.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

United States Environmental Protection Agency. 2007. Method 6200, Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, Revision 0. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Washington, D.C. January 2008.

New Jersey Department of Environmental Protection Site Remediation Program. 1994. Field Manual. Trenton, NJ. July 1994.

Thermo Scientific, Niton XL3t 600 Analyzer User's Guide, Version 6.5. Billerica, MA 2009

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

# Appendix C

# Required Preservation, Container and Maximum Holding Times

# Appendix C-1: Required Preservation, Container, and Maximum Holding Times for Solid and Aqueous Samples

◂ Return to TOC

## Table 2.2 Required Preservation, Container, and Maximum Holding Times for Drinking Water Samples, Except Radiochemical Parameters

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| Total Coliform<br>Finished Drinking Water | Cool 4°C, 0.008% sodium thiosulfate ($Na_2S_2O_3$) | P or G | 30 hours |
| Heterotrophic Plate Count<br>Finished Drinking Water | Cool 4°C, 0.008% $Na_2S_2O_3$ | P or G | 8 hours |
| Total Coliform<br>Source Water | Cool 4°C, 0.008% $Na_2S_2O_3$ | P or G | 8 hours |
| Fecal Coliform<br>Source Water | Cool 4°C, 0.008% $Na_2S_2O_3$ | P or G | 8 hours |
| Cryptosporidium | Cool 0-8°C, No Freezing | LPDE Cubitainer | Elution must begin within 96hrs of sampling[14] |
| Giardi cysts | Cool 0-8°C, No Freezing | LPDE Cubitainer | Elution must begin within 96hrs of sampling[14] |
| Alkalinity | Cool 4°C | P or G | 14 days |
| Antimony | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Arsenic | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Asbestos | Cool 4°C | P or G | Filter within 48 hours |
| Barium | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Beryllium | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Bromate | 50 mg/L Ethylenediamine (EDA) solution | P or G | 28 days |
| Bromide | None | P or G | 28 days |
| Cadmium | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Calcium | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Chlorate | 50 mg/L Ethylenediamine (EDA) solution | P or G | 28 days |
| Chloride | None | P or G | 28 days |
| Chlorite | 50 mg/L Ethylenediamine (EDA) solution Cool 4°C | P or G | 14 days |
| Chlorinated Hydrocarbons | Refrigerate at 4°C. After collection, Ascorbic acid | Glass with foil or Teflon®-lined cap | 14 days until extraction; 40 days after extraction |

Table 2.2 (continued) Required Preservation, Container, and Maximum Holding Times for Drinking Water Samples, Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Chlorinated Pesticides | 80mg/L $Na_2S_2O_3$ if residual chlorine ($Cl_2$) is present, Cool 4°C | Glass with Teflon®-lined septum | 7 days until extraction;<br>14 days after extraction |
| Chlorinated Phenoxy Acids | 80mg/L $Na_2S_2O_3$ if residual chlorine ($Cl_2$) is present, Cool 4°C | Glass with Teflon®-lined septum | 14 days until extraction;<br>28 days after extraction |
| Chlorine Dioxide | None | P or G | Analyze Immediately |
| Chlorinated Acids | Refrigerate at 4°C after collection, Ascorbic acid | Glass with foil or Teflon®-lined cap | 7 days until extraction;<br>30 days after extraction |
| Chromium | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Copper | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Cyanide | NaOH to $pH > 12$, Cool 4°C, 0.6 g Ascorbic acid | P or G | 14 days |
| EDB/DBCP/1,2,3-TCP | Cool 4°C, 0.08% $Na_2S_2O_3$ | Glass with Teflon®-lined septum | extract: 14 days;<br>24 hours to analysis |
| Fluoride | None | Polyethylene only | 28 days |
| Free Chlorine Residual | None | P or G | Analyze Immediately |
| Lead | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Mercury | Conc. $HNO_3$ to $pH < 2$ | P or G | 28 days |
| N-Methyl-Carbamoyloximes<br>N-Methyl-Carbamates | Monochloroacetic acid to pH 3, 80mg/L $Na_2S_2O_3$, Cool 4°C until storage, Store at -10°C | Glass with Teflon®-lined septum | 28 days at -10°C |
| Nickel | Conc. $HNO_3$ to $pH < 2$ | P or G | 6 months |
| Nitrate-Nitrate | Conc. $H_2SO_4$ to $pH < 2$; Cool 4°C | P or G | 28 days |
| Nitrate-N | Cool 4°C | P or G | 48 hours |
| Nitrite-N | Cool 4°C | P or G | 48 hours |
| Nitrogen- and Phosphorus-Containing Pesticides | 80mg/L $Na_2S_2O_3$ (if residual $Cl_2$) Cool 4°C | Glass (dark) with Teflon®-lined septum | 14 days until extraction;<br>14 days after extraction |
| o-Phosphate | Cool 4°C | P or G | 48 hours |
| Perchlorates | None Required | P or G | 28 days |

Table 2.2 (continued) Required Preservation, Container, and Maximum Holding Times for Drinking Water Samples, Except Radiochemical Parameters

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| Odor | Cool 4°C | P or G | 24 hours |
| Organic Compounds | If residual $Cl_2$ 40-50 mg sodium arsenite or sodium thiosulfate; if unchlorinated, 6 N HCl to pH < 2 | Glass with Teflon®-lined septum | 7 days until extraction; 30 days after extraction |
| Organohalide Pesticides and Commercial PCB Products (Arochlors) | 3mg $Na_2S_2O_3$ or 7uL $Na_2S_2O_3$ (0.04g/mL), Cool 4°C until analyzed | Glass with Teflon®-lined septum | If Heptachlor, 7 days until extraction; 40 days after extraction. If no extraction, analysis within 14 days |
| Ozone | None | G | Analyze Immediately |
| pH | None | P or G | Analyze Immediately |
| Selenium | Conc. $HNO_3$ to pH < 2 | P or G | 6 months |
| Silver | Conc. $HNO_3$ to pH < 2 | P or G | 6 months |
| Sodium | Conc. $HNO_3$ to pH < 2 | P or G | 6 months |
| Sulfate | Cool 4°C | P or G | 28 days |
| Temperature | None | P or G | Analyze Immediately |
| Thallium | Conc. $HNO_3$ to pH < 2 | P or G | 6 months |
| TTHMs | $Na_2S_2O_3$ if residual $C1_2$ and 6N HC1 | Glass with Teflon®-lined septum | 14 days |
| Total Dissolved Solids | Cool 4°C | P or G | 7 days |
| Turbidity | Cool 4°C | P or G | 48 hours |
| Volatile Aromatic and Unsaturated Organic Compounds | 1:1 HCl to pH < 2 Cool, 4°C until analysis, Ascorbic acid | Glass with Teflon®-lined septum | 14 days |
| Volatile Halogenated Organic Compounds | 1:1 HCl to pH < 2 Cool, 4°C until analysis, Ascorbic acid | Glass with Teflon®-lined septum | 14 days |
| Volatile Organic Compounds | 1:1 HCl to pH < 2 Cool, 4°C until analysis, Ascorbic acid | Glass with Teflon®-lined septum | 14 days |

◂ Return to TOC

### Table 2.3 Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| **Bacterial Tests** | | | |
| Coliform (fecal) | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | P, G | 6 hours |
| Coliform (total) | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | P, G Cool | 6 hours |
| Fecal streptococci | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | P, G | 6 hours |
| Enterococcii | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | P, G (sterile) | 6 hours |
| Escherichia coli | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | P, G (sterile) | 6 hours |
| Heterotrophic Plate Count | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | P, G (sterile) | 8 hours |
| Salmonella sp. Bacteria | Cool 4°C | P, G (sterile) | 24 hours |
| Helminth Ova | Cool 4°C | P, G (sterile) | 24 hours |
| Enteric Viruses[13] | Cool 4°C | P, G (sterile) | 8 hours |
| **Toxicity Test** | | | |
| Acute or Chronic Toxicity | Cool 4°C | P, G | 36 hours[12] |
| **Inorganic Tests** | | | |
| Acidity, as $CaCO_3$ | Cool 4°C | P, G | 14 days |
| Alkalinity as $CaCO_3$ | Cool 4°C | P, G | 14 days |
| Aluminum-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Ammonia (as N) | Cool 4°C $H_2SO_4$ to pH < 2 | P, G | 28 days |
| Antimony-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Arsenic-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Barium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Beryllium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Biochemical Oxygen Demand | Cool 4°C | P, G | 48 hours |
| Boron-total[3] | $HNO_3$ to pH < 2 | P,G | 6 months |
| Bromide[3] | None required | P, G | 28 days |
| Cadmium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Calcium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Carbonaceous Biochemical Oxygen Demand | Cool 4°C | P, G | 48 Hours |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Chemical Oxygen Demand (COD) | Cool 4°C $H_2SO_4$ to pH < 2 | P, G | 28 days |
| Chloride | None required | P, G | 28 days |
| Chlorine total residual (TRC) | None required | P, G | Analyze Immediately |
| Chromium VI (dissolved) | Cool 4°C | P, G | 24 hours |
| Chromium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Cobalt-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Color | Cool 4°C | P, G | 48 hours |
| Copper-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Cyanide-total[3] | Cool 4°C, NaOH to pH > 12,0.6g ascorbic acid | P, G | 14 days (24 hours when sulfide is present)[2] |
| Cyanide amenable to chlorination[3] | Cool 4°C, NaOH to pH > 12,0.6g ascorbic acid | P, G | 14 days (24 hours when sulfide is present)[2] |
| Fluoride | None required | Polyethylene only | 28 days |
| Gold-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Hardness-total as $CaCO_3$ | $HNO_3$ to pH < 2 $H_2SO_4$ to pH < 2. | P, G | 6 months |
| Hydrogen ion (pH) | None required | P, G | Analyze Immediately |
| Iridium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Iron-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Kjeldahl & Organic Nitrogen | Cool 4°C, $H_2SO_4$ to pH < 2 | P, G | 28 days |
| Lead-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Magnesium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Mercury-dissolved[11] (does not include methyl mercury) | 5mL/Lof 12 N HCl or<br>5mL/L of 12 N BrCl<br>Cool 4°C | Fluoropolymer with fluoropolymer or fluoropolymer lined cap | 28 days |
| Mercury-dissolved[11] (includes methyl mercury) | 5mL/L of 12 N HCl<br>Cool 4°C | Fluoropolymer with fluoropolymer or fluoropolymer lined cap | 28 days |
| Mercury-total[3] | $HNO_3$ to pH < 2 | P, G | 28 days |
| Mercury-total[11](does not include methylmercury) | 5mL/L of 12 N HCl or<br>5 mL/L of 12 N BrCl | Fluoropolymer with fluoropolymer or | 28 days |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| | Cool 4°C | fluoropolymer lined cap | |
| Mercury-total[11] (includes methylmercury) | 5mL/L of 12 N HCl<br>Cool 4°C | Fluoropolymer with fluoropolymer or fluoropolymer lined cap | 28 days |
| Molybdenum-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Nickel-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Nitrate (as N) | Cool 4°C | P, G | 48 hours |
| Nitrate-Nitrite(as N) | Cool 4°C, $H_2SO_4$ to pH < 2 | P, G | 28 days |
| Nitrite (as N) | Cool 4°C | P, G | 48 hours |
| Oil and grease | Cool 4°C HCl or $H_2SO_4$ to pH < 2 | G | 28 days |
| Organic carbon-total (TOC) | Cool 4°C, HCl or $H_2SO_4$ to pH < 2 or phosphoric acid | P, G | 28 days |
| Orthophosphate (as P) | Filter Immediately, Cool 4°C | P, G | 48 hours |
| Osmium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Oxygen dissolved (probe) | None Required | Glass bottle and top | Analyze Immediately |
| Oxygen dissolved (Winkler) | Fix on site and store in dark | Glass bottle and top | 8 hours |
| Palladium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Petroleum Hydrocarbons | HCl to pH 2 | G | 7 days |
| Phenols | Cool 4°C, $H_2SO_4$ to pH < 2 | G only | 28 days |
| Phosphorus (elemental) | Cool 4°C | G | 48 hours |
| Phosphorus-total | Cool 4°C, $H_2SO_4$ to pH < 2 | P, G | 28 days |
| Platinum-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Potassium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Residue-total | Cool 4°C | P, G | 7 days |
| Residue-filterable (TDS) | Cool 4°C | P, G | 7 days |
| Residue-nonfilterable (TSS) | Cool 4°C | P, G | 7 days |
| Residue-settleable | Cool 4°C | P, G | 48 hours |
| Residue-volatile | Cool to 4°C | P, G | 7 days |
| Rhodium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Ruthenium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Salinity | Cool 4°C | G | 28 days |
| Selenium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Silica-dissolved | Cool 4°C | P | 28 days |
| Silver-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Sodium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Specific conductance | Cool 4°C | P, G | 28 days |
| Sulfate | Cool 4°C | P, G | 28 days |
| Sulfide | Cool 4°C, add zinc acetate & NaOH to pH > 9 | P, G | 7 days |
| Sulfite | None required | P, G | Analyze Immediately |
| Surfactants | Cool 4°C | P, G | 48 hours |
| Temperature | None required | P, G | Analyze Immediately |
| Thallium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Tin-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Titanium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Turbidity | Cool 4°C | P, G | 48 hours |
| Vanadium-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| Zinc-total[3] | $HNO_3$ to pH < 2 | P, G | 6 months |
| **Organic Tests[4]** | | | |
| Acenaphthene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$ Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Acenaphthylene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$ | Glass, Teflon®-lined cap<br>Store in dark | 7 days until extraction;<br>40 days after extraction |
| Acrolein | Cool 4°C, 0.008% $Na_2S_2O_3$<br>Adjust pH to 4-5[6] | Glass, Teflon®-lined septum | 14 days |
| Acrylonitrile | Cool 4°C, 0.008% $Na_2S_2O_3$<br>Adjust pH to 4-5[6] | Glass, Teflon®-lined septum | 14 days[6] |
| Anthracene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$ | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Benzene | Cool 4°C, 0.008% $Na_2S_2O_3$<br>HCl to pH 2 | Glass, Teflon®-lined septum | 14 days |
| Benzidine[7] | Cool 4°C, 0.008% $Na_2S_2O_3$ | Glass, Teflon®-lined cap | 7 days until extraction[8] |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| Benzo(a) anthracene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Benzo(a)pyrene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Benzo(b) fluoranthene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Benzo(g,h,i) perylene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Benzo(k) fluoranthene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Benzyl chloride | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined septum | 14 days |
| Benzyl butyl phthalate[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Bis(2-chloroethoxy) methane[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Bis(2-chloroethyl) ether[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Bis(2-ethylhexyl) phthalate[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Bromodichloro-methane | Cool 4°C 0.008% $Na_2S_2O_3$[1], HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Bromoform | Cool 4°C 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Bromomethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Carbon tetrachloride | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 4-Chloro-3-methylphenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Chlorobenzene | Cool 4°C 0.008%$Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Chloroethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 2-Chloroethylvinyl ether | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Chloroform | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Chloromethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 2-Chloronaphthalene[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2-Chlorophenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 4-Chlorophenylphenyl ether[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Chrysene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Dibenzo (a,h)anthracene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Dibromochloro-methane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 1,2-Dichloro-benzene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 1,3-Dichloro-benzene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 1,4-Dichloro-benzene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 3,3'-Dichloro-benzidine[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined septum | 14 days |
| Dichlorodifluoro-methane | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined septum | 14 days |
| 1,1-Dichloroethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 1,2-Dichloroethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 1,1-Dichloroethene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| trans-1,2-Dichloro-ethene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 2,4-Dichlorophenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 1,2-Dichloropropane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| cis-1,3-Dichloro-propene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| trans-1,3-Dichloro-propene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Diethyl phthalate[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2,4-Dimethylphenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Dimethyl phthalate | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Di-n-butyl phthalate[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Di-n-octyl phthalate[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2,3-Dinitrophenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2,4-Dinitrotoluene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2,6-Dinitrotoluene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Epichlorohydrin | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined septum | 14 days |
| Ethylbenzene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Fluoranthene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Fluorene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Hexachlorobenzene[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Hexachlorobutadiene[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Hexachlorocyclo-pentadiene[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Hexachloroethane[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Ideno(1,2,3-cd)pyrene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Isophorone[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| Methylene chloride | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined cap | 14 days |
| 2-Methyl-4,6-dinitro phenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Naphthalene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Nitrobenzene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| 2-Nitrophenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| 4-Nitrophenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| N-Nitrosodimethyl amine[7, 10] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| N-Nitrosodi-n-propyl-amine[7, 10] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| N-Nitrosodiphenyl-amine[7, 10] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| 2,2'-Oxybis(1-chloro-propane) | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| PCB-1016[7] | Cool 4°C | Glass, Teflon®-lined cap, | 7 days until extraction; 40 days afterextraction |
| PCB-1221[7] | Cool 4°C | Glass, Teflon®-lined cap, | 7 days until extraction; 40 days after extraction |
| PCB-1232[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| PCB-1242[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| PCB-1248[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| PCB-1254[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| PCB-1260[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Pentachlorophenol | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Phenanthrene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Phenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Pyrene[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>Store in dark | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2,3,7,8-Tetra-chlorodi-benzo-p-dioxin[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 1,1,2,2-Tetrachloro-ethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Tetrachloroethene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Toluene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 1,2,4-Trichloro-benzene[7] | Cool 4°C | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 1,1,1-Trichloroethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 1,1,2-Trichloroethane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Trichloroethene | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| Trichlorofluoro-Methane | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2[5] | Glass, Teflon®-lined septum | 14 days |
| 2,4,6-Trichloro-phenol[7] | Cool 4°C, 0.008% $Na_2S_2O_3$[1] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Vinyl chloride | Cool 4°C, 0.008% $Na_2S_2O_3$[1]<br>HCl to pH 2 | Glass, Teflon®-lined septum | 14 days[5] |
| **Pesticides Tests[7]** | | | |
| Aldrin | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Ametryn | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Aminocarb | Cool 4°C pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Atraton | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Atrazine | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| Azinphos methyl | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Barban | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| alpha-BHC | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| beta-BHC | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| delta-BHC | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Gamma-BHC (Lindane) | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Captan | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Carbaryl | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Carbophenothion | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Chlordane | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Chloropropham | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| 2,4-D | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| 4,4'-DDD | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| 4,4'-DDE | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| 4,4'-DDT | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Demeton-O | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Dementon-S | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Diazinon | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Dicamba | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Dichlofenthion | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Dichloran | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Dicofol | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Dieldrin | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Dioxathion | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Disulfoton | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Diuron | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Endosulfan I | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Endosulfan II | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Endosulfan Sulfate | Cool 4°C,pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Endrin | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Endrin aldehyde | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Ethion | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Fenuron | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Fenuron-TCA | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Heptachlor | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Heptachlor epoxide | Cool 4°C,pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Isodrin | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |
| Linuron | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction; 40 days after extraction |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/ Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Malathion | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Methiocarb | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Methoxychlor | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Mexacarbate | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Mirex | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Monuron | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Monuron-TCA | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Nuburon | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Parathion methyl | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Parathion ethyl | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| PCNB | Cool 4°C,pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Perthane | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Prometron | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Prometryn | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Propazine | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Propham | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Propoxur | Cool 4°C,pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Secbumeton | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Siduron | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |

Table 2.3 (continued) Required Preservation, Container, and Maximum Holding Times for Wastewater Samples and Solid/Hazardous Waste Samples (Aqueous Matrices), Except Radiochemical Parameters

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time** |
|---|---|---|---|
| Simazine | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Strobane | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Swep | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2,4,5-T | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| 2,4,5-TP (Silvex) | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Terbuthylazine | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Toxaphene | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |
| Trifluralin | Cool 4°C, pH 5-9[10] | Glass, Teflon®-lined cap | 7 days until extraction;<br>40 days after extraction |

## Table 2.6 Required Preservation, Container and Maximum Holding Times for Solid/Hazardous Waste Samples (Soils, Liquids, Sediments, Sludges, and Ambient Air)

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| Volatile Organics for soil/ sediment, and sludge | Cool 4°C | Glass Teflon®-lined cap | 14 days |
| Volatile Organics (Non-Aqueous sample) | Cool 4°C, dark | Encore™ or equivalent field core sampling/ storage containers & 60 ml septum sealed glass vial | Transfer immediately upon receipt to methanol and sodium bisulfate solution, analyze within 14 days |
| Volatile Organics (Non-Aqueous sample) | Cool 4°C, dark | Field preserved vials methanol & sodium bisulfate Glass, 40 ml vial stir bar [sodium bisulfate only], septum sealed glass vial & 60 ml septum sealed glass vial | 14 days |
| Volatile organics in liquid samples | Cool 4°C, if residual $Cl_2$ add $Na_2S_2O_3$ and HCl to pH < 2 | Glass, Teflon®-lined cap | 14 days |
| Acrolein and Acrylonitrile in liquid samples | Cool 4°C Adjust to pH 4-5 | Glass, Teflon®-lined cap | 14 days |
| Semivolatile organics/ organochlorine pesticides/ PCBs and herbicides for soil/sediment, and sludge | Cool 4°C | Glass, Teflon®-lined cap | 14 days until extraction; 40 days after extraction |
| Semivolatile organics/ organochlorine pesticides/ PCBs and herbicides for concentrated waste samples | Cool 4°C | Glass, Teflon®-lined cap | 14 days until extraction; 40 days after extraction |
| Metals except Cr VI and Hg (total) for liquid samples | Cool 4°C, $HNO_3$ to pH < 2 | P, G | 6 months |
| Metals except Cr VI and Hg (dissolved) for liquid samples | Cool 4°C, Filter on-site $HNO_3$ to pH < 2 | P, G | 6 months |
| Metals except Cr VI and Hg (suspended) for liquid samples | Cool 4°C Filter on-site | P, G | 6 months |

Table 2.6 (continued) Required Preservation, Container and Maximum Holding Times for Solid/Hazardous Waste Samples (Soils, Liquids, Sediments, Sludges, and Ambient Air)

| Parameter | Preservation | Container | Maximum Holding Time |
|---|---|---|---|
| Metals except Cr VI and Hg for solid samples | Cool 4°C | P, G | 6 months |
| Chromium VI for solid samples | Cool 4°C | P, G | 30 days to digestion; analysis 168 hours after digestion |
| Chromium VI for liquid samples | Cool 4°C | P, G | 24 hours |
| Mercury (total) for liquid samples | $HNO_3$ to pH < 2 | P, G | 28 days |
| Mercury (dissolved) for liquid samples | Filter on-site $HNO_3$ to pH < 2 | P, G | 28 days |
| Mercury (total) for solid samples | Cool 4°C | P, G | 28 days |
| **Ambient Air Analysis** | | | |
| TO-15 Volatile Organics in Specially Prepared Canisters – GC/MS | None | Specially prepared canisters | 30 days from sample collection |
| TO-17 Volatile Organics in Ambient Air using Active Sampling onto Sorbent Tubes | Cool ≤4°C after sample collection and in refrigeration unless samples are analyzed the same day of collection. The samples must be stored in an organic solvent free environment. Small packages of activated charcoal/silica gel must be with each shipment container of multiple tubes. | Sorbent Tubes | 30 days from sample collection; except 7days if limonene, carene, labile sulfur, bischloromethylether or nitrogen containing volatiles |

◂ Return to TOC

## Table 2.7 Required Preservation, Container and Maximum Holding Times From VTSR for CERCLA-CLP Aqueous and Non-Aqueous Samples

| Parameter | Preservation | Container | Maximum Holding Time From Validated Time of Sample Receipt (VTSR) |
|---|---|---|---|
| Volatile Organics (Aqueous) | Cool 4°C, dark 0.08% $Na_2S_2O_3$ if residual $Cl_2$ | Glass, white polypropylene or black phenolic plastic screw Teflon®-lined septum | 10 days |
| Volatile Organics (Non-Aqueous) | Cool 4°C, dark | Glass, polypropylene cap, white Teflon® liner | 10 days |
| Volatile Organics (Non-Aqueous) | Cool 4°C, dark | Encore™ or equivalent field core sampling/ storage container & 60 ml septum sealed glass vial | Transfer immediately upon receipt to methanol and sodium bisulfate solution analyze within 10 days |
| Volatile Organics (Non-Aqueous) | Cool 4°C, dark | Field preserved vials methanol & sodium bisulfate glass, 40 ml vial stir bar [sodium bisulfate only], septum sealed glass vial & 60 ml septum sealed glass vial | 10 days |
| Pesticide/PCBs | Cool 4°C, dark | Amber Glass, white polypropylene or black phenolic, baked polyethylene cap | Extraction Aqueous: continuous liquid-liquid extraction must be started within 5 days, Non-Aqueous: 10 days analysis, 40 days from VTSR |
| Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Dibenzofurans (PCDFs) (Non Aqueous) | Cool 10°C, dark | Amber Glass, white polypropylene or black phenolic, baked polyethylene cap | Extraction: 30 days from VTSR, analysis 45 days from extraction |

Table 2.7 (continued) Required Preservation, Container and Maximum Holding Times From VTSR for CERCLA-CLP Aqueous and Non-Aqueous Samples

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time From Validated Time of Sample Receipt (VTSR)** |
|---|---|---|---|
| Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Dibenzofurans (PCDFs) (Aqueous) | Cool 4°C, dark | Amber Glass, white polypropylene or black phenolic, baked polyethylene cap | Extraction: 30days from VTSR, analysis: 45 days from extraction |
| Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Dibenzofurans (PCDFs) (Fish and Tissue Samples) | Cool 4°C, dark until prepared then-10°C until analysis | Wrapped in aluminum foil in field | Extraction: 1 year from VTSR. Once thawed, must be analyzed within 24 hours. Analysis: 45 days from extraction |
| Cyanide, total amenable to chlorination | Aqueous - 0.6g ascorbic acid if residual $Cl_2$, NaOH to pH>12, cool 4°C, $CaCO_3$ in presence of sulfide | Plastic bottle, plastic cap, plastic liner | 14 days |
| Metals except Hg (Aqueous) | $HNO_3$ to pH<2, cool 4°C, until analyzed | Plastic bottle, plastic cap, plastic liner | 180 days |
| Metals – Dissolved except Hg (Aqueous) | Field filter 0.45 µm pore diameter filter, rinse bottle with sample then immediately $HNO_3$ to pH<2, cool 4°C until analyzed | Plastic bottle, plastic cap, plastic liner | 180 days |
| Metals except Hg (Non-Aqueous) | Cool 4°C until analyzed | Flint glass bottle, black phenolic cap, polyethylene liner | 180 days |
| Hg (Aqueous) | $HNO_3$ to pH<2, Cool, 4°C until analyzed | Plastic bottle, plastic cap, plastic liner | 26 days |
| Hg – Dissolved (Aqueous) | Field filter 0.45 µm pore diameter filter, rinse bottle with sample immediately, $HNO_3$ to pH<2, Cool, 4°C until analyzed | Plastic bottle, plastic cap, plastic liner | 26 days |
| Hg (Non-Aqueous) | $HNO_3$ to pH<2, Cool, 4°C until analyzed | Flint glass bottle, black phenolic cap, polyethylene liner | 28 days |

Table 2.7 (continued) Required Preservation, Container and Maximum Holding Time From VTSR for CERCLA-CLP Aqueous and Non-Aqueous Samples

| **Parameter** | **Preservation** | **Container** | **Maximum Holding Time From Validated Time of Sample Receipt (VTSR)** |
|---|---|---|---|
| Cyanide (Aqueous) | 0.6g ascorbic acid if residual $Cl_2$ NaOH to pH>12, cool 4°C until analyzed | Plastic bottle, plastic cap, plastic liner | 14 days |
| Cyanide (Non-Aqueous) | Cool 4°C, until analyzed | Plastic bottle, plastic cap, plastic liner | 14 days |
| Low Level Volatile Organics | Cool 4°C, dark, 0.008% $Na_2S_2O_3$ | Glass, black phenolic or white polypropylene screw cap, Teflon®-lined septum | 7 days |
| Low Level Semi-volatile Organics | Cool 4°C, dark | White polypropylene or black phenolic, baked polyethylene cap | Extraction: continuous extraction must be started within 5 days of VTSR. Analysis: 40 days from start of extraction |
| Low Level Pesticides/PCBs Organics | Cool 4°C, dark | Amber glass, white polypropylene or black phenolic, baked polyethylene cap | Extraction: continuous extraction must be started within 5 days of VTSR. Analysis: 40 days from start of extraction |

## Footnotes

[1] Use only in the presence of residual chlorine.

[2] Optionally, all samples may be tested with lead acetate paper before pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then the NaOH is added to pH 12.

[3] Filter samples immediately on-site before adding preservatives for dissolved metals.

[4] Applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

[5] Sample receiving no pH adjustment shall be analyzed within seven days of sampling.

[6] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment shall be analyzed within three days of sampling.

[7] When the extractable analytes of concern fall within a single chemical Category, the specified preservative and maximum holding times shall be observed for optimum safe guard of sample integrity. When the analyses of concern fall within two or more chemical categories, the sample may be preserved by cooling to four (4) degrees Celsius, reducing residual chlorine with 0.008% $Na_2S_2O_3$, storing in the dark and, for pesticides only, adjusting the pH to 6-9.Samples preserved in this manner may be held for seven days before extraction and 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in reference 1 (regarding the requirement for thiosulfate reduction of residual chlorine), and references 8 and 9 (regarding the analysis of benzidine).

[8] Extracts may be stored up to seven days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.

[9] For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

[10] The pH adjustment may be performed upon receipt at the environmental laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

[11] Method 1631 Revision B: Mercury in Water by Oxidation, Purge and Trap and Cold Vapor Atomic Fluorescence Spectrometry is required. Samples may be shipped to laboratory unpreserved if collected in fluoropolymer bottles, filled to top with no headspace, capped tightly, and maintained at 4°C from time of collection until preservation. The samples must be acid preserved within 48 hours after sampling.

[12] First use of samples shall begin within 36 hours of collection. For storm water discharges, first use of the sample shall begin within 48 hours of collection.

[13] Once collected if the assay can not begin within 8 hours then the sample must be frozen. Once defrosted, the sample can be held at 4°C until the assay begins. The assay must then be done the day that the sample is defrosted.

[14] Elution, concentration and the application of the purified sample to the slide must be completed in one work day. The sample must be stained within 72 hours of the application of the purified sample to the slide. Up to 7 days are permitted between sample staining and examination.

# Appendix C-2: Required Preservation, Container, and Maximum Holding Times for Air Samples

## Required Preservation, Container, and Maximum Holding Times for Air Samples

| Parameter | Preservation | Container | Maximum Holding Times |
|---|---|---|---|
| Hexavalent Chromium | Cool 4°C ± 2°C | 47 mm PVC filter and cellulose backup pads loaded in a Federal Reference Method (FRM) type cassette with holder<br>Place sample cassette assemblies in a clean Ziploc ® bag | The laboratory SOP specifies holding times only for samples from chromium plating or paint operations. A maximum holding time of 30 days from sample collection which conforms to NJDEP requirements for hexavalent chromium in non-aqueous samples will be used. In general filter samples will be analyzed and reported within 5 business days of collection. |
| Particulate Matter ($PM_{10}$) | None, ambient temperature | 47 mm $PM_{10}$ filter in static, dissipative plastic petri dish slides for particulate filter transit and/or storage | None |

# Appendix D

# Analytical Laboratory Standard Operating Procedures (SOPs)

# D-1: Accutest Laboratories SOPs

(Lab procedures are proprietary information and provided to the NJDEP only)

# APPENDIX D-1

## ACCUTEST LABORATORY SOP LIST
## PPF FSP/QAPP

| Matrix | Analysis | SOP Title | SOP No./Date | Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid and Aqueous | Polychlorinated Biphenyls (PCBs) | SW846 8082: Determination of Polychlorinated Biphenyls (PCBs) Using GC System | EGC8082-11 10/20/09 | SW846 8082 | Certified |
| Solid and Aqueous | Extractable Petroleum Hydrocarbons (EPH) | Extractable Petroleum Hydrocarbons | EGCNJEPH-01 1/7/10 | NJDEP EPH | Certified |
| Solid | Percent Solids | Percent Solids and Total Solids in Soil/Solid Matrices | EGN007-08 9/22/09 | SM 2540G, ASTM D4643-00 | NA |
| Aqueous | Total Dissolved Solids (TDS) | Total Dissolved Solids (Total Filterable Residue) | EGN020-08 4/21/09 | SM 2540C | Certified |
| Aqueous | Nitrate/Nitrite | Nitrate/Nitrite and Nitrate only by Cadmium Reduction Analysis (Lachat Autoanalyzer) | EGN026-06 02/09/09 | EPA 353.2 | Certified |
| Aqueous | Alkalinity | Alkalinity, Total (pH 4.5) | EGN037-07 10/06/08 | SM 2320B | Certified |
| Aqueous | Total Suspended Solids (TSS) | Total Suspended Solids (Non-Filterable Residue) | EGN087-08 11/16/09 | SM 2540D | Certified |
| Solid and Aqueous | Carbon Oxygen Demand (COD) | Chemical Oxygen Demand - HACH 8000, Aqueous Samples, HACH 8000, Modification for Solid Samples | EGN099-06 4/22/07 | SM 5220 C | Certified aqueous, certification NA for soil |
| Aqueous | Orthophosphate | Orthophosphate | EGN102-06 3/18/10 | SM 4500-P E | Certified |
| Aqueous | Nitrite | Nitrogen, Nitrite (Total-Waters), Nitrogen, Nitrite (soluble-Soils) | EGN103-05 07/29/04 | SM 4500-NO2 | Certified |
| Solid and Aqueous | Sulfide (acid soluble and insoluble) | Sulfide | EGN118-06 10/12/09 | SW846 9034 | Certified |
| Aqueous | Chloride | Chloride | EGN131-04 4/25/07 | SM 4500-Cl C | Certified |
| Aqueous | Biological Oxygen Demand (BOD) | Biological Oxygen Demand and Carbonaceous Oxygen Demand | EGN134-08 3/11/09 | SM 5210B | Certified |
| Solid and Aqueous | Ignitability | Ignitability | EGN140-09 12/22/09 | SW846 1010A | Certified |
| Solid | TCLP -Organics | TCLP | EGN142-10 10/3/09 | SW846 1311 | Certified |
| Aqueous | Total Cyanide - Spectrophotometric | Cyanide (Lachat Autoanalyzer) | EGN207-14 12/14/09 | EPA 335.4 | Certified |
| Solid | Hexavalent Chromium - Colorimetric | Hexavalent Chromium (Soils) | EGN214-08 10/6/08 | SW846 3060A for digestion<br>SW846 7196A for analysis | Certified |
| Aqueous | Phenols | Phenols (Lachat Autoanalyzer) | EGN217-13 9/23/09 | SW846 9066 | Certified |
| Solid | Total Organic Halides (TOX) | Total Organic Halides, Solid and Oil Matrices | EGN219-04 5/6/08 | SW846 9023 | Certified |
| Solid and Aqueous | Reactivity | Sulfide Analysis and Reactive Sulfides | EGN228-06 1/2/03 | SW846 9034 | Certified |
| Aqueous | Hexavalent Chromium - Colorimetric | Hexavalent Chromium in Waters | EGN230-08 4/22/09 | SW846 7196A | Certified |
| Solid | Total Organic Carbon (TOC) | Total Organic Carbon in Soils Samples | EGN233-07 11/8/07 | SW846 9060 | Certified |
| Aqueous | Total Organic Carbon | Total Organic Carbon in Aqueous Samples | EGN234-10 7/16/08 | SM 5310 B | Certified |
| Aqueous | pH and Corrosivity | pH and Corrosivity for Aqueous and Multiphasic Wastes | EGN238-05 5/30/08 | SW846 9040C | Certified |
| Solids | Synthetic Precipitation Leaching Procedure (SPLP) for Non-volatile Analytes | Synthetic Precipitation Leaching Procedure for Non-Volatile Analytes | EGN239-03 4/28/09 | SW846 1312 | Certified |
| Solids | Synthetic Precipitation Leaching Procedure (SPLP) Volatile Analytes | Synthetic Precipitation Leaching Procedure for Volatile Analytes | EGN240-03 4/28/09 | SW846 1312 | Certified |
| Solid | Cation Exchange Capacity (CEC) | Cation Exchange Capacity of Soils (Sodium Acetate) | EGN242-03 1/19/06 | SW846 9081 | Certified |
| Aqueous | Ferrous and Ferric Iron | Ferrous Iron | EGN243-05 3/20/09 | SM 3500B-Fe B | Certified |
| Solid and Aqueous | Anions - bromide, chloride, sulfate (using Dionex DX500) | Determination of Inorganic Anions by Ion Chromatography | EGN251-08 5/16/06 | EPA 300 & SW846 9056 | Certified |
| Solid | Shake Extraction with Water | The Neutral Leaching of Solid Waste Samples Using Shake Extraction | EGN252-03 1/7/09 | ASTM D3987-85 | NA |
| Solid and Aqueous | Oxidation-Reduction Potential (Redox) | Oxidation-Reduction Potential | EGN253-07 10/6/08 | ASTM D1498-76 | NA |
| Aqueous | Total Phosphorus | Total Phosphorus | EGN256-08 8/10/09 | EPA 365.3 | Certified |
| Solid | Total Cyanide - Colorimetric | Cyanide Distallation/Soil Samples /Micro Method | EGN276-08 12/14/09 | SW846 9012B M | Certified |
| Solid | Phenols | Phenols Micro Distillation, Soil Samples | EGN280-04 8/24/08 | SW846 9065 | Certified |
| Solid and Aqueous | Anions - bromide, chloride, sulfate (using Dionex ICS-2000) | Determination of Inorganic Anions by Ion Chromatography | EGN281-07 3/24/10 | EPA 300 & SW846 9056 | Certified |

## APPENDIX D-1

## ACCUTEST LABORATORY SOP LIST
## PPF FSP/QAPP

| Matrix | Analysis | SOP Title | SOP No./Date | Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid | Particle Size Reduction | Procedure for Particle Size Reduction (Crushing) of Solid Matrices | EGN297-01<br>08/06/07 | NA | NA |
| Solid | Pore Water Extraction from Saturated Soils | Procedure for Pre Water Extraction from Soil Samples for Non-Volatile or Metals Analysis | EGN299-01<br>8/25/09 | NA | NA |
| Aqueous/ Solid | Sample Waste Disposal | Sample Waste Disposal | EHS004-03<br>10/21/09 | NA | NA |
| Solids | Mercury - Cold Vapor | Cold Vapor Analysis of Mercury for Soil Samples | EMA072-14<br>9/16/08 | SW846 7471A | Certified |
| Aqueous | Mercury - Cold Vapor | Cold Vapor Analysis of Mercury for Water Samples | EMA215-09<br>9/16/08 | SW846 7470A | Certified |
| Solid and Aqueous | Total and Dissolved Metals by ICP | Metals by Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) | EMA217-08<br>7/31/08 | SW846 6020 | Certified |
| Solid and Aqueous | Total and Dissolved Metals by ICP-MS | Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) Using Solid State ICP | EMA222-07<br>1/13/10 | SW846 6010B | Certified |
| Aqueous | Acid Digestion for Metals - Aqueous | Digestion of Non-Portable Waters for ICP or ICP-MS Analysis | EMP070-12<br>1/15/10 | SW846 3010A | Certified |
| Solid | Acid Digestion for Metals - Solids | Digestion of Soils for ICP and ICP-MS Analysis | EMP073-12<br>9/1/09 | SW846 3050B | Certified |
| Aqueous | Acid Digestion for Metals - Aqueous | Digestion of Non-Potable Waters for Total Recoverable or Dissolved Metals for ICP or Flame Analysis | EMP081-04<br>10/3/09 | SW846 3005A | Certified |
| Solid and Aqueous | Volatile Organic Compounds (VOCs) | Method 8260B, Volatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS) | EMS8260-19<br>9/11/2009 | SW846 8260B | Certified |
| Solid and Aqueous | Semivolatile Organic Compounds (SVOCs) | Method 8270C, Semivolatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS) | EMS8270-16<br>2/3/09 | SW846 8270C | Certified |
| Aqueous | Separatory Funnel Extraction for SVOCs | Preparation of Semi-Volatile Extractables in Aqueous | EOP001-09<br>11/3/09 | SW846 3510C | Certified |
| Solid | Ultrasonic Extraction - SVOCs | Extraction of Semivolatile Organics from Solids by Sonication (Base, Neutral, Acid Organics; Pesticides, Polychlorinated Biphenyls, Diesel Range Organics) | EOP002-11<br>9/20/07 | SW846 3550B | Certified |
| Aqueous | Continuous Liquid-Liquid Extraction for SVOCs | Continuous Liquid-Liquid Extraction | EOP007-03<br>7/28/03 | SW846 3520C | Certified |
| Solid and Aqueous | Preparation for PCBs | Preparation of Petroleum Oils and Organic Wastes for PCB Analysis by SW8082 | EOP017-02<br>9/25/08 | SW846 3580A | Certified |
| Solid | Cleanup - Sulfur Removal | The Removal of Elemental Sulfur from Organic Extracts using Tetrabutylammonium Sulfite | EOP018-01<br>9/27/04 | SW846 3660B | Certified |
| Solid | Soxhlet Extraction - SVOCs | Preparation of Solids for Semi-Volatile Organics by Soxhlet Extraction | EOP020-03<br>7/29/03 | SW846 3540C | Certified |
| Solid | Cleanup - Florisil | Florisil Column Cleanup | EOP3620-04<br>5/25/06 | SW846 3620B | Certified |
| Solid | Cleanup - Sulfuric Acid | Sulfuric Acid/Permanganate Cleanup | EOP3665-03 | SW846 3665A | Certified |
| Aqueous | Purge & Trap for VOCs | Purge-and-Trap Extraction for Aqueous Samples | EOP5030-03<br>8/6/03 | SW846 5030B | Certified |
| Solid | Purge & Trap for VOCs - low level | Collection, Preservation, Management and Handling of Solid Samples for Volatile Organic Analysis by SW-846 Methodology | EOP5035-12<br>3/2/09 | SW846 5035L & 5035H | Certified |
| Aqueous/ Solid | Sample Container Receipt, Cleaning, and Quality Control | Sample Container Receipt, Cleaning, and Quality Control | EQA006-07<br>10/18/06 | NA | NA |
| Solid | Homogenization | Procedure for Obtaining Representative Sample Aliquots | EQA042-03<br>2/17/06 | NA | NA |

NA - Not applicable

# D-2: Air Laboratories SOPs

(Lab procedures are proprietary information and provided to the NJDEP only)

APPENDIX D-2

# AIR LABORATORY SOP LIST
PPG FSP/QAPP

| Matrix | Analysis | Laboratory | SOP Title | SOP No./Date/Rev. # | Source Method | Certification Status |
|---|---|---|---|---|---|---|
| Air | Hexavalent Chromium | Galson | Preparation of PVC Filters for the Determination of Hexavalent Chromium by IC | II-CR6PREP | OSHA Method ID-215 | Certified |
| Air | Hexavalent Chromium | Galson | Analysis of Hexavalent Chromium by Ion Chromatography | II-CR6IC | OSHA Method ID-215 | Certified |
| Air | Particulates | AECOM | Filter Processing Method for the Determination of Suspended Particulates in Ambient Air | 2000-105,<br>March 2007,<br>Rev. No. 6 | 40 CFR 50 | Certified |

# D-3: GeoTesting Express SOPs

(Lab procedures are proprietary information and provided to the NJDEP only)

# APPENDIX D-3

## GEOTESTING EXPRESS SOP LIST
## PPG FSP/QAPP

| Matrix | Analysis | Laboratory | SOP Title | SOP No./Date/Rev. # | Source Method | Certification Status |
|---|---|---|---|---|---|---|
| Solid | Compressive Strength | GeoTesting Express | Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders[1] | D 1633 – 00 (Reapproved 2007) | ASTM D1633 | NA |
| Solid | Moisture Content | GeoTesting Express | Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock Mass | ASTM D 2216, June 2006, Revision 4 | ASTM D2216 - latest revision | NA |
| Solid | Strength and stress-strain relationships of cohesive soil | GeoTesting Express | Test Method for Unconsolidated Undrained Triaxial Compression Test on Cohesive Soils | ASTM D 2850, June 2006, Revision 3 | ASTM D2850 - lastest revision | NA |
| Solid | Grain Size Analysis | GeoTesting Express | Test Method for Particle Size Analysis of Soils | ASTM D 422, June 2009, Revision 6 | ASTM D 422- latest revision | NA |
| Solid | Plasticity of soils | GeoTesting Express | Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils | ASTM D 4318, June 2006, Revision 3 | ASTM D 4318 – latest revision | NA |
| Solid | Strength and stress-strain relationships of saturated cohesive soil | GeoTesting Express | Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils | ASTM D 4767, June 2006, Revision 3 | ASTM D 4767 – latest revision | NA |
| Solid | Resistance of Solid Wastes to Freezing and Thawing | GeoTesting Express | Standard Test Method for Determining the Resistance of Solid Wastes to Freezing and Thawing[1] | D 4842 – 90 (Reapproved 2001) | ASTM D 4842 | NA |
| Solid | Wetting and Drying Test of Solid Wastes | GeoTesting Express | Standard Test Method for Wetting and Drying Test of Solid Wastes[1] | D 4843 – 88 (Reapproved 1999) | ASTM D 4843 | NA |
| Solid | Hydraulic Conductivity | GeoTesting Express | Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter | ASTM D 5084, June 2006, Revision 6 | ASTM D 5084 – latest revision | NA |
| Solid | Specific gravity | GeoTesting Express | Standard Test Method for Specific Gravity of Soil Solids by Water Pycnomete | ASTM D 854, June 2009, Revision 4 | ASTM D 854 – latest revision | NA |

NA - Not applicable

# D-4: Test America SOPs

(Lab procedures are proprietary information and provided to the NJDEP only)

APPENDIX D-4

# TEST AMERICA LABORATORY SOP LIST
# PPG FSP/QAPP

| Matrix | Technique Description | SOP Title | SOP No./Date/Rev. # | NJDEP Approved Method(s) | Certification Status |
|---|---|---|---|---|---|
| NA | Solvent and Acid Lot Testing | Solvent & Acid Lot Testing & Approval | CA-Q-S-001 10/1/07 Rev. 0 | None | NA |
| Solid and Aqueous | Calibration Curves | Calibration Curves (General) | CA-Q-S-005 12/15/09 Rev. 2 | None | NA |
| Solid and Aqueous | Preparation and Screening for SVOC | Preparation and Screening of Semivolatile Organic Extracts for GC/MS Analysis | ED-GCS-001 1/24/08 Rev. 6 | None | NA |
| Solid | Headspace for VOCs | Screening for Volatile Organics, Static Headspace with GC FID, SW846 Method 5021 | ED-GCV-001 10/23/09 Rev. 8 | SW846 5021 | Certified |
| NA | Control of Non-Conformances | Standard Operating Procedure for Control of Non-Conformances and Corrective Action | ED-GEN-003 3/13/09 Rev. 3a | None | NA |
| Solid | SubSampling | SubSampling | ED-GEN-007 3/13/09 Rev. 2a | None | NA |
| NA | Reagents and Standards | Traceability and Storage of Standards and Reagents | ED-GEN-008 1/26/10 Rev. 3 | None | NA |
| Solid | Calibration of Balances | Calibration of Analytical Balances | ED-GEN-010 6/8/09 Rev. 5 | None | NA |
| Solid | Thermometer Calibration | Thermometer Calibration | ED-GEN-014 7/6/09 Rev. 5 | None | NA |
| NA | Training | Training | ED-GEN-022 6/11/08 Rev. 1 | None | NA |
| NA | Bulk Solvent testing | Bulk Solvent Testing and Approval | ED-GEN-023 4/1/08 Rev. 0 | None | NA |
| Solid and Aqueous | Semivolatile Organic Compounds (SVOCs) | Semi-Volatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS), SW846 Method 8270C | ED-MSS-002 2/15/10 Rev. 10 | SW846 8270C | Certified |
| Aqueous | Purge and Trap for VOCs in Aqueous | Purge and Trap for Aqueous Samples, SW846 Method 5030 | ED-MSV-001 10/6/08 Rev. 7 | SW846 5030B | Certified |
| Solid | Purge and Trap for VOCs in Solid Samples | Closed System Purge and Trap and Extraction for Volatile Organics in Soil, SW846 Method 5035A | ED-MSV-002 11/4/08 Rev. 7 | SW846 5035A | Certified |

APPENDIX D-4

# TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

| Matrix | Technique Description | SOP Title | SOP No./Date/Rev. # | NJDEP Approved Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid and Aqueous | Volatile Organic Compounds (VOCs) | SW846 Method 8260B, Volatile Organic Compounds By Gas Chromatography/ Mass Spectrometry (GC/MS) | ED-MSV-005 10/23/08 Rev. 8 | SW846 8260B | Certified |
| Solid and Aqueous | Metals by ICP | Trace Metals Analysis by Inductively Coupled Plasma Emission Spectroscopy [Method No. SW846 Method 6010B] | ED-MT-004 6/26/08 Rev. 6 | SW846 6010B | Certified |
| Solid and Aqueous | Use of ICP | The Use of the Thermo Jarrell Ash Model 61E Trace Simultaneous Inductively Coupled Plasma Emission Spectrometer | ED-MT-013 11/25/09 Rev. 6 | None | NA |
| Solid | Mercury by Manual Cold Vapor | Mercury Analysis for Sediment and Soil Samples using the Leeman Mercury Analyzer (Cold Vapor Technique) by SW846 Method 7471A | ED-MT-016 3/17/09 Rev. 7 | SW846 7471A | Certified |
| Aqueous | Mercury by Manual Cold Vapor | Mercury Analysis for Water and Wastewater using EPA 245.1 and SW846 7470A; Mercury in Drinking Water using EPA245.1; Leeman Mercury Analyzer (Cold Vapor Technique) | ED-MT-017 9/3/09 Rev. 6 | SW846 7470A | Certified |
| Solid and Aqueous | Metals by ICP-MS | Trace Metals Analysis for Water, Wastewater, Soil, Sediment, and Leachate Samples by ICP-MS Method No(s). EPA Methods 200.8 and SW-846 Method 6020 | ED-MT-029 9/11/09 Rev. 6 | SW846 6020 | Certified |
| Aqueous | Acid Digestion - SW and GW | Digestion of Water and Wastewater Samples for Analysis by ICP and ICP-MS [Method No. 3005A] | ED-MTP-002 10/20/09 Rev. 6 | SW846 3005A | Certified |
| Aqueous | Acid Digestion for Metals - Aqueous | Digestion of Water and Wastewater Samples for Analysis by ICP and ICP-MS [Method No. 3010A] | ED-MTP-003 11/24/08 Rev. 6 | SW846 3010A | Certified |

APPENDIX D-4

# TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

| Matrix | Technique Description | SOP Title | SOP No./Date/Rev. # | NJDEP Approved Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid | Acid Digestion for Metals - Solids | Hot Block Digestion of Sediments, Sludges and Soils, SW846 Method 3050B | ED-MTP-005 3/30/10 Rev. 8 | SW846 3050B | Certified |
| Aqueous | Separatory Funnel Extraction for SVOCs | Extraction of Semi-Volatile Organic Compounds in Aqueous Samples and Leachates - Separatory Funnel, (SW846 Method 3510C) | ED-ORP-002 11/24/08 Rev. 6 | SW846 3510C | Certified |
| Aqueous | Continuous Liquid-Liquid Extraction for SVOCs | Extraction of Semi-Volatile Organic Compounds in Water by Continuous Liquid-Liquid Extraction, SW846 Method 3520C | ED-ORP-003 11/24/08 Rev. 6 | SW846 3520C | Certified |
| Solid | Automatic Soxhlet Extraction for SVOCs | Automated Soxhlet Extraction of Solid Samples for Semivolatile Organic Compounds by SW846 Method 3541 | ED-ORP-004 1/26/10 Rev. 7 | SW846 3541 | Certified |
| Solid | Ultrasonic Extraction for SVOCs | Extraction of Semivolatile Organic Compounds in Soil Using a Medium-Level Extraction Technique (SW846 Method 3550B) | ED-ORP-006 1/19/08 Rev. 3 | SW846 3550B | Certified |
| Aqueous | Separatory Funnel Extraction for Pesticides and PCBs | Extraction of Pesticides and PCBs in Water by Separatory Funnel using SW846 Method 3510C | ED-ORP-014 10/30/09 Rev. 6 | SW846 3510C | Certified |
| Solid | Automatic Soxhlet Extraction for Pesticides and PCBs | Automated Soxhlet Extraction of Solid Samples for Semivolatile Pesticides/PCBs Compounds by SW846 Method 3541 | ED-ORP-016 1/25/10 Rev. 7 | SW846 3541 | Certified |
| Solid | Ultrasonic Extraction for Pesticides and PCBs | Ultrasonic Extraction of Pesticides & PCBs in Soils using SW846 Method 3550B | ED-ORP-018 12/1/09 Rev.6 | SW846 3550B | Certified |
| Solid and Aqueous | Dilution | Waste Dilution Preparation for Pesticides and PCBs using SW846 Method 3580A | ED-ORP-019 11/23/09 Rev. 6 | SW846 3580A | Certified |
| Solid | Cleanup - Florisil | Florisil Cleanup of Pesticide/PCB Sample Extracts by SW846 Method 3620B | ED-ORP-020 11/23/09 Rev. 5 | SW846 3620B | Certified |

APPENDIX D-4

## TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

| Matrix | Technique Description | SOP Title | SOP No./Date/Rev. # | NJDEP Approved Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid | Cleanup - Sulfur Removal | The Removal of Elemental Sulfur from Pesticide/PCB Extracts using SW846 Method 3660/3660B | ED-ORP-021 11/23/09 Rev. 5 | SW846 3660B | Certified |
| Solid | Cleanup - Sulfuric Acid | Sulfuric Acid Cleanup of PCB Extracts using SW846 Method 3665A | ED-ORP-022 11/16/09 Rev. 6 | SW846 3665A | Certified |
| Solid | TCLP for organic and inorganic analytes | Extraction Procedure Using the Toxicity Characteristic Leaching Procedure (TCLP), SW846 1311 | ED-ORP-038 11/2/09 Rev. 7 | SW846 1311 | Certified |
| Solids | Synthetic Precipitation Leaching Procedure (SPLP) | Extraction Procedure Using the Synthetic Precipitation Leaching Procedure (SPLP), SW846 1312 | ED-ORP-040 11/8/09 Rev. 4 | SW846 1312 | Certified |
| Solid | Shake Extraction with Water | ASTM Leachate Procedure for the Extraction of Solid Waste with Water | ED-ORP-041 10/28/09 Rev. 5 | ASTM D3987-85 | Certified |
| Solid and Aqueous | Polychlorinated Biphenyls (PCBs) | Analysis of Polychlorinated Biphenyls by Gas Chromatography using SW846 Method 8082 | EDS-GCS-04 1/12/10 Rev. 7 | SW846 8082 | Certified |
| NA | Sample Storage and Handling | Sample Storage & Handling Procedures for Mitigation of Sample and Laboratory Contamination | ED-SPM-004 2/1/08 Rev. 5 | None | NA |
| Aqueous/Solid | Laboratory Waste Disposal | Laboratory Waste Disposal Procedures | ED-SPM-008 Rev. 2 | None | NA |
| Solid and Aqueous | Reactive Cyanide | Cyanide-Reactivity, Analysis of Cyanide Reactivity [Method No(s). Vol. 1c 7.3.3] | ED-WET-001 9/15/08 Rev. 4 | Vol. 1c 7.3.3 | NA |
| Solid and Aqueous | Cyanide | Analysis of Total and Amenable Cyanide in Water, Drinking water, Wastewater, and Soil- Automated [Method No(s). SW846 9012A/9012B; 335.4 and SM 4500CN-C] | ED-WET-002 9/28/09 Rev. 4 | SW846 9012A<br>EPA 335.4<br>SM 4500 CN C | Certified |
| Solid | Hexavalent Chromium Digestion | The Alkaline Digestion of Soil Samples for the Analysis of Hexavalent Chromium [Method SW846 3060A] | ED-WET-010 2/03/10 Rev. 9 | SW846 3060A | Certified |

APPENDIX D-4

TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

| Matrix | Technique Description | SOP Title | SOP No./Date/Rev. # | NJDEP Approved Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid | Hexavalent Chromium by Colorimetric | The Analysis of Digestates for Hexavalent Chromium by SW846 7196A | ED-WET-011 8/25/09 Rev. 7 | SW846 7196A | Certified |
| Aqueous | Hexavalent Chromium by Colorimetric | The Analysis of Waters for Hexavalent Chromium by EPA SW846 Method 7196A | ED-WET-012 1/22/08 Rev. 4 | SW846 7196A | Certified |
| Aqueous | Nitrate/Nitrite | Analysis of Nitrate and Nitrite in Water, Wastewater, and Soil-Automated [EPA 353.2 and SM 4500-NO3F] | ED-WET-021 9/15/09 Rev. 4 | SM 4500-NO3 F | Certified |
| Solid and Aqueous | Phenol | PHENOL, Analysis Total Phenols in Water and Wastewater - Discreet Analyzer [Method No(s). EPA 420.1 and SW846 9065] | ED-WET-026 5/20/08 Rev. 5 | SW846 9065 | Certified |
| Aqueous | Total Dissolved Solids (TDS) | TDS, The Determination of Filterable Residue [Method No. Standard Method 2540C] | ED-WET-027 7/16/08 Rev. 5 | SM 2540C | Certified |
| Aqueous | Total Suspended Solids (TSS) | TSS, Analysis of Total Suspended Solids in Water and Wastewater Samples [Method No. Standard Method 2540D] | ED-WET-028 10/8/08 Rev. 5 | SM 2540D | Certified |
| Solid | Percent Moisture | Percent Moisture Determination | ED-WET-32 2/16/10 Rev. 4 | EPA CLP SOW SOM01.1 | NA |
| Aqueous | Alkalinity | ALKALINITY, Analysis of Alkalinity in Water, Wastewater and Soil by Manual Titration or Auto-Titrator, Standard Method 2320B | ED-WET-039 11/10/08 Rev. 6 | SM 2320B | Certified |
| Aqueous | Biological Oxygen Demand (BOD) | Analysis of Biological Oxygen Demand in Water and Wastewater [Method No. SM 5210B] | ED-WET-041 4/1/08 Rev. 7 | SM 5210B | Certified |
| Aqueous | Chloride | Analysis of Chloride in Water, Wastewater, and Soil by Method No(s). SM 4500-CL B and SW846 9253 | ED-WET-043 11/18/09 Rev. 4 | SM 4500-CL B | Certified |

# APPENDIX D-4

## TEST AMERICA LABORATORY SOP LIST
## PPG FSP/QAPP

| Matrix | Technique Description | SOP Title | SOP No./Date/Rev. # | NJDEP Approved Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid and Aqueous | Chloride - Colorimetric | Analysis of Chloride in Water, Wastewater, and Soil by Colorimetric Automated Ferricyanide [Method No(s). Standard Methods | ED-WET-044<br>10/1/09 Rev. 5 | SM 4500-CL E<br>SW846 9251 | Certified |
| Aqueous | Carbon Oxygen Demand (COD) | Analysis of Chemical Oxygen Demand in Water Wastewater and Soil | ED-WET-048<br>5/5/06 Rev. 3 | EPA 410.4<br>SM 5220D | Certified |
| Aqueous | Dissolved Oxygen (DO) | DISSOLVE OXYGEN, Titrimetric Analysis of Dissolved Oxygen by Standard Method 4500-O C | ED-WET-053<br>2/22/10 Rev. 5 | SM 4500-O C | Certified |
| Aqueous | Ferrous Iron | Analysis of Ferrous Iron in Aqueous Samples by Discreet Analyzer | ED-WET-057<br>5/8/06 Rev. 3 | SM 3500 - Fe D | NJDEP certifies ferrous iron determination only for analysis of aqueous samples in the field |
| Solid and Aqueous | Ignitability | IGNITABILITY, Setaflash Method for Determining the Ignitability of Soil and Water Samples [Method No. SW846 1020A] | ED-WET-058<br>7/9/08 Rev. 5 | SW846 1020A | Certified |
| Solid and Aqueous | pH (Corrosivity) | Analysis of pH for Waters and Drinking water Measured Electrochemically [EPA 150.1, SM 4500 H $^+$B, SW846 9040B] | ED-WET-060<br>10/5/09 Rev. 5 | SW846 9040B | Certified |
| Solid | pH | Analysis of pH for Soils and Organic Samples Determined Electrochemically [Method No. SW846 9045C] | ED-WET-061<br>10/6/09 Rev. 4 | SW846 9045C | Certified |
| Aqueous | Ortho Phosphate | Analysis of Orthophosphate in Water | ED-WET-064<br>5/8/06 Rev. 3 | SM 4500-P E | Certified |

APPENDIX D-4

TEST AMERICA LABORATORY SOP LIST
PPG FSP/QAPP

| Matrix | Technique Description | SOP Title | SOP No./Date/Rev. # | NJDEP Approved Method(s) | Certification Status |
|---|---|---|---|---|---|
| Solid and Aqueous | Oxidation-Reduction Potential (Redox) | REDOX, Analysis of Oxidation-Reduction Potential by Standard Methods 2580 | ED-WET-066 11/30/09 Rev. 5 | SM 2580 | NA; NJDEP does not certify this parameter |
| Solid and Aqueous | Sulfate | Photometric Analysis of Sulfate in Water Wastewater and Soil | ED-WET-068 3/29/07 Rev. 5 | SW846 9038 | Certified |
| Solid | Sulfide Reactivity | Analysis of Sulfide Reactivity | ED-WET-070 5/5/06 Rev. 3 | SW846 9034 | Certified |
| Solid | Acid Soluble Sulfide | Analysis of Acid Soluble Sulfides in Soil, SW846 9030B & 9034 | ED-WET-071 5/8/06 Rev. 3 | SW846 9030B<br>SW846 9034 | Certified |
| Aqueous | Total Organic Carbon (TOC) | Analysis of Total Organic Carbon in Aqueous Samples, SW846 9060 | ED-WET-073 11/12/07 Rev. 4 | SW846 9060 | Certified |
| Solid | Total Organic Carbon (TOC) | The Determination of Total Organic Carbon in Solid Samples by Flash EA 1122 Analyzer, Lloyd Kahn | ED-WET-076, 7/11/2007 Rev. 2 | SW846 9060 | Certified |
| Solid and Aqueous | Extractable Petroleum Hydrocarbons (EPH) | Preparation and Analysis of Extractable Petroleum Hydrocarbons (EPH) in Solid and Water Samples using NJDEP EPH 10/08: Analysis of Extractable Petroleum Hydrocarbon Compounds (EPH) in Aqueous and Soil/Sediment/Sludge Matrices | ED-GCS-012, 4/19/2010 Rev 2 | NJDEP EPH Method 10/08, Rev. 2, October 2009. | Certified |

NA - Not Applicable

# Appendix E

# Sample Hit List

# Summary Hit List
# PPG Industries, Inc.

## Summary Hit List Format
## PPG Industries, Inc

| | |
|---|---|
| **Site Name** | |
| **NJDEP Case No.** | |
| **Sampling Date** | |
| **Lab Name/ID** | |
| **SDG No.** | |
| **Sample Matrix** | |

| | |
|---|---|
| **Trip Blank ID** | |
| **Field Blank ID** | |

| Sample ID | Analyte Name[1] | Method Blank Results[2] | Lab Concentration | Validator Concentration | QA Decision | Data Validation Qualifier[3] | NJDEP Footnote[4] |
|---|---|---|---|---|---|---|---|
| (Units) | | (Units) | (Units) | (Units) | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Notes:**

[1] - ND values are not listed

[2] - Units must be mg/kg for solid samples

[3] - Flagging code added by validator

[4] - NJDEP Reason Codes listed in Section 20 of *Standard Operating Procedures for the Completion of the Data Validation Report Forms and the Preparation of the Final Data Validation Report,* SOP 5.A.15, Rev. 2, October 2001.