

Chemical Data Quality Management Plan

**New York District
Formerly Utilized Sites Remedial Action Program
Maywood Superfund Site**

Prepared by:


Shaw® Shaw Environmental, Inc.
100 West Hunter Ave.
Maywood, New Jersey 07607

for:

**US Army Corps of Engineers - Kansas City District
Formerly Utilized Sites Remedial Action Program
Contract No. DACW41-99-D-9001**



**US Army Corps
of Engineers®**

September 2003, Revision 01

CHEMICAL DATA QUALITY MANAGEMENT PLAN

FUSRAP MAYWOOD SUPERFUND SITE
MAYWOOD, NEW JERSEY

SITE-SPECIFIC ENVIRONMENTAL RESTORATION
CONTRACT No. DACW41-99-D-9001
TASK ORDER 10041
WAD 01 WBS 01

Submitted to:

Department of the Army
U.S. Army Engineer District, New York
Corps of Engineers
FUSRAP Project Office
26 Federal Plaza
New York, New York 10278

Department of the Army
U.S. Army Engineer District, Kansas City
Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106

Submitted by:

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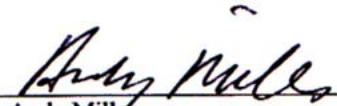
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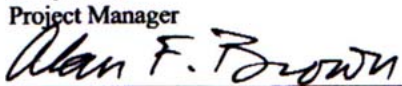
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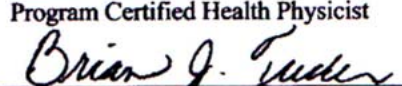
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CDQMP Volume 1, Quality Assurance Project Plan

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Volume 1

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ABBREVIATIONS AND ACRONYMS

CAR	Corrective Action Report
CCQC	Contractor Chemical Quality Control
CDQMP	Chemical Data Quality Management Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liabilities Act of 1980
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CO	Contracting Officer
COC	contaminant of concern
cpm	counts per minute
CQAB	Chemical Quality Assurance Branch
CQCP	Contractor Quality Control Plan
CQCSM	Contractor Quality Control System Manager
CX	Center for Expertise
%D	percent difference
DOD	Department of Defense
DOE	U. S. Department of Energy
dpm	disintegrations per minute
dps	disintegrations per second
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
EE/CA	Engineering Evaluation / Cost Analysis
EM	Engineering Manual
EMC	Elevated Measurement Comparison
EPA	U.S. Environmental Protection Agency
FCO	Field Change Order
FCRF	Field Change Request Form
FFA	Federal Facilities Agreement
FMSS	FUSRAP Maywood Superfund Site
FSP	Field Sampling Plan
FSS	Final Status Survey
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	gram
GC	Gas Chromatography
GEPP	General Environmental Protection Plan
GWQC	Groundwater Quality Criteria
ha	hectare
HPLC	High Performance Liquid Chromatography
HTRW	Hazardous, Toxic, and Radiological Waste
ICP	Inductively Coupled Plasma
km	kilometers
L _c	Critical Level
L _d	Detection Limit
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	Maximum Contaminant Level

MCW	Maywood Chemical Works
MD	matrix duplicate
MDA	Minimum Detectable Activity
MDL	Method Detection Limit
MEK	Methyl Ethyl Ketone
mi	mile
MISS	Maywood Interim Storage Site
MNA	Monitored Natural Attenuation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NaI	Sodium Iodide
NCR	Nonconformance Report
NESHAP	National Emission Standards for Hazardous Air Pollutants
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
pCi	picocurie
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCB	Polychlorinated biphenyl
PCOC	Primary Contaminant Concern
PDI	Pre-Design Investigation
PE	Performance Evaluation
PEBS	Proposed Exploratory Boring Sites
PID	Photoionization Detector
POTW	Publicly Owned Treatment Works
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
PQCM	Program Quality Control Manager
PQL	Practical Quantitation Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QCSR	Quality Control Summary Report
%R	percent Recovery
Ra	Radium
²²⁶ Ra	Radium-226
RF	Response Factor
RL	Reporting Limit
²²² Rn	Radon-222
ROC	Radionuclides of Concern
ROD	Record of Decision
RPD	Relative Percent Difference
RPT	Radiation Protection Technician
%RSD	% Relative Standard Deviation
RSO	Radiation Safety Officer
S	Standard Deviation
S&W	Stone & Webster, Inc.
SAP	Sampling and Analysis Plan

SEC	Safety and Ecology Corporation
SOP	Standard Operating Procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVOC	semi-volatile organic compound
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
Th	Thorium
²³² Th	Thorium-232
TIC	Tentatively Identified Compound
TRPH	Total Recoverable Petroleum Hydrocarbons
U	Uranium
²³⁸ U	Uranium-238
µg	Microgram
U _(tot)	Total Uranium
uR/hr or µR/hr	micro-Roentgen per hour (either abbreviation is acceptable)
USACE	U.S. Army Corps of Engineers
VOC	Volatile Organic Compound

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1.0 PROJECT MANAGEMENT

This Quality Assurance Project Plan (QAPP) describes the project organization established to ensure attainment of quality data; data quality objectives; the quality assurance and quality control methods employed for sample collection, handling, and testing; documentation requirements; assessment and oversight activities including audits and reports to management; and data validation. The QAPP is the project document that establishes the data quality required for attainment of project data quality objectives, which are in turn determined by site cleanup levels dictated by regulatory authorities.

1.1 PROJECT ORGANIZATION

This section of the Chemical Data Quality Management Plan (CDQMP) summarizes the project organization for the Formerly Utilized Sites Remedial Action Program (FUSRAP) Maywood Superfund Site (FMSS) project. It provides specific Shaw Environmental, Inc. (Shaw) and subcontractor personnel responsibilities and lines of authority and communication. Names of personnel fulfilling these responsibilities are also provided.

1.1.1 Quality Assurance / Quality Control Organization

Project Quality Assurance (QA) will be maintained under the direction of the Contract Quality Control System Manager (CQCSM) in accordance with the CDQMP and the Contractor Quality Control Plan (CQCP) (USACE 1999b). In addition, the CQCSM will direct field audits. Quality Control (QC) for the following tasks will be the responsibility of the individuals and organizations listed below:

<u>General Responsibility</u>	<u>General Tasks</u>	<u>Responsibility for Quality Control</u>
Field Sampling	Environmental sampling of soil, water, and building materials	Shaw
Sample Management	Maintenance of correct custody and proper preservation of environmental samples	Shaw
Radiological Investigations	Radiological investigations	Shaw and Subcontractors
Laboratory Analyses	Radiological and chemical analysis of soil, water, air, and building materials	Analytical Laboratory(ies) and Shaw and Subcontractors
Data Validation	Validation of laboratory data using USACE guidelines	Data Validator and Shaw
Field Demonstration	Performance of QA measurements on Field Demonstration units.	Shaw and vendor (to be selected)
Laboratory Audits	Performance of systems and performance audits of laboratory(ies)	Shaw and possibly a Subcontractor Auditor
Field Audits	Performance of field quality control audits	Shaw and USACE Personnel

The USACE Contracting Officer and the Corporate Vice President for Quality will be notified prior to any deviation from the approved CDQMP.

1.1.2 Personnel, Responsibilities, and Qualifications

The organizational chart shown in **Figure 1-1** outlines the management structure that will be used to implement the project's sampling and analysis activities. Shaw is the designated USACE contractor responsible for conducting the remedial action at the FMSS. The functional responsibilities of key personnel are described in this section. These roles will be filled by a combination of Shaw staff and subcontractors. The assignment of personnel to each position will be based on a combination of:

1. Experience in the type of work to be performed.
2. Experience working with USACE personnel and procedures.
3. A demonstrated commitment to high-quality and timely job performance.
4. Staff availability.

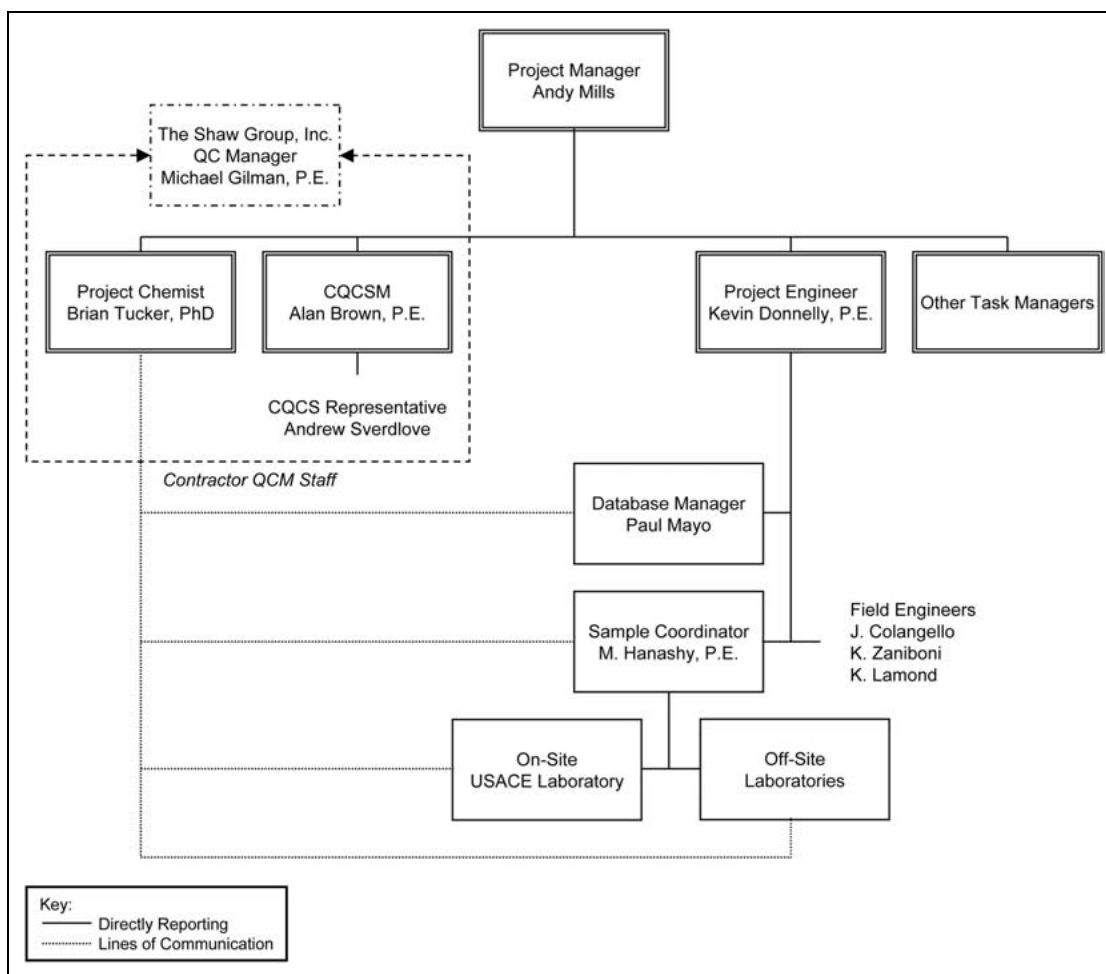


Figure 1-1
Chemical Data Quality Control Organization

1.1.2.1 Project Manager

The Project Manager ensures the overall management and quality of Shaw work on the FMSS project. This individual will ensure that all project goals and objectives are met in a high quality and timely manner. Project QA and nonconformance issues will be addressed by this individual for corrective action.

1.1.2.2 Project Environmental Engineer

The Project Environmental Engineer shall ensure that remediation goals, including required analytical data, are obtained consistent with applicable environmental laws and regulations. The Project Environmental Engineer reports directly to the Project Manager.

1.1.2.3 Task Managers

Task Managers will be assigned to the project to implement specific tasks. They will have direct responsibility for implementing the CDQMP, including all phases of work plan development, field activities, data management, and report preparation. These individuals will also provide the overall management of the tasks, and serve as the points of contact with the USACE. These activities will involve coordinating all personnel working on the assigned tasks, interfacing with USACE personnel, and tracking task budgets and schedules. Task Managers are responsible for ensuring proper technical performance of drilling operations and field sampling activities, adherence to required sample custody and other related QA/QC field procedures, coordination of field personnel activities, management of investigation-derived wastes, checks of all field documentation, and preparation of Field Change Orders (FCOs), if required. The Task Managers will also develop, monitor, and fill task staffing needs; delegate specific responsibilities to task team members; and coordinate with administrative staff to maintain a coordinated and timely flow of all project activities. The Task Managers report directly to the Project Environmental Engineer.

1.1.2.4 Field Personnel

In addition to the Task Managers, other field personnel participating in the implementation of field activities are geologists, geotechnical engineers, environmental engineers, hydrogeologists, and sampling technicians. These individuals, in coordination with field subcontractor personnel, will be responsible for performance of drilling operations; collection of soil, groundwater, sediment, surface water, and air samples; radiation monitoring; and preparation of field logbooks and other required documentation. These individuals will be responsible for performing all field activities in accordance with the CDQMP, and will report directly to the Task Managers.

1.1.2.5 Contracted Field Support

Consistent with Contract Management Procedure Number 21, five Team Subcontractors support Shaw on this project. These subcontractors and their respective areas of expertise are as follows:

<u>Subcontractor</u>	<u>Support Service</u>
Malcolm Pirnie 104 Corporate Park Drive White Plains, New York 10602	Engineering Design and Hydrogeological Investigations
Safety & Ecology Corporation 1400 Centerpoint Blvd Knoxville, Tennessee 37932	Field Radiological Technicians, Laboratory Technicians, Radiological Safety Officer, and Support Services
Franklin Environmental 329 Chamberlain Highway Meriden, Connecticut 06451	Remedial Construction
Railroad Construction 75-77 Grove Street Patterson, New Jersey 07503	Railroad Remedial Construction
Garden State Survey 25 E. Spring Valley Avenue Maywood, New Jersey 07607	Engineering Survey Support Services

In addition to the team subcontractors, non-team subcontractors are providing support to the FMSS Project. Many of the services are competitively bid on an annual basis so that the identified subcontractors may change over time. A few of the subcontractors currently supporting the project are:

<u>Subcontractor</u>	<u>Support Service</u>
Cabrera Services, Inc.	Radiological Engineering
Keyes Associates	Temporary Administrative Staff
Severn Trent	Radiological and Chemical Laboratory Services
Kestrel Environmental Services	Data Validation
NAEVA	Underground Utility Clearance

Other subcontractors may also provide support on an as needed basis.

1.1.2.5.1 Subcontractor Field Personnel

Subcontractor field personnel, under the supervision of the Task Managers, will be responsible for performing their specific scopes of work that have been derived from the task-specific work plan. These individuals will be required to review the sampling sections of the work plan and the entire FMSS *Site Safety and Health Plan* (SSHP) (USACE 2002) prior to field mobilization. All subcontractor field personnel report directly to the Task Managers who will be responsible for ensuring that all subcontractor activities comply with project requirements.

1.1.2.6 Subcontracted Laboratory Support

Analytical laboratory support specific to these investigations and remedial actions will be obtained from on-site testing and screening and one or more off-site laboratories.

On-site testing and screening for radiological parameters will be performed in an on-site laboratory operated for Shaw by Safety and Ecology Corporation (SEC). The on-site laboratory has the ability to dry and grind soil samples during the sample preparation phase. They can perform gamma spectrometry on these samples using one Canberra 30% germanium and one Canberra 40% Germanium one-hole detector systems. They can also take gamma counts on wet samples using a cross-correlation between dry equilibrated and wet unequilibrated samples. This laboratory also performs gross air sample and swipe counting using a combination of a Protean Low-Background Gas-Flow Proportional Counter and several Ludlum 2000/2929 alpha-beta scalers. The on-site laboratory is currently in the process of becoming revalidated by the USACE (revalidation is imminent as of the issuance date of this document), and has obtained New Jersey Department of Environmental Protection (NJDEP) certification, to analyze soil samples by gamma spectrometry. When certified, sample testing by the on-site laboratory shall reduce overall laboratory costs and improve turnaround time. A new onsite laboratory is being constructed on the Maywood Interim Storage Site (MISS). The new laboratory will be operated by SEC, and will have improved gamma spectrometry testing capability, as well as alpha spectrometry testing capability. This laboratory prepares and analyzes samples and generates data in accordance with the 600 series Standard Operating Procedures (SOPs) (see Appendix A of the Field Sampling Plan [FSP]) and using the quality assurance principles described within their Quality Manual (USACE 2003b).

On-site testing for chemical parameters is being considered. Severn Trent Laboratories has on-site laboratory capabilities for semivolatile and volatile organics, pesticides, polychlorinated biphenyls (PCBs), metals, herbicides, and total recoverable petroleum hydrocarbons (TRPH). The detection limits achievable for some metals are not low enough to meet typical cleanup standards. Thus, metals analysis will be subcontracted to an off-site laboratory. The maximum number of samples that can be analyzed by this onsite lab, depending on the number of parameters, is typically between 50 and 75 per week. Test results would be available within 24 hours of sample submittal, and full data packages can be provided in 7 days. This on-site laboratory would require validation by the USACE.

At this time, Severn Trent Laboratories (STL) of St. Louis, Missouri and Paragon Analytics, Inc. of Fort Collins, Colorado (for radiological testing) and STL of Monroe, Connecticut and Paragon Analytics (for chemical testing) are the off-site contract laboratories for the FMSS tasks.

All current and future subcontract laboratories will be validated by the USACE Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Expertise (CX), Omaha, Nebraska, and will be certified by the State of New Jersey to perform the pertinent tests. The subcontract labs are required to implement and maintain a QA/QC program in accordance with USACE and NJDEP guidelines. Relevant QA Manual, laboratory qualification statements, certifications, and license documentation will be made available upon request. Geotechnical laboratory support will be designated to a separate subcontractor certified by the State of New Jersey.

Organization charts outlining the key laboratory personnel and organization will be identified in their QA Plans. The responsibilities of key personnel are described in the following paragraphs. The assignment of personnel to each position will be based on a combination of

1. Experience in the type of work being performed.
2. Experience working with USACE personnel and procedures.
3. A demonstrated commitment to high quality and timely job performance.

Prior to commencement of project field activities for the project, Shaw will send a complete copy of the CDQMP to all subcontracted laboratories.

1.1.2.6.1 Laboratory Quality Assurance / Quality Control Manager

The subcontractor laboratory QA/QC Manager is responsible for the laboratory QA/QC in accordance with the requirements of this QAPP in conjunction with the established laboratory QA Program. In coordination with the Shaw CQCSM and Project Chemist, the laboratory QA/QC Manager will be responsible for documenting sample analysis in accordance with required methodologies. In addition, the laboratory QA/QC Manager will be responsible for documenting instrument calibration, field, and internal laboratory QC sample analysis, and that analytical results for both field and QC samples are reported to the USACE and Shaw in the format required in the laboratory scope of work, this QAPP and the task-specific Work Plans. Further, the laboratory QA/QC Manager is responsible for processing laboratory Nonconformance Reports (NCRs) in a timely manner and for implementing Corrective Action Report recommendations and requirements. The Subcontractor Laboratory Project Manager reports directly to the Shaw CQCSM and Project Chemist for issues related to this project.

1.1.2.6.2 Laboratory Project Manager

The responsibilities of each laboratory Project Manager include the following: initiation and maintenance of contact with Shaw on individual job tasks; preparation of laboratory-associated work plans, schedules, and resource allocations; initiation of laboratory-associated procurement for the project; provision of day-to-day direction of the laboratory project team including analytical department managers, supervisors, QA personnel, and data management personnel; coordination of laboratory related financial and contractual aspects of the project; provision of formatting and technical review for laboratory reports; provision of day-to-day communication with Shaw; provision of final review and approval on all laboratory analytical reports to Shaw; and response to all post project inquiries.

1.1.2.6.3 Laboratory Manager

The responsibilities of the Laboratory Manager include the following: coordination of all analytical production activities conducted within the analytical departments; working with the Laboratory Project Manager to ensure all project objectives are met; provision of guidance to analytical department managers; and facilitation of transfer of data produced by the analytical departments to the report preparation and review staff for final delivery to the client.

1.1.2.6.4 Laboratory Section Heads, Department Managers, and Technical Leads

The responsibilities of each laboratory section or department include the following: coordination of all analytical functions related to specific analytical areas; provision of technical information to and oversight of all analyses being performed; review and approval of all analytical results produced by their specific analytical area of expertise; and maintenance of all analytical records and information pertaining to the analysis being performed.

1.1.2.7 Project Quality Control Manager

The Project Quality Control Manager (PQCM) consults with the Shaw Director of Quality Assurance as required for direction on all quality matters. The PQCM is responsible for the planning, development, implementation, and effectiveness of the project-specific QC program included in the CQCP (USACE 1999b). The effectiveness of the program is measured through the use of audits, surveillances, document reviews, and other QA monitoring activities defined throughout this document.

The PQCM's duties include, but are not limited to, reviewing and approving the project-specific CQCP (USACE 1999b) and all revisions thereto; reviewing and approving supporting QC procedures;

evaluating the effectiveness of the quality program; assigning qualified QC personnel to projects; directing and supporting project QC management staff; training and qualifications oversight; ensuring the necessary QC resources are provided consistent with project needs.

1.1.2.8 Contractor Quality Control System Manager

The CQCSM, Alan Brown, is responsible for implementation and documentation of all project QA/QC protocols during field activities. In this capacity the CQCSM will direct and implement the various components of the Contractor Chemical Quality Control (CCQC) program as identified in USACE Engineering Manual (EM) 200-1-3. This will include but not be limited to: documentation of QAPP instructions to field personnel; oversight of field sampling and analytical activities; documentation of field QC activities; and completion of Daily Quality Control Reports (DQCRs). In order to maintain independence, the CQCSM reports directly to the PQCM and interfaces with the Project Manager and other project personnel as required to keep them informed and support their activities. The QC organization is also discussed in the CQCP (USACE 1999b).

1.1.2.9 Site Safety and Health Officer and Radiation Safety Officer

The Site Safety and Health Officer (SSHO), Wil Stephan, and Radiation Safety Officer (RSO), Mike Winters, are responsible for ensuring that health and safety procedures designed to protect personnel are maintained throughout the field activities. This will be accomplished by strict adherence to the project SSHP (USACE 2002), which has been prepared as a separate document for this project. These individuals will have the authority to halt fieldwork if health or safety issues arise that are not immediately resolvable in accordance with the project SSHP (USACE 2002). The Radiation Safety Officer reports directly to the SSHO.

1.1.2.10 Project Chemist

The Project Chemist, Brian Tucker, together with the CQCSM, will oversee the field sampling and sample handling activities as well as laboratory quality control to ensure that the requirements of the CDQMP are met. In particular, the Project Chemist is responsible for oversight of chemical and radiochemical analysis and reporting performed by the subcontract laboratory(ies), in accordance with the requirements defined in the CDQMP. The Project Chemist will also resolve questions the laboratory may have regarding QAPP requirements and deliverables, and coordinating data reduction, validation, and documentation activities related to sample data package deliverables received from the laboratories. The Project Chemist is responsible for writing the Quality Control Summary Reports (QCSRs) for each task, and for periodically revising the CDQMP. The Project Chemist reports directly to the Project Manager.

The Project Chemist is also defined as the QA Officer of the FMSS Onsite Laboratory as required under the certification designation of the NJDEP. The responsibilities of the QA Officer are defined under NJAC 7:18 of the NJDEP Office of Quality Assurance.

1.1.2.11 Sample Coordinator

The Sample Coordinator, Maurice Hanashy, is responsible for coordination of sample shipment to the analytical laboratory(ies), and verification of the accuracy of chain-of-custodies. The Sample Coordinator will also coordinate the shipment of samples to the USACE QA Laboratory(ies), which will be designated by the USACE for the project. This individual will be responsible for obtaining required sample containers from the laboratory(ies) for use during field sample collection. Along with the Project Chemist, the Sample Coordinator ensures that off-site laboratories understand the FMSS project QC requirements, and that quality concerns and problems are resolved in a timely manner. The Sample

Coordinator also tracks the samples of a given task from shipment to the laboratory through delivery of results and transmittal to a data validation subcontractor, if required.

1.1.2.12 Project Environmental Sampler

The Project Environmental Sampler must be familiar with all of the SOPs pertaining to sampling in this CDQMP. Specifically, the sampler must be familiar with methods of collecting various matrices, the types of containers and preservatives required, how and how often to collect field sample quality control samples, safety guidelines described in the FMSS Site Safety and Health Plan, documentation including how to fill out a Field Notebook and Chain-of-Custody, labeling, packaging, and shipping requirements as per project guidelines. The Project Environmental Sampler interacts with the Sampling Coordinator on a regular basis.

1.1.2.13 USACE QA Laboratory

The USACE QA Laboratory for this project will be assigned by the USACE Chemical Quality Assurance Branch (CQAB) in Omaha, Nebraska. This laboratory is responsible for analyzing designated project QA samples. The QA laboratory designated by the CX for testing of QA split samples is Severn Trent Laboratories (STL), at 13715 Rider Trail North, Earth City, Missouri 63415 (referred to as STL-St. Louis), for both chemical and radiological parameters. The point of contact at the STL-St. Louis facility is John Powell (314-298-8566).

1.2 PROBLEM DEFINITION / BACKGROUND

1.2.1 Problem Definition

Shaw will perform remedial actions at the FMSS, a FUSRAP site under the jurisdiction of the USACE Kansas City and New York Districts. Task-specific Work Plans will contain a problem definition section that describes the problem to be solved and project goals. Site-specific maps, diagrams, existing data, and possible regulatory requirements shall be discussed.

Soils located on the FMSS contain thorium and radium, and to a lesser degree uranium, above the site-specific cleanup levels established for the FMSS. Deposition of radionuclides was either by soil and sediment transport along the former Lodi Brook and Westerly Brook channels, by emplacement of fill containing radionuclides, or by past waste disposal practices. Properties with FUSRAP waste include 88 designated commercial, government, and residential tracts. Sixty-four (64) of these properties have previously been remediated by removal actions as authorized under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Maywood Feasibility Study addresses soil and building contamination meeting the definition of FUSRAP waste at the remaining 24 properties (including the MISS and the Stepan Company) within the FMSS. Maximum concentrations of these radionuclides of 1,981 picocuries per gram (pCi/g) ^{232}Th , 514 pCi/g ^{226}Ra , and 307 pCi/g ^{238}U have been detected in buried residues or soils.

Chemicals are also known to be present on some of these properties. In particular, the soils have exhibited elevated concentrations of volatile organics (methylene chloride, acetone, methyl ethyl ketone [MEK], benzene, toluene, and ethylbenzene in the parts per million [ppm] range); acid extractables; and metals (aluminum, arsenic, barium, cadmium, chromium, copper, cobalt, lead, manganese, mercury, beryllium, silver, thallium, zinc, and nickel varying in concentrations from 1 ppm to several hundred ppm). In addition, all of the target compound list (TCL) pesticides have been detected infrequently in the low part-per-billion (ppb) range. Some soil borings also exhibited the presence of gasoline and fuel oil components, various methylated benzenes, caffeine, and the essential oils alpha-pinene and d-limonene.

Groundwater analyses have detected volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs), including but not limited to benzenes, toluene, xylenes, 1,2-dichloroethene, and phenol; the pesticide gamma-BHC at a maximum concentration of 0.03 ppb; and metal contaminants including aluminum, arsenic, lead, chromium, copper, cobalt, nickel, vanadium, and barium.

The USACE is responsible for FUSRAP waste as defined in the Federal Facilities Agreement that states:

- All radioactive and chemical contamination, whether commingled or not, occurring on the MISS.
- All radioactive contamination exceeding the action levels agreed to in the Record of Decision and related to thorium processing at the Maywood Chemical Works (MCW), occurring on a vicinity property.
- Nonradioactive chemical contamination that occurs on vicinity properties if the contamination is mixed or commingled with radioactive contamination that exceeds cleanup criteria.
- Nonradioactive contamination that originated at the MISS or is associated with specific thorium manufacturing or processing activities at (MCW) that resulted in the radioactive contamination.

Detection of these chemicals in various matrices has been accomplished as part of several tasks. Much of this effort was focused on characterization of soils and groundwater, as well as evaluation of a soil sorting and rinsing operation as a mechanism for reducing the volume of soil to be shipped and thus reduce cost.

The tasks completed to date on this project include:

- Pre-design investigations to delineate soil excavation limits at all commercial / government vicinity properties.
- On-site field demonstrations of gravel separation and rinsing and radiological sorting of soil technologies.
- Development and implementation of work plan for the FMSS groundwater remedial investigation.
- Time critical removal action of contaminated sediments in the West Howcroft Road drainage swale, following heavy rains deposited by Hurricane Floyd on September 16-17, 1999.
- Characterization of radiological contamination in Stepan buildings.
- Remediation of the 72 Sidney Street and Ballod properties including shipment and off-site disposal of the contaminated soils.
- Ongoing water treatment of groundwater encountered during excavation and stormwater runoff.

The tasks currently in progress are:

- Remediation of the I-80 Westbound Right-of-Way, 160-174 Essex Street, and 150 Essex Street properties in support of planned Department of Transportation activities.
- Remediation of the footprint for upgrade to the on-site radioanalytical laboratory.

The scope of future work currently planned for this project include:

- General
 - Design and remediation of MISS, Stepan, and commercial / government vicinity properties.
 - Possible treatment of soil materials.

- Design and implementation of groundwater remedial action if necessary.
- Excavation, handling, transportation, and off-site disposal of the remaining accessible radiological contaminated soils exceeding cleanup standards at the commercial / government vicinity properties and MISS and Stepan properties.
- Verification sampling of remaining excavations during final status surveys using Environmental Protection Agency (EPA) document 402-R-97-016, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (EPA 2000b).
- Backfill of remaining commercial / government vicinity property excavations with clean soil obtained from an off-site source.
- Backfill of MISS and Stepan properties with separated soil below cleanup standards supplemented by clean material from an off-site source as necessary.
- Excavation, handling, sampling, analysis, and disposal of buried drums and contents currently located on the Sears Warehouse property.
- Structures
 - Further characterization of radiological contamination in buildings.
 - Demolition of Building 76, the pumphouse, and the reservoir on the MISS to allow access to contaminated soils.
 - Potential demolition of Buildings 11, 13, 15, 20, 67, and 78 on the Stepan property to allow access to contaminated soils.
 - Demolition and/or decontamination of Buildings 4, 10, 13, 15, 20, 67, and 78 to remediate contamination in buildings.

For each delivery order involving sampling and analysis of environmental media, the corresponding task-specific Work Plans will contain sampling and analysis sections. They will address the site- and task-specific issues that are not discussed in this CDQMP. A narrative describing the task will be included that will state the specific problem to be solved or the decision to be made. The goal of the investigation will be clearly stated. A description of the work site, including an area map, location map, site map, site history as it relates to the current work, and any unusual conditions will be included. The text will include diagrams detailing areas to be sampled as relevant to the definition of the investigation goals. These sections will also contain a summary of site geology / hydrogeology as known, prepared to a level of detail such as to provide a comprehensive description of the site. The discussion will include enough information about the problem, the past history, any previous work or data, the regulatory or legal context, and any relevant regulatory requirements to present a clear description of the project objectives. It also should specify rationale for selection of sampling locations and test methods and frequencies.

1.2.2 Goals of the Investigation and Remediation

Remedial action has been and will continue to be conducted at the FMSS to ensure that risks to human health or the environment from potential exposure to impacted materials are either eliminated or reduced to prescribed safe levels. Media of concern will be remediated to these levels.

To meet the overall project objective, procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action have been developed and implemented and are described in other sections of this CDQMP. They will provide information for site evaluation and assessment leading to

remediation. The procedures will ensure technically sound and legally defensible data. Each task-specific Work Plan will be used to identify specific task objectives as they relate to site action levels and remediation. The task-specific Work Plan for each FMSS task or activity will also provide the details, in tabular form, of the analytical parameters, methods, and quantitation levels.

General objectives of this CDQMP are as follows:

- To provide data of sufficient quality and quantity to support ongoing remedial efforts and further define the project contaminants of concern, such as those for groundwater.
- To provide data of sufficient quality to meet applicable State of New Jersey and federal concerns (e.g., reporting requirements) as identified in the FMSS General Environmental Protection Plan (GEPP) (USACE 1999c).
- To ensure samples are collected using approved techniques and are representative of existing site conditions.
- To specify QA/QC procedures for both field and laboratory methodology to meet the USACE and other applicable guidance document requirements such as:
 - EPA SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, Third Edition, Update II, January 1995 (EPA 1998).
 - EPA, QA/R-5, *Requirements for Quality Assurance Project Plans for Environmental Data Operations*, March 2001 (EPA 2001).
 - USACE, EM 200-1-6, *Chemical Quality Assurance for HTRW Projects*, October 1997 (USACE 1997).
 - USACE, CENWK-PE-ES, *Data Quality Evaluation Guidance*, July 26, 1999 (USACE 1999a).
 - USACE, *USACE Kansas City and St. Louis District Radionuclide Data Quality Evaluation for Alpha and Gamma Spectroscopy*, June 2001 (USACE 2001).

1.2.3 Work Sites Description

The FMSS is located in Bergen County, New Jersey, approximately 20 kilometers (km) (12 miles [mi]) north-northwest of New York City and 21 km (13 mi) northeast of Newark, New Jersey. It is described in detail in the GEPP (USACE 1999c). The reader is directed there.

1.2.4 Site History

The MCW was constructed in 1895. In 1916, the plant began extracting thorium and rare earth metals from monazite sands, by an acidic process, for use in manufacturing industrial products such as mantles for gas lanterns. The plant also produced a variety of other materials, including lithium compounds, detergents, alkaloids, and oils. The plant stopped accepting monazite sands for extraction of thorium in 1956, but it processed stockpiled materials until 1959. Based on available historical information and knowledge of the chemical processes involved, the chemicals identified as having been used in the thorium extraction process include sulfuric acid, nitric acid, ammonium hydroxide, and ammonium oxalate. Oxalic acid was also used at the site in the production of higher-grade thorium.

A detailed discussion of the site history is given in the GEPP (USACE 1999c) and the reader is directed to the GEPP for follow-up.

1.3 PROJECT DESCRIPTION

Each task-specific Work Plan provides a description of the work that will be performed in order to provide an overall picture of how the project will resolve the problem or questions described in Section 1.2.1 (Problem Definition). A general description of the sampling will be included. Anticipated task start and completion dates will be included in addition to the following:

- Measurements that are expected during the course of the task and the approach that will be used.
- Applicable technical, regulatory, or program-specific quality standards, criteria, or objectives if they differ from those in this CDQMP.
- Any special personnel and equipment requirements that may indicate the complexity of the project.
- Assessment tools that will be employed for the task (program technical reviews, peer reviews, surveillance, technical audits, etc.).
- Project schedule or a sequence of milestones and their expected durations. If individual sampling plans will be developed for discrete task plans, their preparation schedule will be included.

2.0 DATA QUALITY OBJECTIVES (DQO)

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data required to support decisions made during investigation activities, and are based on the end uses of the data being collected. Detailed, site-specific DQOs shall be provided in the task-specific Work Plans and shall clearly describe what data are needed and how that data will be used to satisfy project DQOs.

For radiological samples, analytical test methods will be selected that have Minimum Detectable Activities (MDA) that meet the DQOs for the project. Similarly, for chemical analyses, methods shall be chosen that have Practical Quantitation Limits (PQLs) lower than the established Data Quality Objectives to the greatest extent practicable. Such test method pre-selection provides the highest probability that generated data is useful in making project decisions.

The DQO process is designed to provide a means to determine what type of data need to be collected, as well as to ensure that the data collected are scientifically sound, legally defensible, and of known, documented quality. The DQO process used for this remedial action follows the method outlined in MARSSIM (EPA, 2000b) and the *Guidance for the Data Quality Objectives Process* (EPA, 1994) and in EM-200-1-2, *Technical Project Planning Process*, (USACE, 1998). The DQO process was chosen because it is an established process that identifies quality of data required for decisions.

An analytical DQO summary for these investigations is presented in the form of quality control limits for precision and accuracy in Appendix B. Any deviations or exceptions will be detailed in the task-specific Work Plan. All QC parameters stated in the specific SW-846 methods (i.e., percent recoveries) will be adhered to for each chemical listed.

Laboratories are required to comply with all methods as written. Laboratories selected will be required to submit all lab method standard operating procedures (SOPs) and references, and the actual method detection limits (MDLs) to be achieved in all chemical analyses to Shaw and the USACE. For radiological parameters in soil, Shaw and the USACE will set the MDA (or the L_c for radiological parameters in water and air) to comply with the project requirements and the selected laboratory will be required to meet these limits.

In accordance with Environmental Protection Agency (EPA) guidance (EPA, 1994) and USACE guidance (USACE, 1997), a combination of Screening Level and Definitive Level data will be required for each project. Definitive data is typically data generated under laboratory conditions using EPA-approved procedures. Data of this type, both qualitative and quantitative, are used for determination of source, extent, or characterization and to support evaluation of remedial technologies and preliminary assessment memorandum. The elements in the DQO process are as follows:

- Statement of the problem / Data Uses
- Identification of the decisions
- Data needed to meet objectives
- Definition of study boundaries
- Determination of decision rules
- Placement of limits on decision errors
- Optimization of design

The ability of a data generation process to meet the DQOs is provided through the establishment of data quality criteria, which include precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters. DQOs are also met by meeting certain goals for the PQL concentrations. Laboratory and field sampling activity documentation will be used to assess the PARCCS parameters. To provide for reliability of field sampling procedures and materials, QC samples will be collected or prepared at a defined frequency for each medium sampled, sample shipment, and each sampling event.

In addition to the collection of QC samples, QA samples will be collected at a frequency of 10 percent of the field samples collected. These samples will be submitted to a separate USACE QA lab. The QA laboratory will be assigned by the USACE CQAB.

The following subsections present the development of the DQOs for the FMSS investigations, remedial designs, and remedial actions.

2.1 STATEMENT OF THE PROBLEM / DATA USES

The FMSS vicinity property soils have been impacted primarily by radionuclides, specifically ^{226}Ra , ^{232}Th , and ^{238}U . If certain FMSS property soils and debris are contaminated with these radionuclides, or any other parameters listed in the final Record of Decision (ROD), at concentrations that exceed acceptable risk levels, they will be removed and transported off-site for disposal. Additionally, it will be necessary to show that remedial activities do not result in contaminant concentrations in the air, surface, and/or groundwater that exceed regulatory limits for on-site or off-site impact to workers, members of the public, and the environment.

The problem is to identify the types, quality, and quantity of data that will be used to support the remedial action within the planned project schedule.

The remainder of chapter two addresses DQOs for soil and groundwater remediation.

2.2 IDENTIFICATION OF DECISIONS

There are four key decisions that must be made to support project objectives. The key questions are:

1. Work Area Remediation - Do post-remedial site soil concentrations meet the appropriate cleanup criteria?
2. Verification of Remedial Action - Are there sufficient data to demonstrate that the FMSS vicinity properties have been remediated as specified in the ROD?
3. Groundwater Remedial Investigation - Have enough groundwater sample data been generated to adequately characterize groundwater contamination and thus allow for informed groundwater treatment decisions to be made? Is there enough data to allow us to assert that batches of groundwater collected during remediation activities and treated on-site are below the discharge limits established by the Bergen County POTW?
4. Transportation / Disposal - Are the concentrations of contaminants of concern below the maximum concentrations allowed by a given soil disposal facility?

Associated with each of the key decisions are intermediate or follow-on decisions termed decision elements. The key decisions and decision elements are discussed in the following sections.

2.2.1 Work Area Remediation

The primary decision for work area remediation is whether soil concentrations for radionuclides and selected metals are reduced to levels that are less than the appropriate cleanup criteria. Decision elements are associated with individual soil excavation areas within each of the identified work areas. The decision as to whether all contaminated soils have been removed, and therefore that remaining soil analyte concentrations meet cleanup action levels, will be made for each excavation. The following are actions that would be taken to help answer the study questions:

- The excavation area is backfilled
- Additional soils are excavated

Inputs to this decision are discussed in Section 2.3.

The key decision for the demonstration of clean closure is whether there is sufficient site data to demonstrate that all accessible contaminated soils have been removed. The following are actions that would be taken to help answer the study questions:

- The FMSS properties are qualified as remediated via the radioisotopic results of a final status survey.
- Additional excavation of soil is required for successful remediation.

Sampling activities described in this document are used to support preparation of excavations for clean closure. Final verification surveys and verification sampling will be described in property-specific final status survey work plans.

2.2.2 Groundwater Remedial Investigation

The key question concerning the adequacy of groundwater sampling is whether groundwater characterization is sufficient to determine whether groundwater contaminant concentrations exceed action levels, and whether the exceedances can be attributed to historical site operations, or other offsite sources. To some extent, the answers to these questions will depend on the accuracy of groundwater modeling in predicting contaminant distribution. This will likely be an iterative process, in which initial sampling guidance, which may be provided by numerical models, will be succeeded by follow up sampling events. The actions that could be taken to help answer the study questions are that:

- Groundwater has been adequately characterized to determine
 - Whether remediation is required, and if required, to develop preliminary remediation goals by evaluating the feasibility of remedial alternatives.
 - Whether contamination can be attributed to historical operations, or to offsite sources.
- More samples are needed.
- The model needs to be revised or a new model employed.

In addition, as part of the groundwater program, wastewater (excavation water, stormwater runoff, etc.) shall be tested periodically. The accuracy of this data relative to Publicly Owned Water Treatment facility (POTW) requirements shall be considered in deciding whether to ship these waters to the POTW.

2.2.3 Transportation and Disposal

The key question concerning the adequacy of sampling of soils destined for off-site disposal depends on the following:

- Whether sampled soils are representative of the soil quantity being shipped.
- The accuracy and precision of test data relative to the landfill disposal criteria and permitting requirements for contaminant concentrations.
- Possible changes in the concentration of contaminants over time.

The actions that may result are:

- Additional soil samples are collected from the disposal pile.
- Soil is shipped to the off-site disposal facility.

2.3 DATA NEEDED TO MEET OBJECTIVES

One major input decision is assurance that an individual work area has been remediated. This will be demonstrated through the use of field screening methods, in situ field measurements, and laboratory analytical methods for measurement of radiological constituents (see Appendix A of the FSP for appropriate field procedures, and Appendix D of the QAPP for laboratory analytical procedures). Inorganic and organic concentrations have been and will continue to be determined by laboratory analysis. These measurements will be used in nonparametric statistical tests as part of the final status surveys to demonstrate successful remediation for all contaminants of concern at the FMSS properties (^{238}U , ^{226}Ra , and ^{232}Th , plus any other contaminants listed in the ROD) or that may be discovered during a given site investigation). According to the ROD, the required cleanup levels for all property soils at all depths are 5 pCi/g above background total for ^{232}Th plus ^{226}Ra , and 50 pCi/g above background for ^{238}U (USACE 2003c).

A second major input decision is the conclusion that groundwater has been characterized adequately enough to determine the source of the contamination and the feasibility of treatment. PQLs (see Section 2.8.3 for definition of PQLs, also known as reporting limits [RLs]) for groundwater testing, must be lower than the proposed Maximum Contaminant Levels (MCLs) and New Jersey Groundwater Quality Criteria for chemicals and the National Primary Drinking Water Regulations for radionuclides. The 95% upper confidence limit of wastewater contaminant levels, calculated from the variability in wastewater contamination as well as the accuracy of the test methods, shall be used to determine whether wastewaters can be sent to the POTW. The groundwater program has adequately characterized the nature and extent of all chemical and radiological contamination in groundwater. Several groundwater plumes within the MISS, notably a benzene, lithium, and arsenic plume have been delineated. The remedial investigation determined that tetrachloroethene, trichloroethene, and dichloroethene plumes in Rochelle Park are derived from an offsite source; i.e., they are not associated with waste derived from the MCW. A baseline risk assessment is presently being prepared to determine the risk to various receptors within the FMSS due to contaminants present in groundwater, surface water and sediment. Additionally, initial stages of the Feasibility Study have been initiated. Monitored Natural Attenuation (MNA) is being evaluated in conjunction with groundwater modeling efforts to determine if a reduction of benzene to below cleanup standards is likely due to the presence of aerobic and anaerobic bacteria present in the groundwater system. Two other chemicals, lithium and arsenic, exhibit concentrations well above cleanup action levels. The source of these two chemicals is believed to be the retention ponds on the MISS. No treatment schemes have been proposed yet for these chemicals.

2.4 DEFINITION OF STUDY BOUNDARIES

The study boundaries for the FMSS vicinity properties are defined in the EE/CA (DOE 1995). The FMSS consists of properties in the boroughs of Maywood and Lodi and the township of Rochelle Park, New Jersey that became contaminated by thorium processing operations at the former MCW. The EE/CA states that these remedial actions are limited to hazardous substances released during the aforementioned thorium processing operations. More specifically, the Federal Facilities Agreement (FFA) states that USACE is responsible for FUSRAP waste, defined as:

- All radioactive and chemically impacted materials, whether mixed together or not, occurring on MISS.
- All radioactive impacted materials from past thorium processing at the MCW site above action levels on any nearby property.
- Any chemically impacted material on nearby properties that is mixed with radioactivity above cleanup criteria.
- Impacted material that originated at MISS or was associated with specific thorium manufacturing or processing at MCW.

The remedial actions are to remove and dispose of all accessible soils that are above the cleanup criteria and to treat and discharge groundwater and excavation water that is contaminated with radionuclides of concern or chemicals above acceptance criteria.

2.5 DEVELOPMENT OF DECISION RULES

2.5.1 Work Area Remediation

The cleanup criteria for radionuclides, SVOCs, VOCs, metals, etc. are contained in Appendix A of this CDQMP.

During excavation activities, exposure rate monitoring will be conducted to determine if radiological contaminants have been removed. When exposure rates have been reduced to levels suggesting that the appropriate cleanup level has been attained, final status survey measurements will be collected. These will consist of soil samples collected and analyzed by laboratory gamma spectroscopy. The following decision rules will be used during work area excavation and remediation:

- If exposure rate monitoring indicates that radionuclide concentrations are likely to exceed the cleanup criteria, then excavation will continue.
- If exposure rate monitoring indicates that radionuclide concentrations are not likely to exceed the cleanup criteria, then final status survey measurements and/or soil samples will be collected. A final status survey will be performed based on guidance provided in NUREG 1575 (MARSSIM, EPA 2000b).
- If the statistical test conducted as part of the final status survey indicate that the cleanup criteria have not been attained, then additional excavation will be performed.
- As part of the final status survey, samples will be collected from the number of locations specified by MARSSIM (EPA, 2000b) for USACE and NJDEP-certified laboratory gamma spectroscopic analysis.
- When all soil sample analytical results from a work area show that all accessible soils above the cleanup criteria have been removed, then the work area is considered to be clean. As part of the

final status survey process, a data evaluation will be performed based on guidance provided in MARSSIM (EPA, 2000b). Once the area is found to be compliant, it may be backfilled. Section 2.1.3 of the FSP discusses the final status surveys to be performed.

2.5.2 Groundwater Remediation

For the groundwater program, the upper 95% confidence limit of the mean of each chemical and radiological contaminant data set shall be compared to the most stringent (lowest) groundwater and soil action levels. The action levels used for this project are the MCL and New Jersey Groundwater Quality Criteria for water and the soil impact to groundwater and New Jersey direct contact residential criteria for soils. If the upper 95% confidence limit is less than the action level, no cleanup action will be required. If the upper 95% confidence limit is greater than the action level, a treatment scheme shall be developed. The radiological cleanup levels for groundwater and surface water are as follows:

- Ra-226 plus Ra-228: 5 pCi/L
- Total uranium: 30 µg/L
- Gross alpha: 15 pCi/L (excluding uranium and radon)
- Gross beta: 50 pCi/Ls

As stated earlier, the cleanup criteria for chemical parameters are listed in Appendix A of this CDQMP.

2.6 SPECIFY THE LIMITS ON DECISION ERRORS

Because decisions pertaining to remediation will be based on analytical data, an attempt is made to define, and if possible, limit decision errors that may result from the limitations of the sampling and analyses. To limit decision errors, analytical method data indicator objectives have been established and are presented in Section 2.8.

Limits on decision errors will be controlled through development of a sampling and analytical methodology to demonstrate that sufficient data have been generated for a decision. Methodology described in MARSSIM (EPA, 2000b) will be followed to determine the number of measurements needed for final status surveys. This methodology consists of a statistical determination of the number of required sampling points. Statistical determination of the number of sampling points will also be used for the groundwater and material transportation and disposal programs. Determination of the number of samples depends on:

- The difference between the mean value of a contaminant of concern and the cleanup level.
- The precision of the mean values for a given parameter as determined by the standard deviation of the mean.
- The distribution of past and more recent data; e.g., normal, lognormal, non-parametric, etc.
- Values established for decision errors.

Analysis of soil samples could potentially result in the incorrect reporting of the concentration of a contaminant. The two types of decision errors that could result are the reporting of false positives and the reporting of false negatives. False positives and false negative decision errors are defined in the context of hypothesis testing, where the terms are defined with respect to a null hypothesis. The null hypothesis states that the concentration of a given contaminant of concern is above the cleanup action level. A false positive decision error occurs when the null hypothesis is rejected when it is true and corresponds with an analytical false negative (or more accurately, the analytical result is biased so low that the incorrect

decision is made that the contaminant concentration is below the cleanup action level). A false negative decision occurs when the null hypothesis is not rejected when it is false and corresponds with an analytical false positive (the analytical result is biased so high that the incorrect decision is made that the contaminant concentration is above the cleanup action level).

Potential consequences of an analytical false positive (for the work area remediation decision) are as follows:

- Unnecessary excavation and disposal of soils that meet cleanup criteria.
- Incorrect identification of additional areas as exceeding cleanup criteria when in reality they meet cleanup criteria.

Potential consequences of an analytical false negative (for the work area remediation decision) are:

- Failure to remove soils that exceed the cleanup criteria.
- Failure to identify additional areas within the FMSS properties that require remediation.
- Verifying that the property under consideration is remediated when in fact accessible soils exceeding the cleanup criteria remain.

Potential consequences of an analytical false positive (for the groundwater treatment decision) are:

- Unnecessary treatment of FMSS groundwater that is below cleanup standards.
- Possible incorrect interpretation that contaminated groundwater is migrating off-site.

Potential consequences of an analytical false negative (for the groundwater treatment decision) are:

- Failure to treat groundwater that is contaminated above specific parameter action levels.
- Failure to notify adjacent property owners that groundwater migrating onto their property is contaminated.

Potential consequences of an analytical false positive (for the soil disposal decision) are:

- Unnecessary shipment of below cleanup criteria soils to the soil disposal facility.

Potential consequences of an analytical false negative (for the groundwater treatment decision) are:

- Failure to ship soils that are contaminated above cleanup criteria to a disposal facility.

Definitive data are required for supporting project decisions. It is assumed that if the precision, accuracy, and completeness requirements specified in this section are met, and the minimum number of samples are collected in accordance with the z-test, then definitive data will be obtained and can be used for performing remedial actions and monitoring. The limits on the magnitudes of decision errors selected for the FMSS site radiological data will be 5% for false positive (α) decision errors (corresponding to an analytical false negative; see consequences on previous page) and 10% for false negative (β) decision errors (corresponding to an analytical false positive; see consequences on previous page). A decision level will be established for each sample count and/or count protocol so that there is 5% probability of a false positive result. This decision level is defined as the Critical Level, or L_c . The count result shall be reported as the sample activity where the sample counts are greater than the L_c . The Minimum Detectable Activity (MDA) will be reported in place of the sample activity for those sample results that are less than

the L_c - except where unbiased results are permitted. The MDA shall be equal to or less than the DQO for those cases where the count results are less than the L_c , - except where it is permitted that the DQO be exceeded.

For chemical data, the decision error limits shall be 5% for false positive (α) and 15% for false negative (β) decision errors.

2.7 OPTIMIZATION OF THE DESIGN

As a result of the DQO process, the optimum sampling design is derived for this remedial action. While all of the properties have been sampled, the quality and quantity of existing data do not enable completion of accurate designs. Two types of survey data will be collected to optimize the design. Characterization data for radionuclides will be collected at all accessible FMSS properties for which the quality and quantity of existing data do not enable completion of accurate designs. Remedial action support survey data will be collected to guide the excavations such that all soils containing radionuclide concentrations that exceed the cleanup criteria are removed.

To optimize the design for the groundwater characterization effort, additional data shall be collected from areas of known contamination to better define contamination plumes and sources.

2.8 STANDARDS / CONTROLS TO ENSURE OBJECTIVES ARE MET

The analytical data used as inputs to the DQO process must be of known and sufficient quality to support the end use of the data. Analytical data of known and acceptable quality for the intended use are generated by the implementation of carefully chosen (QA/QC) protocols, both in the field and in the laboratory. (QA/QC) goals are set for:

- Each single measurement.
- The entire data set of which the single measurement is a part.

Each individual measurement should be precise, accurate, representative, comparable, and part of a complete data set. Precision, accuracy, representativeness, comparability, and completeness are often referred to by the acronym PARCC, and are known as the PARCC parameters. The PARCC parameters of precision and accuracy can be quantified for a single measurement and for a complete data set. Representativeness and comparability are not as quantifiable as precision and accuracy, although there is necessarily some overlap between the parameters of representativeness, precision, and accuracy. Analytical completeness is assessed by comparing the total number of analytical results expected for a data set (based on the number of samples collected) with the total number of usable (i.e., not qualified R, or rejected) analytical results. The test measurement method must be sensitive enough to ensure that method detection limits are less than project cleanup criteria. The count time for radiological samples will be set so that the Minimum Detectable Activity (MDA) for a typical sample type meets the DQOs for the project. Similarly, for chemical parameters, the method chosen will be, to the greatest extent practicable, the one that achieves reporting limits that are below cleanup levels. Methods may require modifications to achieve project DQOs.

The goal for analytical precision and accuracy is that each measurement should be associated with laboratory QC that is within limits. QC limits for both chemical and radiological parameters are those required by the requested analytical method. This CDQMP sets forth the QC limits (see Appendix A) required for the FMSS properties remediation for radiological and chemical analyses. Matrix samples including matrix spike (MS) and matrix spike duplicate (MSD) samples (MS/MSD for organics and MS/MD (matrix duplicate) for inorganics), will be used to assess the effect of matrix on the measurement

process. Laboratory control samples (LCSs), or blank spikes, will be used to assess the accuracy and precision of the measurement process in the absence of effects from field samples. Method blanks will be used to assess possible laboratory contamination, and field blanks, such as trip blanks and equipment rinseate blanks will be used to determine sources of contamination from the sampling location, the sample container, the sampling equipment, or sample transport.

Requirements for precision and accuracy to meet data quality goals are identified in Appendix B. Requirements for completeness are noted in Section 2.8.4.

Data quality indicators are percent differences between replicate or duplicate sample (precision), percent recoveries of blank or matrix spike results (accuracy), and MDLs or MDAs, and PQLs (sensitivity). Data indicator objectives are established to ensure the quality of the analytical data produced by the laboratory. A general description of each of the data indicator objectives is given below along with the data assessment procedures. All data must meet or exceed limits for precision and accuracy stated in the individual analytical methods.

2.8.1 Precision

Precision is the degree to which the measurement is reproducible and is frequently determined by comparison of laboratory designated duplicates or designated laboratory MS/MSDs. Precision is important because it represents the ability of the laboratory to produce consistent results. Precision of analyte concentrations in field samples is typically measured by the collection and testing of field duplicate samples. In that case, precision is calculated by the percent difference (%D) between the field duplicate results; i.e.,

$$\%D = (A - B) / [(A + B) / 2] \times 100$$

where: A = first sample result
 B = second sample result

Standard deviation (S) is calculated as follows:

$$S = \left(\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1} \right)^{1/2}$$

x_i = measured value of the i^{th} replicate
 $\bar{x}$ = average of replicate measurements
 n = number of replicates

If more than two samples are collected at the same location and at the same time, precision will be calculated as % relative standard deviation (%RSD). %RSD may be calculated as follows:

$$\%RSD = \frac{S}{\bar{X}} \times 100\%$$

$\bar{X}$ = average of replicate measurements
 S = standard deviation

2.8.2 Accuracy

Accuracy is reported as the percent recovery (%R) of a parameter from a laboratory or field sample spiked with a known value of the parameter for a given analytical procedure. Accuracy is important because it is a measure of the true concentration of a parameter for a given analytical procedure. The determination of the accuracy of a measurement requires knowledge of the true or accepted value for the parameter being measured and the value of the parameter for the unspiked sample. Accuracy is monitored for each matrix type. The %R may be calculated as follows:

$$\%R = \frac{X_s - X_u}{K} \times 100\%$$

where: X_s = measured value for spiked sample
 X_u = measured value of unspiked sample
 K = known value of the spike in the sample

2.8.3 Method Detection Limits and Reporting Limits

RLs will be based on MDLs, except that the RLs for samples analyzed under the Toxicity Characteristic Leachate Procedure (TCLP) will be the regulatory limits for individual compounds as listed in 40 CFR, Part 261.24, Table 1. The RL is often called the PQL.

MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from the analyses of seven blanks, each spiked in an identical fashion with the analytes of interest, so that the final concentration of the spiked solution is approximately two to five times the expected method detection limit. Following analyses, the mean and standard deviation of the seven results is calculated. The MDL may be calculated as follows:

$$MDL = t_{(n-1, \alpha=0.99)} \times S$$

where: S = standard deviation of the replicate analyses
 $t_{(n-1, \alpha=0.99)}$ = one-sided 99% t-statistic
 n = number of measurements of analyte

Typical RLs are provided in Appendix A of this QAPP. They are typically 2 to 10 times the MDL.

It should be recognized that MDLs and RLs are sample matrix dependent and may be raised due to matrix interferences and/or dilution factors.

Several parameters unique to radiochemical analyses are used to describe the sensitivity of the detection systems. These parameters are lifted directly out of the NUREG/MARSSIM guidance (EPA, 2000b). They include the critical level (L_c), detection limit (L_d), and MDA.

L_c is the net response level (in counts) at which the detector output can be considered above background. It may be calculated as follows:

$$L_c = k\sqrt{2B} = 2.33\sqrt{B} \text{ for } \alpha, \beta = 0.05$$

L_d is the net response level (in counts) that can be expected to be seen with a detector with a fixed level of certainty. It may be calculated as follows:

$$L_d = k^2 + 2k\sqrt{2B} = 3 + 4.65\sqrt{B} \text{ for } \alpha, \beta = 0.05$$

where: k = Poisson probability sum for α and β (assuming α and β are equal)
 B = number of background counts that are expected to occur while performing an actual measurement

The MDA is the a priori net activity level above the L_c that an instrument can be expected to detect 95% of the time. It may be calculated as follows:

$$MDA = C \times (3 + 4.65\sqrt{B})$$

where: C = factor to convert from counts to concentration
 B = number of background counts that are expected to occur while performing an actual measurement

2.8.4 Data Completeness

Completeness refers to the amount of valid data obtainable (by the specific method the laboratory used with the instrument to be employed) from a measurement system compared to the expected amount of data, and is usually expressed as a percentage. Completeness may be calculated as follows:

$$\text{Completeness} = \frac{\text{amount of valid data}}{\text{expected amount of data}} \times 100 \%$$

Valid data can be defined as either acceptable data or quality data. Quality data are data that passed all QC indicators. Acceptable data are data that are either quality data or data for which corrective actions have been performed. The minimum completeness for acceptable data required for this project is 95%. The minimum completeness is 98% for each of the analytical methods employed in the task-specific Sampling and Analysis Plans (SAPs). Completeness for quality data shall be 80%.

Analytical data will be divided into two categories:

- Non-critical measurements
- Critical measurements

Non-critical measurements are defined as organic and wet chemistry (e.g., anions, alkalinity, Total Kjeldahl Nitrogen (TKN), etc.) soil and water quality parameters, while critical measurements are defined as radiological constituents, metals, and TCLP. Non-attainment of QA objectives for non-critical measurements will have a minor impact on project objectives. The most important objective for critical measurements is completeness because it is based on data validity and directly impacts project decisions. Non-attainment of completeness may result in the need for resampling at specific locations. Water quality parameters may be critical if one is considering discharge of groundwater, stormwater, or decontamination water.

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3.0 DOCUMENTATION AND RECORDS

3.1 DATA REDUCTION, VALIDATION, AND DOCUMENTATION

3.1.1 Calculations

The off-site laboratory method to be used for routine detection of ^{232}Th and ^{238}U in soils utilizes an isotopic tracer spike followed by acid digestion. The Standard Operating Procedures (SOPs) for these methods are equivalent to DOE Methods 4.5.5 and U-02 for Th-232 and U-238, respectively, and are located in Appendix D. Following acid digestion, the actinides are then selectively preconcentrated using an iron hydroxide precipitation step. The iron hydroxide is dissolved in the appropriate acid solution prior to separation and purification of the individual actinides using anion exchange. The ^{232}Th concentration, C (pCi/g), is calculated from the alpha spectrometry count as follows:

$$C \text{ (pCi/g)} = \frac{\text{Cpm of sample (}^{232}\text{Th peak)} - \text{Cpm background (}^{232}\text{Th peak)}}{(2.22 \text{ dpm/pCi}) \times D \times W \times Y}$$

where: D = efficiency of counting for the alpha spectrometer (cpm/dpm)

W = weight of solid (grams)

Y = fractional recovery of the Th-229 (^{229}Th) tracer.

The value of 2.22 disintegrations per minute (dpm) per picocurie (pCi) is based on the standard value for 1 curie of $3.700\text{E}10$ disintegrations per second (dps) (CRC 1974-75). $3.7\text{E}10 \text{ dps/curie} \times 60 \text{ sec/min} \times (1 \text{ curie} / 10^{12} \text{ pCi}) = 2.22 \text{ dpm/pCi}$.

Most ^{232}Th measurements will be made on-site using gamma spectrometry. Such measurements will quantify the ^{232}Th concentration by counting the gamma-emitting decay product, ^{228}Ac . Since the two are assumed to be in equilibrium, the quantity of actinium equals the quantity of thorium.

The ^{238}U concentration, F (pCi/g) is calculated from the alpha spectrometry count as follows:

$$F \text{ (pCi/g)} = \frac{\text{Cpm of sample (}^{238}\text{U peak)} - \text{Cpm background (}^{238}\text{U peak)}}{(2.22 \text{ dpm/pCi}) \times D \times W \times Y}$$

where: D = efficiency of counting for the alpha spectrometer (cpm/dpm)

W = weight of solid (grams)

Y = fractional recovery of the U-232 (^{232}U) tracer

For ^{226}Ra the off-site laboratory will routinely follow EPA Method Ra-04 or 903.1 located in Appendix D. The method coprecipitates radium out of solution with barium sulfate. The precipitate is then dissolved in ethylene diamine tetraacetic acid. The solution is then transferred to a radon bubbler and the existing radon in the liquid purged. After ingrowth of Radon-222 (^{222}Rn), the radioactive gas is purged from the bubbler into a Lucas scintillation cell and counted for alpha activity.

For SW-846 methods, the procedures to be used for calculation of the concentration of organics can be found in Sections 7.7 of both Method 8260B and 8270C for volatile and semivolatile organics, respectively, and Sections 7.5.6 and 7.6 of Method 8081A for pesticides, and Sections 7.8 and 7.9 of Method 8082 for PCBs. For metals by Method 6010B, there is no calculation for aqueous samples; that is, the instrument response, which is based on a method acceptable calibration, provides the analyte

concentration. If a dilution is required, the instrument response must be multiplied by the dilution factor to obtain the analyte concentration in the original sample. For metals in soils by 6010B, the dilution factor incurred by sample preparation is approximately 100 (depends on actual sample weight and percent moisture). The instrument response is then multiplied by the dilution factor to obtain the analyte concentration in the sample. For solid samples, the result is also divided by the weight fraction of dry solids in the sample to obtain the final result.

3.1.2 Procedures to Ensure Data Integrity

The principal criteria to assure data integrity during collection and reporting shall include the following:

- For collection, the number of samples to be collected will be statistically determined to provide the highest probability that the data quality objectives outlined in this CDQMP will be met.
- For testing, both field and laboratory QC samples will be analyzed in order to evaluate potential blank contamination, analyte recovery from the sample matrix, laboratory and field sample testing precision, and proper instrument calibration. The laboratory will be instructed how to proceed when recoveries are outside of established QC limits, blank contamination is present, or other unforeseen problems arise. These instructions are contained within Appendix E, Section 10 Corrective Actions, of this QAPP.

3.1.3 Treatment of Outliers

Outliers are extreme high or low measurements that are set apart from most of the data. They may arise from matrix interferences, errors in transcription, sample preparation, analytical method, or regional variations in the background geochemistry. Apparent outliers may also represent areas with unusually high concentrations.

Outliers that are obvious mistakes should be corrected, otherwise they will disproportionately affect the statistical descriptors of the data set. Outlier statistical tests, however, should only be used to identify potential outliers that require further evaluation (see EPA, 2000a). EPA 1996 recommends 1 of 4 types of statistical tests: Dixon's Extreme Value test (when sample size is less than or equal to 25), Discordance test, Walsh's test (non-parametric test), or Rosner's test. After identification as a potential outlier, consideration should be given to the magnitude of the observation with respect to the assumed distribution for the data set. It is important to note that no datum should be discarded as an outlier based solely upon the results of these statistical tests. The chosen statistical test should be performed on the original data set and the truncated data set.

Decisions on the use or rejection of outlier data will be aided by the laboratory supplying information justifying an extreme result, especially when associated with QC results that exceed criteria.

3.1.4 Data Management

The laboratory will employ a three-phase review. First, the analyst reviews the data, then the analyst's supervisor, and finally a QA person checks for proper QA/QC protocol as well as any results that appear unusual.

3.1.5 Data Archive

Sample data is saved electronically on tapes. Hardcopies are retained for 6 months in file cabinets within the laboratory building. After the 6-month period, data is shipped in boxes for storage off-site. Hardcopy

data packages and data validation reports received by the FMSS Project Chemist or Sample Coordinator are scanned and the scanned files moved into Documentum, an electronic data and document repository for the FMSS project. Data will be stored for 10 years from the date of submission of the certificate of analysis.

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4.0 MEASUREMENT / DATA ACQUISITION

4.1 SAMPLING PROCESS DESIGN

Systematic evaluation of the objectives of the investigation, the use of the data to be collected, and an evaluation of the data quality requirements form a methodology for designing an adequate and appropriate sampling plan. The following discussion presents three approaches to defining the sampling requirements: the Observational Approach, which focuses on the data needed to define and evaluate site conditions based on source / pathway / receptor evaluation; Adaptive Sampling and Analysis, which incorporates field analytical methods and on-site decision-making; and EPA's DQO process, which focuses on a need / decision / action evaluation for the site. Each of these planning methodologies is used to define the minimum acceptable and necessary data set for each investigative area or media type. Once the minimum data set is defined, refinements and additions are made to fulfill all identified and anticipated data requirements, and to resolve or constrain uncertainty. These approaches require systematic identification of the end use of the data. If there is no identifiable action to be taken or decision to be made based on a given proposed data set, then these data are deleted from the sampling plan. The systematic evaluation of collected data and the decision / action process result in collecting only needed data in a cost-effective and expedited manner.

This Section describes the approach that will be employed in the task-specific Work Plans for defining sampling requirements. Shaw shall follow EM 200-1-2, Technical Project Planning Guidance for HTRW Data Quality Design, for defining data needs and data quality objectives for FMSS project tasks in those Work Plans.

4.1.1 Observational Approach

The Observational Approach assesses the site's "probable conditions" based on the available data. It is intended that the "probable conditions" be understood to the extent necessary to meet the sampling objectives (i.e., evaluate potential risks and resolve data gaps).

As part of the approach, a detailed conceptual model is developed based on the current understanding of site conditions including:

- Primary Sources.
- Primary release mechanisms.
- Secondary sources.
- Secondary release mechanisms.
- Pathway of migration.
- Exposure routes.
- Potential receptors.

The primary release mechanisms for the primary contaminants of concern (PCOCs) are:

- Erosion.
- Wind-blown dust.
- Surface water runoff.
- Operation activities / construction disturbances.
- Infiltration / percolation to adjacent and underlying soils.

- Solubility or suspension in ground water.
- Ground-water infiltration / discharge to surface water.

Secondary sources of PCOCs include surface water and features receiving surface water such as drainageways and sediments, ground water, soils surrounding and underlying storage and disposal areas, and on-site and off-site sediments. Secondary sources may also include receptors, which consume contaminated biotic or abiotic matrices.

Secondary release mechanisms include:

- Channel flow / surface water transport.
- Sediment deposition (in-channel and over-bank).
- Sediment traps.
- Dredging of sediments from drainageways.
- Overland flow / stormwater runoff.
- Infiltration to subsurface soil.
- Fugitive dust
- Potential ground-water movement from source areas.

Potential contaminant of concern (COC) exposure routes for human and ecological receptors include:

- Inhalation of dust
- Ingestion of soil, surface water, ground water, contaminated fish, plants, or animals
- External exposure.
- Dermal contact with soil, surface water, sediments, or ground water.

The Observational Approach uses "decision rules" (as does the DQO process) for the purpose of linking data needs and uses. This approach helps to focus the sampling plan and sampling strategies by developing a conceptual model that identifies sources, pathways, and potential receptors. To augment the conceptual model, a DQO discussion that follows EPA's guidance is presented in Section 2.0.

4.1.2 Adaptive Sampling and Analysis

Adaptive Sampling and Analysis is an approach that has been successfully used at a number of Department of Defense (DOD) facilities (Robbart and Johnson 1996; and EPA 1995). This approach allows the use of field (as well as off-site) analytical methods, which can produce data quickly and allow on-site decision-making to determine the need to collect additional data. This approach requires analytical techniques that produce prompt turnaround results, adequate data quality, and detection limits that meet the project objectives. The adaptive sampling approach also requires a means for rapidly making decisions in the field regarding the course of the sampling program. This is accomplished by on-site computer processing using geostatistical, visualization, and other data analysis software. The use of an on-site laboratory and technical decision team should also be used. The Adaptive Sampling and Analysis approach is believed to be the most favorable for FMSS site remedial actions.

4.1.3 Data Quality Objective Process

The DQO process is discussed in Section 2.0.

4.1.4 Sampling Network

For soils, the line transect method will be used to locate areas of contamination. The types of samples required will include all matrices known or having the potential to be contaminated including surface and subsurface soils, concrete, building interior and exterior surfaces, groundwater, surface water, sediments, and stormwater.

4.2 SAMPLING METHODS REQUIREMENTS

Field screening and sampling covers all sampling activities at the FMSS properties including sampling of soils, building materials, backfill materials, air, groundwater, surface water, sediments, and wastewater. Additionally, it covers radiological background determination (downhole logging, gamma walkover surveys, soil gas surveys for VOC screening, meteorological monitoring, and air monitoring for industrial hygiene requirements. Section 2.0 of the FSP describes the methods and techniques to be used for sampling / monitoring all applicable media and parameters. Sampling protocols will follow USACE Environmental Sampling Instructions (EM-200-1-3). The task-specific Work Plans will describe specific soil sampling activities for the various tasks such as pre-design investigation, remedial confirmation / final status surveys, groundwater remedial investigation, wastewater treatment, and materials handling in preparation for transport and disposal. In the FSP, **Tables 3-1** and **3-2** provide bottle requirements, preservation, and holding times to extraction and/or analysis for all analytical parameters and matrices. Support facilities will be required and will include:

1. Area where hand-held field surveying equipment can be properly calibrated and kept periodically charged.
2. Decontamination area for cleaning of sampling equipment, including drill bits and sampling tools.
3. Area for storing / stocking sampling supplies such as tape, foil, solvents, bailers, paper towels, etc.
4. Clean area for sample management.

4.2.1 Corrective Actions

Technical staff and project personnel will be responsible for reporting all suspected technical and QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the Project Manager or his / her designee and the CQCSM. The Project Manager will be responsible for assessing the suspected problems in consultation with the CQCSM and Sampling Coordinator to make a decision based on the potential for the situation to impact the quality of the data. When it is determined that the situation warrants a reportable nonconformance and corrective action, then the CQCSM will initiate a NCR, or Corrective Action Report (CAR) in accordance with the CQCP (USACE 1999b). The CQCSM will be responsible for ensuring that corrective actions for nonconformances are initiated by:

- Evaluating all reported nonconformances.
- Controlling additional work on nonconforming items.
- Determining disposition or action to be taken.
- Maintaining a log of nonconformances.
- Reviewing NCRs and corrective actions taken.
- Ensuring that NCRs are included in the final site documentation project files.

If appropriate, the CQCSM will ensure that no additional work dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include:

- Repeating the measurement to check the error.
- Checking for all proper adjustments for ambient conditions such as temperature.
- Checking the batteries.
- Re-calibrating equipment.
- Checking the calibration.
- Modifying the analytical method including documentation and notification (eg., standard additions).
- Replacing the instrument or measurement devices.
- Stopping work (if necessary).

The Project Manager or designee is responsible for all site activities. In this role, the Project Manager may at times be required to adjust the site activities to accommodate activity-specific needs. When it becomes necessary to modify an activity, the responsible person notifies the Project Manager of the anticipated change and implements the necessary changes after obtaining the approval of the Project Manager and the USACE Task / Technical Lead, as required. All such changes will be documented on USACE Field Change Request Form (FCRF, see **Figure 4-1**) that will be signed by the initiators and the Project Manager and USACE Task / Technical Lead. The FCRF for each document will be numbered serially as required. The FCRF will be attached to the file copy of the affected document. The Project Manager must approve the change in writing or verbally before field implementation. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

The Project Manager for the site is responsible for controlling, tracking, and implementing the identified changes. Reports on all changes will be distributed to all affected parties, including the USACE Task / Technical Lead. USACE will be notified whenever significant program changes in the field are made.

 Field Change Request (FCR)			
Section 1 through 4 to be filled out by Shaw Environmental (Shaw), Section 5 to be filled out by USACE			
PROJECT: FUSRAP Maywood Superfund Site	OFS No:	Field Change Request: FCR # Rev #	
To: _____ Dept: _____ Location _____ Date _____			
Re: ☐ Drawing No. _____ Title _____ ☐ Spec. No. _____ Title _____ ☐ Other _____			
1. DESCRIPTION (Items involved, submit sketch if applicable) _____ _____ _____			
2. REASONS FOR CHANGE (If from disposition of nonconformance report, list report number) _____ _____ _____			
3. RECOMMENDED DISPOSITION ☐ Technical Clarification (COR approval required) ☐ Out of Scope (COR/ACOR approval required) ☐ Cost of Growth _____ ☐ ROM Estimate (If Applicable) \$ _____ ☐ Schedule Impact _____			
Shaw Initiator (Signature/Title): _____		Date _____	
4. Shaw Project Manager (Signature) _____		Date _____	
Site Manager Concurrence (Signature) _____		Date _____	
5. USACE DISPOSITION ☐ Approved per recommended disposition ☐ Not approved (give reason) _____ ☐ Approved with modification(s) [describe below] _____ _____ _____			
Technical Mgr. (Signature) _____		Date _____	
COR Concurrence (Signature) _____		Date _____	
ACOR Concurrence (Signature if required) _____		Date _____	
COR Approval (Signature) _____		Date _____	
ACOR Approval (Signature if required) _____		Date _____	
Engineer signs and transmits to Project Engineer with copies to: _____ Project Manager _____ Contract Manager _____ Quality Control Representative Project Engineer _____ Cost (WVN & ATP) _____ Doc Control File: Q1.5.1 _____			

Figure 4-1
USACE Field Change Request Form

4.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Once the samples have been received the sample custodian must inspect the samples against the chain of custody and any other documentation for nonconformances. Any discrepancies are documented on the sample receipt verification form and communicated to the laboratory project manager immediately. The laboratory project manager shall contact the Project Chemist to resolve the issue. Once the paperwork from the sample receipt is completed and reviewed, it is given to the laboratory project manager for log-in to the Laboratory Information Management System (LIMS) computer system.

4.4 ANALYTICAL METHODS REQUIREMENTS

4.4.1 Analytical Procedures

The following text provides detailed information on analytical procedures. The task-specific Work Plans shall contain tabular summaries of analyses required for each site or project. These summaries shall contain the number of samples to be collected for each method including field and laboratory QC samples. The actual quality assurance methods and procedures employed in the subcontractor laboratory's daily activities are provided in Appendix E.

4.4.1.1 Laboratory Analytical Procedures

All samples shall be prepared and analyzed in accordance with the methods identified in Appendix A. Examples of the off-site and on-site laboratories' Standard Operating Procedures (SOPs) are provided in Appendix D of this QAPP, and Appendix A of the FSP, respectively. These procedures contain detailed descriptions of the sample preparation and analyte detection steps, including instrumentation and other laboratory apparatus, reagent and standards preparation, and calibration. It also includes discussions of interferences, sample collection including containers and preservation, QC samples, calculations, and reporting of results. Each individual task Work Plan shall reference one or more of these analytical methods. Use of alternate procedures or modified Appendix A procedures must be pre-approved by the Contracting Officer (CO).

4.4.1.2 Field Measurement Methods

Initial field measurements may consist of geophysical surveys, gamma walkover surveys, building surveys, soil gas surveys, organic screening or inorganic screening.

The geophysical survey will be used primarily to define subsurface features to be considered during the remedial work. Geophysical screening techniques are presented in Appendix A of the FSP.

Radiological screening of soils by gamma spectrometry may be employed using an existing on-site laboratory (see description in Section 1.1.2.6). This laboratory's SOPs are provided in the FSP, Appendix A.

Soil gas surveys will be conducted as appropriate. The SOP for conducting soil gas surveys is SOP 105 in Appendix A of the FSP.

Data collected from these field reconnaissance activities will be used to establish the boundaries, soil sample locations, and well locations for further site investigations and remedial actions.

Organic and inorganic screening methods including hand-held monitors or real time soil analyses by an on-site laboratory may be utilized to help determine extent and location of non-radiological contaminants.

4.4.2 Analytical / Statistical / Control Parameters

Refer to *Guidance for Corrective Actions to be used for QC Criteria Exceedances*, contained within Appendix E of this QAPP (the Guidance), for specific corrective actions to be taken when QC control limits are exceeded.

4.4.2.1 Accuracy - Organics

Accuracy shall be evaluated by requiring the laboratory to treat no less than 10% of all FMSS samples (per matrix) as MS/MSD pairs, to analyze at least one blank spike (or LCS) with the entire analyte list for a given method (analyte lists are shown in **Table A-1** of Appendix A for the FMSS project) per matrix per sample batch (a sample batch contains a maximum of 20 environmental samples), to add surrogate spikes to all samples as required by the method, and to analyze method blanks every 12 hours of analysis time or every batch, whichever is more frequent. The field sample coordinator will clearly identify the sample chosen for matrix spiking and the equipment rinsate blanks on the sample chain of custody. Under no circumstances will trip blanks or equipment rinsate blanks be analyzed as MS/MSD pairs. The sample designated for MS/MSD analyses will have approximately triple the volume of a normal sample. Triple volume is required for aqueous samples, not soil samples. For FMSS, it is practical to batch samples and assign MS/MSDs per investigation or remediation site. Obviously, for large sites multiple batches may be necessary. MS/MSD samples should be spiked by the laboratory with those compounds that have been detected in FMSS property soils most frequently. Lists of MS/MSD compounds for the various test methods are provided in **Table B-1** of Appendix B of this QAPP. Both the MS and MSD samples must be reanalyzed if the recoveries are outside of laboratory-derived acceptable recovery ranges listed in **Table B-1** of Appendix B. Specific off-site laboratory corrective action guidelines are provided in Appendix E.

If analysis results show surrogate recoveries outside laboratory-derived acceptable ranges (in-house limits established as per SW-846 guidance [Method 8000, section 8.7]) the laboratory shall take corrective action in accordance with the Guidance, contained within Appendix E of this QAPP. If method blanks are consistently out of control (see Chapter One of SW-846) for one or more analytes, the laboratory will be required to stop analysis of field samples and find and eliminate the source of contamination. If the source of contamination cannot be found in a timely fashion, Shaw shall procure another laboratory subcontractor for those analyses.

LCS samples are clean matrices, such as organic-free water or high purity sodium sulfate spiked with all of the analytes for a given method as listed in **Table A-1** of Appendix A. LCS samples will be analyzed with each batch. If there are aqueous and solid samples within the same batch, the laboratory must run an aqueous LCS for the aqueous samples and a solid LCS for the solid samples. The LCS provides method performance data for samples free from interferences. As such, they serve as a warning for laboratory methods that are out of control. Like surrogate spikes, control limits must be established for LCS results using SW-846 Method 8000, Section 8.7. If an LCS result falls outside QC recovery limits, the LCS should be reanalyzed in real time with respect to sample analyses, to see if the failure represents a transient instrumental condition. A second failure indicates a fundamental problem that must be corrected before sample analysis can restart. All of the sample results associated with that LCS (only for those analytes that failed LCS recovery) need to be reanalyzed after the method performance problem has been corrected. The corrective actions taken by the laboratory must follow the corrective action procedures described in the Guidance (Appendix E). If a laboratory is in the process of implementing a new GC/MS method, and LCS recovery limits have not yet been established, the temporary percent recovery limits shall be 80 to 120% for water and 70 to 130% for solids. For Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), and Total Recoverable Petroleum Hydrocarbons (TRPH)

(413.2 and 418.1) methods, QC limits may be established by the laboratory for surrogate, LCS, and MS/MSD recoveries, as appropriate. If not, a default recovery range of 65-135% may be used.

In all cases, construction of control charts or QC limit ranges should eliminate outliers, which are defined as those exceeding the mean plus or minus three standard deviations. In addition, reanalysis as a result of QC recovery exceedances as described here, may not be required if the spike signal is obscured by gross contamination. In such cases, the laboratory **must** substantiate its case for not reanalyzing or following the Guidance by providing the proper chromatograms or other pertinent raw data. The final decision as to the acceptability of a laboratory deviating from the requirements of this CDQMP will be made by the USACE CO.

4.4.2.2 Accuracy - Inorganics (non-radiological) and General Chemistry

Accuracy shall be evaluated by requiring the laboratory to treat no less than 5% of all FMSS samples (per matrix or per batch) as a MS sample, to analyze LCSs with the entire analyte list for a given method, and to analyze method blanks as required by the selected analytical method. Shaw will coordinate field sample collection with the laboratory so that batch size is maximized and the frequency of MS sample designation is not too high. The sample chosen for matrix spiking should be similar to other samples in the batch. The field sample coordinator will clearly identify the sample chosen for matrix spiking and the equipment rinsate blanks on the sample chain of custody. Under no circumstances will equipment rinsate blanks be analyzed as MS/MD pairs. The sample designated for MS/MD analyses will have approximately triple the volume of a normal sample. Triple volume is required for aqueous samples, not soil samples. For FMSS, it is practical to batch samples and assign MS samples per investigation or remediation site.

MS inorganic samples should be spiked with the complete analyte target list for a given method at a concentration per analyte of about 3 to 5 times the expected background. The percent recovery of the spiked compounds will provide a measure of accuracy. The MS must be reanalyzed in accordance with the Guidance in the QAPP Appendix E if any of the analyte recoveries are outside of acceptable recovery ranges. The default QC recovery range typically used for inorganics and general chemistry parameters is 75 to 125%. Prior to any redigestion / reanalysis, sample preparation and test data must be reviewed to see if the cause of the spike recovery exceedance can be determined. If an out-of-control condition is discovered in this process, it must be corrected prior to the redigestion / reanalysis.

Similar to organics, the LCS should be performed for each sample batch up to a maximum of 20 samples per batch. If there are aqueous and solid samples within the same batch, the laboratory must run an aqueous LCS for the aqueous samples and a solid LCS for the solid samples. If the LCS recovery falls outside of the QC criteria (default range is 80 to 120%), the LCS must be reanalyzed for the analyte(s) falling outside criteria. If the LCS recovery fails a second time, corrective action must be taken to improve test measurement performance for the analyte(s) of concern. All samples associated with the faulty LCS must be reanalyzed (only for those analytes that failed LCS recovery) after the problem has been corrected.

The post-digestion spike sample recovery test described in Section 8.5 of Method 6010B of SW-846 must be performed on one representative sample from a given analytical batch whenever new or unusual matrices are encountered. It is the responsibility of the analyst to look at the samples prior to digestion and select the representative sample in a conservative manner, such that in his or her judgement, the selected sample is the one most likely to contribute interference. If the results of the interference tests are outside the QC limits provided in Section 8.5, these results must be discussed in the case narrative. For SW-846 Series 7000 methods, spiked samples may be analyzed as described in Section 8.6.2. If the

results are outside of the QC limits stipulated in Section 8.6.2, the method of standard additions (Section 8.7) must be employed.

QC criteria for metals analysis will conform to the requirements of SW-846 and Appendix B of this CDQMP QAPP.

4.4.2.3 Accuracy - Radionuclides

The accuracy described here apply to isotopic radium, thorium, uranium, and gross alpha and beta. Accuracy shall be evaluated by requiring the laboratory to analyze a method blank and LCS at a minimum frequency of 5% of field samples per matrix or per sample preparation batch, whichever is more frequent. For alpha spectroscopy, isotopic tracers shall be added to every sample to evaluate matrix effects. Shaw will coordinate field sample collection with the laboratory so that batch size is maximized. In addition, a field duplicate shall be collected at a minimum frequency of 10% of field samples. The field sample coordinator will clearly identify the sample chosen for the equipment rinsate blank on the sample chain of custody.

The LCS should be performed for each sample batch up to a maximum of 20 samples per batch. If there are aqueous and solid samples within the same batch, the laboratory must run an aqueous LCS for the aqueous samples and a solid LCS for the solid samples. If any of the LCS or isotopic tracer analyte recoveries fall outside of the current control limits established by the laboratory (default limits are 80 to 120% for aqueous samples and 70 to 130% for solid samples (for LCS) and should only be used if laboratory-established limits are not available), the LCS and/or tracer spike solution must be reprepared and reanalyzed for the analyte(s) falling outside criteria (see the Guidance). All samples associated with a faulty LCS must be reanalyzed (only for those analytes that failed LCS recovery) after the problem has been corrected. The LCS should mimic the nominal activity of samples of interest. Recommended LCS activity levels for the radionuclides of interest are 2 to 3 pCi/g each of ^{226}Ra and ^{232}Th , and 5 to 15 pCi/g for ^{238}U .

Radionuclide quantitation must be calculated according to project-approved standard operating procedures (SOPs). Minimum Detectable Activities (MDAs) specified in the SOPs and in Appendix A of this QAPP must be met. Analytical uncertainties shall be reported with all results, including all uncertainties associated with the analyses.

For alpha spectrometry measurements, chemical separation specificity shall be verified. The observed peak energy of each radionuclide shall be within 40 keV of the actual radionuclide energy.

For gamma spectroscopy measurements, a target radionuclide list must be provided. It must contain an example calculation plus uncertainties for all quantitated radionuclides. Positive identification shall be achieved by the following:

1. The observed peak energy is within 2 keV of the target energy.
2. There are no radionuclide gamma peaks interfering with the radionuclide of interest. If an interference is present, the peak for the radionuclide of interest must be corrected to remove the contribution from the interferent.
3. Calibration standards will have been run at the frequency specified in the approved SOP.

4.4.2.4 Sensitivity

The laboratory will have developed MDLs in accordance with 40 CFR 136 Appendix B. The PQL, also known as the reporting limit, shall be set at 3 to 5 times the MDL. It is understood that PQLs are subject

to approval by the USACE Contracting Officer. MDLs should be consistent with the MDLs shown in SW-846. **Table A-1** of Appendix A contains the most current Contract Laboratory PQLs for all analyses. All results for dilution runs must be provided. A discussion as to which values are to be reported must also be provided in the Case Narrative.

Matrix effects caused by highly contaminated samples will be reviewed to assess the laboratory's ability to meet sensitivity requirements. A detailed analysis of all failures to meet sensitivity requirements must be provided in the Case Narrative.

4.4.2.5 Precision

Precision is defined in DQOs Section 2.8.1 of this QAPP. It is represented by the Relative Percent Difference (RPD) between duplicate sample results, and the relative standard deviation for more than two results. Laboratory control sample results can be used to determine the precision (from the results of many analyses) and accuracy (from the average percent recovery of a given analyte) of a method since there are no matrix effects. For metals and radionuclides, laboratory duplicates (replicates of 1 field sample) will be analyzed at a rate of at least 1 in 20 or 1 per batch, whichever frequency is greater. Laboratory duplicates not meeting QC criteria must be re-extracted / reanalyzed once. For organics, precision may be calculated from spiked and unspiked (if present) analyte results obtained from analysis of MS/MSD samples. Field duplicate results are used for both metals and organics to provide a measure of precision. Field duplicate samples are collected at a frequency of 5% for organic and inorganic, and 10% for radiological of the total number of samples of a given matrix or site, or one per batch, whichever is more frequent.

4.4.2.6 Laboratory Internal QC Checks

1. The analytical batch is defined by the group of samples that are prepared (extracted, digested, etc.) together and analyzed sequentially on a single instrument.
2. The Laboratory shall analyze internal QC samples at a frequency consistent with a given method. These shall include method blanks, MS/MSD (MS and laboratory duplicates for inorganic analyses) and LCSs. The matrix used for LCS samples will be reagent grade water for aqueous samples and reagent sand for soils and sediments. Failure to analyze either a matrix spike, LCS, or method blank will result in rejection of data.
3. One method blank will be analyzed per extraction batch. At a minimum, a method blank must be analyzed for every 12 hours analysis time for GC / mass spectrometry analyses. Chronic blank contamination from one or more analytes shall result in reselection of the Laboratory Subcontractor.
4. Second column confirmation will be required for all GC analyses except when results are between the MDL and PQL. The results obtained from the two columns should be less than 40% different.
5. The Laboratory should have control charts for surrogate recoveries and LCSs at a minimum. These charts should be updated at least monthly. The Laboratory Quality Assurance Plan must have detailed procedures describing corrective actions to be taken if QC criteria are exceeded for LCSs, method blanks, surrogate recoveries, etc. for each method and matrix. It must also describe what changes are made to laboratory protocols or operations to prevent such exceedances from reoccurring.

4.5 ANALYTICAL QUALITY CONTROL REQUIREMENTS

4.5.1 Completeness

Completeness shall be evaluated both qualitatively and quantitatively. The project goals for completeness, expressed in percent, are provided in DQO Section 2.8.4 of this CDQMP. The qualitative determination will be a function of sample handling (in the field and in the lab), labeling, shipping, etc. The quantitative description will depend on the number of sample results that are rejected due to gross exceedances of QC criteria.

The completeness requirement for holding times is 95%. Samples exceeding holding times must be resampled and reanalyzed. Results from samples with proven matrix effects will not be used in calculating completeness.

4.5.2 Representativeness

Shaw accepts responsibility for ensuring that all field samples, including blind duplicates and QA splits, are representative of field conditions and are properly preserved. Samples with results that are rejected due to lack of preservation must be re-sampled and reanalyzed.

Laboratory procedures must detail the steps taken to ensure that the sample aliquot collected for analysis is representative of the whole sample.

4.5.3 Data Comparability

To ensure data comparability, laboratory procedures shall include, but not be limited to the following:

- Use of standard approved methodologies.
- Methodologies for quantitation within test procedures, as appropriate.
- Use of standard units and report format.
- Use of standard measures of accuracy and precision for QC samples.

Samples collected as QA split samples should be analyzed by the same or equivalent analytical methods with comparable MDLs/PQLs.

All final solid sample results shall be reported on a dry weight basis, and the percent moisture will be reported. If QA split samples sent to an independent laboratory yield results that are significantly different from the Contract Laboratory results, Shaw will investigate the discrepancies. If errors in sampling or testing are discovered, samples will be re-sampled / reanalyzed.

4.5.4 Preventive Maintenance

4.5.4.1 Field Instruments and Equipment

The field equipment for this project may include temperature probes, pH meters, conductivity meters, turbidimeter, platinum Eh electrode, dissolved oxygen meter, alpha / beta and gamma survey meters, organic vapor detectors (flame or photo ionization detector), and geophysical equipment. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturers. These procedures are included in the technical procedures governing the use of these instruments (see Appendix A of the FSP).

Field instruments will be checked and/or calibrated before they are shipped or carried to the field. Each field instrument will be checked for good condition and operability prior to use. Items such as frayed cords, loose components, or cracked casings shall be cause for not using the instrument. Operational checks against a traceable standard or reference with a known value shall be performed prior to use to ensure that the instrument is in proper calibration. Reference standards used in the field for calibration checks should be labeled with an expiration date and recorded in the log. Instruments found to be out of calibration or improperly responding to instrument checks will be recalibrated before use in the field. If the instrument cannot be calibrated, it will be returned to the supplier or manufacturer for recalibration, and a back-up instrument will be used in its place. Calibration checks and calibrations will be documented on the Field Meter / Calibration Log Sheets in the Equipment Logbook. Any maintenance conducted on field equipment must be documented in the Equipment Logbook and the process documented including the results of the check / calibration and any adjustments required. Any significant adjustment shall be cause for recalibration by the manufacturer or approved calibration facility.

Critical spare parts such as tapes, papers, pH probes, electrodes, and batteries will be kept on site to minimize down time of malfunctioning instruments. Back-up instruments and equipment should be available on site or within 1-day shipment to avoid delays in the field schedules.

4.5.4.2 Laboratory Instruments

As part of their QA/QC Program, a routine preventive maintenance program will be conducted by all investigation-associated laboratories to minimize the occurrence of instrument failure and other system malfunctions. All laboratory instruments will be maintained in accordance with manufacturers' specifications and the requirements of the specific method employed. This maintenance will be carried out on a regular, scheduled basis and will be documented in the laboratory instrument service logbook for each instrument. The laboratory shall maintain an inventory of expendable parts and supplies to minimize downtime. Emergency repair or scheduled manufacturer's maintenance should be provided under a repair and maintenance contract with the manufacturer or authorized factory representatives.

4.5.5 Performance Evaluation Samples

Testing of performance evaluation (PE) samples by USACE laboratories may be part of a laboratory performance audit. The performance evaluation program may also include a maximum of two blind PE samples (provided by the USACE) for each matrix and analysis. PE samples provide an on-going assessment of laboratory precision and accuracy. The analytical results of the analysis of performance evaluation samples are evaluated by USACE Kansas City District to ensure that laboratories maintain an acceptable performance.

Radiological PEs will be identified and supplied as required by the NJDEP pertinent to the regulations set forth in NJAC 7:18. These PEs may consist of EPA regulated PEs for Drinking Water analysis and US DOE PEs for Solid Hazardous Waste.

4.6 INSTRUMENT CALIBRATION AND FREQUENCY

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment used for conducting field tests and laboratory analyses. These instruments and equipment shall be calibrated before each use or on a scheduled, periodic basis according to manufacturer instructions using certified equipment or standards traceable to nationally recognized standards (as applicable).

4.6.1 Field Instruments / Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency (and at least annually) and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. All field instruments for this purpose will have unique identifiers and each instrument will be entered into the Equipment Logbook before use in the field. The SSHO, Project Environmental Sampler, designee, or other assigned responsible individual will be responsible for performing and documenting daily calibration / checkout records for instruments used in the field.

Equipment to be used during the field sampling will be examined to certify that it is in operating condition. This will include checking the manufacturer's operating manual and instructions for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notation on any prior equipment problems will not be overlooked, and all necessary repairs to equipment will be carried out. Spare parts or duplication of equipment will be available to the sampling effort.

Calibration of field instruments is governed by the specific SOP for the applicable field analysis method, and it will be performed at the intervals specified in the SOP. If no SOP is available, calibration of field instruments will be performed at intervals specified by the manufacturer or more frequently as conditions dictate. Calibration procedures and frequency will be recorded in a field logbook.

Field instruments may include a pH meter; temperature probe; specific conductivity meter; respirable dust meter; turbidimeter; platinum Eh electrode; dissolved oxygen meter; hand held scintillation, Geiger-Muller, or proportional detectors for radioactivity screening levels; photoionization and flame ionization detectors for organic vapor detection; low/high volume air samplers; geophysical equipment, etc. If an internally calibrated field instrument fails to meet calibration / checkout procedures, it will be returned to the manufacturer for service and a back-up instrument will be calibrated and used in its place. Field instrument uses, detection levels, and calibration are summarized in **Table 4-1**.

Table 4-1
Field Instrument Uses, Detection Limits, and Calibration

Instrument	Uses	Detection Limits	Calibration	Comments
Total organic vapor meters	Sample screening for VOCs	PID - 0.2 ppm benzene or	1 point - PID benzene daily	Action level must be stated in Health and Safety Plan
	Health and safety screening	FID - 1.0 ppm methane	1 point - FID methane daily	Instrument cannot differentiate naturally occurring compounds from contaminants
			Verification check every 20 samples	PID cannot detect compounds with ionization potentials > 11 eV
Radiological monitoring	Monitoring of beta-gamma surface, gross gamma, alpha surface contamination levels	Daily calibration check varies by equipment	Daily source check per manufacturer	Validation labels include minimum and maximum acceptable levels
PH meters	Field screening of waters	N/A	2 point with standards at pH 7.0 and 4.0 or pH 7.0 and 10.0 daily	Accuracy is to ∇ 0.5 pH units
Temperature (in-line)	Determining water temperature	N/A	To manufacturer instructions	
Conductivity meter	Determining conductivity of water	N/A	1 point in KCL solution	Calculations and acceptance criteria must be available in the field
Membrane electrode meter	Determining dissolved oxygen levels	N/A	1 point using calculated value for water at ATP at least once every 3 hours	Accuracy is ∇ 0.01 ppm
Gamma Spectroscopy System	Analysis of soil samples for general isotopic conditions	≤ 0.2 pCi/g for ROIs	Yearly at a minimum using a multi-gamma source from 60 - 1840 keV	Requires a low-background condition to enable proper detection conditons

Notes:

PID = photoionization detector

FID = flame ionization detector

N/A = not applicable

TBA = to be added

4.6.1.1 pH Meter Calibration

The pH meter will be calibrated according to SOP 409, Onsite Water Quality Testing (see Appendix A of the FSP).

4.6.1.2 Temperature Calibration

Temperature measurement will be calibrated according to SOP 409, Onsite Water Quality Testing (see Appendix A of the FSP).

4.6.1.3 Conductivity Meter Calibration

A specific conductivity meter will be calibrated according to SOP 409, Onsite Water Quality Testing (see Appendix A of the FSP).

4.6.1.4 Organic Vapor Detection

Organic vapor detectors will be checked according to SOP 401, Operation of the MultiRAE Plus Multi-Gas Monitor and SOP 402, Operation of the TVA-1000 Photoionization / Flame Ionization Detectors.

4.6.1.5 Radiation Testing

Several types of radiation detection instrumentation will be used by Radiation Protection Technicians (RPTs) during the course of the Pre-Design Investigation (PDI), GWRI, GEPP,, remedial action support activities, and final status surveys. They include sodium iodide (NaI) detectors used to monitor exposure rates and collect downhole gross gamma logging data, Geiger Muller detectors used for screening measurements, and scintillation detectors used to quantify levels of surface radioactivity on miscellaneous materials. Proper use of these instruments includes a series of QC measurements that will be reviewed as part of the data validation process. These are described below.

Each detector / meter combination will be calibrated no less than annually at a licensed calibration facility. At a minimum of once per day during use, each instrument utilized in the field will undergo the following: source check, battery check, voltage check, and background check. Results will be recorded in a dedicated notebook in the form of a QC log. Instruments found to be operationally deficient will be tagged "out of service" and sent to an appropriate facility for repair and recalibration. Procedures for the operation and management of portable radiation survey instruments are established in the Radiation Protection Program (*Site Safety & Health Plan*, Appendix C, USACE 2002).

4.6.2 Laboratory Instruments

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

In all cases where analyses are conducted according to the EPA Region II or SW-846 protocols, the calibration procedures and frequencies specified in the applicable EPA Region II SOPs or SW-846 methods shall be followed, or be more stringent. For analyses governed by SOPs, refer to the appropriate SOP for the required calibration procedures and frequencies.

Records of calibration will be kept as follows:

- Each instrument will have a record of calibration with an assigned record number.

- A label will be affixed to each instrument showing identification numbers, manufacturer, model numbers, date of last calibration, signature of calibrating analyst, and due date of next calibration. Reports and compensation or correction figures will be maintained traceable to the instrument.
- A written step-wise calibration procedure will be available for each piece of test and measurement equipment.
- Any instrument that is not calibrated to the manufacturer's original specification or equivalent procedure shall be tagged out of service and not utilized for this project.

4.7 ELECTRONIC DOCUMENT MANAGEMENT SYSTEM

Documentum is the integrated, computer-based document and information control system. It hosts files, databases, quantitative models, and other necessary quantitative data. A quality program with strict controls is in place to ensure quality (USACE 1999b).

5.0 ASSESSMENT / OVERSIGHT

Shaw will maintain an aggressive oversight program and implement a three-phase inspection process. These programs are addressed in detail in the CQCP (USACE 1999b). The task-specific Work Plans shall describe the specific three-phase control procedures with particular emphasis on execution of field operations relating to sampling and analysis. Checklists to be used for implementation of three-phase control shall also be included in the task-specific Work Plans.

5.1 ASSESSMENTS AND RESPONSE ACTIONS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis activities are performed in accordance with the procedures established in the CDQMP and task-specific Work Plans. Audits of laboratory activities will include both internal and external audits. Field audits are described in the CQCP (USACE 1999b).

5.1.1 Laboratory Audits

The USACE HTRW CX conducts on-site audits and validates laboratories on a regular basis. These USACE independent on-site systems audits, in conjunction with performance evaluation samples (performance audits), qualify laboratories to perform USACE environmental analysis during an 18-month period.

These system audits include examining laboratory documentation of sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, and instrument operating records. Performance audits consist of sending performance evaluation samples to USACE laboratories for ongoing assessment of laboratory precision and accuracy, followed by an audit of the facility. Standard audit checklists will be used, modified to include review of radiological test method performance and documentation. The analytical results of the analysis of performance evaluation samples are evaluated by USACE HTRW CX to ensure that laboratories maintain an acceptable performance.

Internal performance and system audits of laboratories will be conducted by the Laboratory QA Manager as directed in the laboratory QA Management Plan (see Appendix E). System audits are conducted annually by the laboratory or corporate QA manager and shall include examination of laboratory documentation of sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, and instrument operating records. Internal performance audits are also conducted at a minimum frequency of twice per year. The current laboratory participates twice annually in a PE study conducted by an outside agency. The double blind format ensures that samples are introduced into the laboratory without their knowledge. Criteria for success of laboratory audits will be compliance with the QC requirements outlined in this QAPP.

Shaw is not contracted to perform laboratory audits; however, additional audits of laboratories may be planned and budgeted within specific USACE task scopes. These project-specific laboratory performance review audits would be conducted by Shaw on an as-needed basis to ensure laboratory compliance.

External audits may be conducted in conjunction with or at the direction of EPA Region 2 or the State of New Jersey Department of Environmental Protection.

5.1.2 Data Quality Assessment

Many projects discover problems associated with the analytical data packages periodically throughout the duration of the project. Such problems may be caused by inadequate communication, different interpretations of work plan (CDQMP) requirements, or simply inadequate attention paid to the QC requirements of the CDQMP. Many of the problems directly or indirectly adversely impact data quality, and therefore the project's ability to meet DQOs. Often resampling and reanalysis is the only solution to such problems, however budgetary constraints prevent such rework. For the FMSS project, it is the intention of the Shaw Project Chemist and quality control team to perform a data quality assessment early in the data production process to eliminate problems and resolve uncertainties in the interpretation of how to carry out certain sampling and testing tasks. A data quality assessment shall be performed by a team comprised of the Project Chemist, CQCSM or designee, and subcontractor data validation company with expertise conducting audits of environmental laboratories. It shall be performed on the first Contractor laboratory data package. The data quality assessment will be performed in addition to the data validation and will focus more on adherence of the data package to CDQMP requirements. Specifically, it will review the following:

- Consistency of the PQLs with the Contract Laboratory 's most recent PQLs submitted just prior to the start of the project.
- Validity of calibration curves, especially at low levels.
- Calculation of test results from raw data.
- Proper hardcopy and electronic reporting format
- Reporting criteria for initial and second column confirmation results.
- Adherence to the laboratory QA manual and laboratory SOPs.

Data quality assessments will be scheduled after receipt of the first data package for each major task (e.g., Field Demonstration, groundwater remedial investigation, etc.). If any major findings are discovered by these audits, the Project Chemist will have the authority to suspend the work of the Contract Laboratory until the problem is resolved. Examples of major findings that would authorize the auditor to suspend work are:

- Incorrect list of analytes
- Incorrect reporting limit
- Method performance not consistent with the requirements of the CDQMP
- Absence of current MDL or other studies affecting method performance

Response actions to unsatisfactory conditions will be addressed by the laboratory QA Manager.

5.2 REPORTS TO MANAGEMENT

5.2.1 Daily Quality Control Reports

During the field investigation activities performed for this project, Shaw will prepare DQCRs as delineated in the CQCP (USACE 1999b).

5.2.2 Quality Control Summary Reports (QCSRs)

At the conclusion of field investigation activities and laboratory analysis for each major task, Shaw, in addition to any review conducted by the laboratory, will prepare a QCSR, which will be included as an

appendix to the final report. This report will be submitted to the USACE Task/Technical Lead as determined by the project schedule. The report will also be submitted to USEPA for review and approval. The contents of the QCSR will include data validation documentation and discussion of all data that may have been compromised or influenced by aberrations in the sampling and analytical processes. Both field and laboratory sampling and analysis QC activities will be summarized, and relevant DQCR information will be consolidated. Problems encountered, corrective actions taken, and their impact on project DQOs will be discussed.

Specific elements to be addressed within the QCSR include the following. Note that only deviations from these elements, as described in the CDQMP or the task-specific Work Plan, are included in the QCSR. The effect of deviations on the data and the rationale for occurrence of the deviations should also be provided.

- Data collection - This will include deviations from sampling procedures, sample handling and custody, equipment calibration and maintenance procedures, and analytical procedures. If new methods or modified standard methods were used, but not described in the QAPP, they should be described in the QCSR. The description of the modified analytical method must include method applicability, detection limit, the presence of interferences and attempts to minimize them, and changes in instrumentation, operating parameters, calibration standard type and concentration, and procedures.
- Data Analysis and Validation - This will include a discussion of how data was analyzed. Typically this will be done according to Section 6.0 of this QAPP. This Section will discuss deviations from the guidance provided in Section 6.0. Treatment of outliers shall be discussed. The typical process for treatment of outliers is described in Section 3.1.3 of this QAPP.
- Data Summaries - Must provide a table of analytical results with the corresponding field and laboratory sample number plus a map with field sample numbers written next to their locations. The Data Summary must also include a table with all QC results that fell outside of QC criteria, including the criteria. A column should be included that summarizes how and which data were qualified, or comments that describe the same. The Data Summaries shall also include the individual soil sample percent moisture results as well as definitions of the data qualifier symbols used to validate the data.
- System Audits - Report the findings from systems audits and how corrective actions were taken to resolve the problem. Include the dates when and by whom audits were performed.
- Chemical Analytical and QA/QC Problems Encountered - This Section will summarize those instances for which project DQOs were not met. A discussion of how the problem was discovered, and how/if it was resolved, should be included. Examples include but are not limited to the following:
 1. Unexpected Tentatively Identified Compounds (TICs) that were detected.
 2. Compounds that should have been included on a method analyte list, but were not.
 3. Analytical methods that were inadequate or that required modification to satisfy project DQOs.
 4. Safety problems that might have been avoided if the chemistry of a sample preparation or other test method procedure had been better understood.
 5. Higher than expected data variability and their cause, such as erratic instrument performance.
 6. Improved strategies for the type, number, or frequency of QC sample testing.

- Appendices - These shall include all copies (**with deviations only**) of the following items submitted during the execution of the subject task:
 1. DQCRs
 2. Chain-of-Custody
 3. Cooler Receipt Forms
 4. All analytical data including the QC data, with corresponding field and laboratory sample IDs
 5. One example copy of each of the forms used to control data collection, labeling, analysis, and reporting.

5.2.3 Non-Routine Occurrences Reports

Shaw will send the USACE CO written reports of all significant non-routine occurrences within 48 hours of the event. These shall include non-routine events in both the laboratory and the field relative to data quality. The reports shall describe the occurrence, corrective action(s) taken, and if available, any instructions provided by the USACE CO to resolve the problem. Significant events are defined as those that adversely impact project cost or schedule, or the quality of the analytical data.

5.2.4 Data Report to the QA Laboratory

Shaw will provide the CQAB Laboratory with a copy of QA/QC results summaries. The primary and QA samples of each split sample pair should be identified. Depending on the %D between split sample results, Shaw and the Laboratory Subcontractor may be asked to resample and reanalyze at the direction of the USACE Project Chemist and the CO. The data report shall be sent to:

Laura Percifield
CQAB Laboratory
420 South 18th Street
Omaha, NE 68102
Ph: (402) 444-4313
Fax: (402) 341-5448

6.0 DATA VALIDATION AND USABILITY

6.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

A systematic process for data verification and validation will be performed to ensure that the precision and accuracy of the analytical data are adequate for their intended use. The greatest uncertainty in a measurement is often a result of the sampling process and inherent variability in the environmental media rather than the analytical measurement. Therefore, analytical data validation will be performed only to the level necessary to minimize the potential of using false positive or false negative results in the decision-making process (i.e., to ensure accurate identification of detected versus non-detected compounds). This approach is consistent with the DQOs for the project, with the analytical methods, and for determining contaminants of concern and calculating risk.

Samples will be analyzed through implementation of definitive analytical methods. Definitive data will be reported consistent with the deliverables identified in the Subcontractor laboratory contract and shown in **Tables 6-1** and **6-2**. This report content typically contains data forms including laboratory QC and calibration information. These definitive data will then be validated through the review process presented here. DQOs identified in Section 2.0 and certain method-specified criteria will be validated. Data from groundwater, environmental monitoring, final status survey, backfill material to be added to excavated area, and treated wastewater samples shall be validated. Data from soil loadout shall not be validated. If wastewater treatment results indicate activities that are at or near background levels for an extended period of time, validation shall not be required. Comprehensive analytical information will be retained by the subcontract laboratory.

Laboratories will prepare and submit analytical and QC data reports to USACE and the contractor in accordance with the requirements of this CDQMP and the task-specific Work Plans, including data forms listed in **Table 6-1**. An electronic copy of data will be provided in Microsoft® Access format and complying with the New Jersey DEP EDD requirements and **Table 6-2** for entry into the database.

Table 6-1
Summary of Analytical Hard-copy Data Deliverables

Method Requirements	Deliverables
Requirements for all methods:	
Holding time and preservation information	Signed chain-of-custody forms; Run logs and sample prep. Sheets with dates and times; Sample receipt log with temperature and pH
Discussion of laboratory analysis, including any laboratory problems	Case narratives
Percent solids calculation for soil/sediments	Appropriate calculation
Organics: GC / Mass Spectrometry analysis	
Sample results and reporting limits	CLP Form 1 or equivalent
Surrogate recoveries	CLP Form 2 or equivalent
Matrix spike/spike duplicate and blank spike data	CLP Form 3 or equivalent, with control criteria
Method blank data	CLP Form 4 or equivalent
GC / Mass Spectrometry initial calibration data	CLP Form 6 or equivalent
GC / Mass Spectrometry continuing calibration data	CLP Form 7 or equivalent
Organics: GC analysis	
Sample results and reporting limits	CLP Form 1 or equivalent
Surrogate recoveries	CLP Form 2 or equivalent
Matrix spike/spike duplicate and blank spike data	CLP Form 3 or equivalent
Method blank data	CLP Form 4 or equivalent
Initial calibration and continuing calibration data	CLP Form 6 or equivalent
If calibration factors are used	A form listing each analyte, the concentration of each standard, the relative calibration factor, the mean calibration factor, and %RSD
Calibration curve if used	Calibration curve and correlation coefficient
Analytical test sequence	CLP Form 8 or equivalent
Positive identification (second column confirmation; Only if mentioned as a problem in the Case Narrative)	CLP Form 10 or equivalent
Metals	
Sample results and reporting limits	CLP Form 1 or equivalent
Initial and continuing calibration	CLP Forms 2A and 2B or equivalent, dates of analysis and calibration curve, and the correlation coeff. factor
Method blanks	CLP Form 3 or equivalent and dates of analyses
Spike sample recovery	CLP Form 5A or equivalent
Post digestion spike sample recovery for ICP metals	CLP Form 5B or equivalent
Lab Duplicates	CLP Form 6 or equivalent
LCS	CLP Form 7 or equivalent that includes acceptable range or window
Method of Standard additions (when implemented)	CLP Form 8 or equivalent
Serial Dilution (required when analyte concentration is > 25 times the MDL)	CLP Form 9 or equivalent
Holding times (prep. and analysis run logs)	CLP Forms 13 and 14 or equivalent
Wet Chemistry	
Sample results and reporting limits	Report result and reporting limits
Matrix spike recovery	%Recovery
Matrix spike duplicate or duplicate	%Recovery and %RPD
Method blank	Report results
Initial calibration	Calibration curve and correlation coefficient

Method Requirements	Deliverables
Continuing calibration check	Recovery and % difference
LCS	LCS result and control criteria
Run log	Copy of run log
Radiochemical Analysis	
Sample results	Report results with uncertainties (errors)
Initial calibration	Energy & Efficiency determination (alpha spec); Full Energy and Shape Cal. & Efficiency Cal. (gamma spec)
Continuing Calibration	Pulser checks (alpha spec); Daily calibration check (gamma spec)
Blanks and Background determinations	Report results
Sample Specific Chemical (spike or tracer) recovery results	Report results, spike concentration added and %recovery (alpha spec only)
Duplicate results	Report results and %RPD
Peak Energies	Alpha Energy Spectrum (alpha spec only)
LCS	LCS results and control criteria
Run log	Copy of run log
Minimum detectable activity (MDA)	MDA value for each radionuclide for each sample specific result
Radionuclide energies	Theoretical (target) and observed peak energies (gamma spec only)
Matrix density variability	Densities (or weights and volumes) of calibration standards and samples (gamma spec only)

Notes:

CLP contract laboratory program
GC gas chromatography
ICP inductively coupled plasma

LCS laboratory control sample
RPD relative percent difference
RSD relative standard deviation

Table 6-2a
Standardized Electronic Data Deliverables for Chemical Analyses

Field No.	Field Name	Data Type	Field Length/Type	Comments
1	S&W Sample ID	Text	11	Shaw Sample ID - Format exactly as follows: 12B-079999: No additional characters
2	Date of Sample Collection	Date/Time	Short Date	Date of Sample Collection (MM/DD/YY)
3	Time of Sample Collection	Date/Time	Short Time	Time of Sample Collection (HH:MM military format)
4	Lab Batch Number	Text	12	Laboratory Analytical Batch/Sample Delivery Group (SDG) Number
5	Sample Matrix	Text	8	Sample Matrix, e.g., Soil, Water, etc.
6	Lab Sample ID Number	Text	20	Laboratory Sample Identification Number
7	Extraction/Prep Date	Date/Time	Short Date	Sample Preparation/Extraction Date (MM/DD/YY)
8	Sample Analysis Date	Date/Time	Short Date	Sample Analysis Date (MM/DD/YY)
9	Sample Analysis Time	Date/Time	Short Time	Sample Analysis Time (HH:MM military format)
10	Result Type	Text	10	REG = Regular Analysis; DUP = Duplicate; DIL = Dilution; REN = Re-analysis
11	CAS Number	Text	12	Chemical Abstract Services (CAS) Number
12	Analyte	Text	40	Chemical Name
13	Analysis Method*	Text	25	Analysis Method (Method numbers shall be the EPA, SW-846, NIOSH, etc. method number)
14	Result	Number	Single	Results (Report PQL if not detected)
15	Result Qualifier	Text	5	Result Qualifier (U, J, etc.)
16	Unit of Measure	Text	12	Unit of Measure
17	PQL**	Text	10	Practical Quantitation Limit
18	Percent Solids	Text	5	Percent Solids (Report "0" for water matrices)
19	Sample Weight/Volume	Text	10	Sample Weight/Volume
20	Sample Weight/Volume Unit	Text	5	Sample Weight/Volume Units
21	Dilution	Text	10	Dilution factor
22	LABNAME	Text	20	Laboratory name performing the analysis
23	RESULTTYPE	Text	1	"A" for Analyte; "P" for Parameter; "T" for Tentatively Identified Compound
24	NJDLABCERT	Text	5	New Jersey Laboratory Certification Number
25	FILTUNFILT	Text	1	"F" for Filtered; "U" for Unfiltered
*If test method follows TCLP leaching procedure, method used should read, 1311/8260B, 1311/8270C, etc.				
**For metals, the IDL shall be substituted for the PQL				

Table 6-2b
Standardized Electronic Data Deliverables for Radiological Analyses

Field No.	Field Name	Data Type	Field Length/Type	Comments
1	S&W Sample ID	Text	11	Shaw Sample ID - Format exactly as follows: 12B-079999: No additional characters
2	Date of Sample Collection	Date/Time	Short Date	Date of Sample Collection (MM/DD/YY)
3	Sample Analysis Date	Date/Time	Short Date	Sample Analysis Date (MM/DD/YY)
4	Lab Batch Number	Text	12	Laboratory Analytical Batch/Sample Delivery Group (SDG) Number
5	Lab Sample ID Number	Text	12	Laboratory Sample Identification Number
6	Sample Volume	Number	Single	Sample Volume
7	W/D	Text	4	"Wet" = analysis on wet sample or "Dry" = analysis on dried sample
8	Sample Type	Text	10	REG = Regular Analysis; DUP = Duplicate; DIL = Dilution; REN = Re-analysis
9	CAS Number	Text	12	Chemical Abstract Services (CAS) Number
10	Analyte	Text	40	Chemical Name
11	Result	Number	Single	Results (Report reporting limit if not detected)
12	Error	Number	Single	Total measurement error ¹
13	Unit of Measure	Text	12	Unit of Measure
14	Result Qualifier	Text	5	Result Qualifier (U, J, etc.)
15	Analysis Method	Text	25	Analysis Method
16	MDA	Text	10	Minimum Detectable Activity
17	Reporting Limit	Number	Single	Reporting Limit is typically 3 to 5 times the MDA
18	Sample Matrix	Text	8	Sample Matrix, e.g., Soil, Water, etc.
19	FILTUNFILT	Text	1	"F" for Filtered; "U" for Unfiltered sample
20	TOP_DEPTH	Number	Single	Top of sample depth, ft
21	BOT_DEPTH	Number	Single	Bottom of sample depth, ft
22	LABNAME	Text	20	Laboratory name performing the analysis
23	RESULTTYPE	Text	1	"A" for Analyte; "P" for Parameter; "T" for Tentatively Identified Compound
24	NJDLABCERT	Text	5	New Jersey Laboratory Certification Number
25	Date Received	Date/Time	Short Date	Date sample was received by laboratory (MM/DD/YY)
¹ Prior to receiving FMSS samples, the Subcontractor must provide the Contractor with a description of what is included in the total measurement error.				

The laboratory will be required to confirm sample receipt and log-in information. The laboratory will return a copy of the completed chain-of-custody and confirmation of the laboratory's analytical log-in to the contractor on a daily basis (see Section 3.2.3 of the FSP).

The subcontract analytical laboratory will prepare and retain full analytical and QC documentation. Such retained documentation will include all hard copies and other storage media (e.g., magnetic tape). As needed, the subcontract analytical laboratory will make available all retained analytical data information.

Validation will be accomplished by comparing the contents of the data packages and QA/QC results to requirements contained in the requested analytical methods. Validation support staff will be responsible for these activities. For final status survey results, the protocol for organic and inorganic analyte data validation is presented in the EPA Region 2 SOPs for data review of specific organic and inorganic parameters.

For all other organic and inorganic analyte data, the USACE Data Quality Evaluation Guidance (CENWK-PE-ES) (see Appendix F) shall be used.

There are no Contract Laboratory Program (CLP) protocols for radiological data. Radiological data validation will be performed on data collected during final status surveys according to the USACE Kansas City and St. Louis District Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy Modified for the Maywood Project (USACE, 2003; see Appendix F).

Validation support staff will conduct a systematic review of chemical data for compliance with the established QC criteria based on the following categories:

- Holding times and preservation.
- Blanks.
- LCSs.
- Surrogate recovery (organic methods).
- MS/MSD and MS/MD percent recoveries and RPDs.
- Field Duplicates and Lab Replicates.
- Calibration.
- Second column confirmation (only if mentioned as a problem in the Case Narrative).
- Postdigestion spike sample recovery for ICP metals (inorganic only).
- Method of standard additions (inorganic only, when implemented).
- Sample specific chemical recoveries (radionuclides).
- Chemical separation specificity (alpha spectroscopy only).
- Target radionuclide list.
- Peak energies (alpha spectroscopy only).
- Run log.
- Minimum detectable activity (MDA).
- Radionuclide energies (gamma spectroscopy only).
- Matrix density variability (gamma spectroscopy only).
- Laboratory case narrative.

Consistent with the data quality requirements as defined in the DQOs, all project data and associated QC will be evaluated on these categories and qualified as per the outcome of the review. Data validation reports will be completed and presented with the QCSR.

6.2 VALIDATION AND VERIFICATION METHODS

The following QC items will be reviewed as part of the data validation task. These QC items apply to all sample types unless noted otherwise:

Holding Times - Evaluation of holding times ascertains the validity of results based on the length of time from sample collection to sample preparation or sample analysis. Verification of sample preservation must be confirmed and accounted for in the evaluation of sample holding times. The evaluation of holding times is essential to establishing sample integrity and representativeness. Concerns regarding

physical, chemical, or biochemical alteration of analyte concentrations can be eliminated or qualified through this evaluation.

Blanks - The assessment of blank analyses is performed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks apply to any blank associated with the samples, including field, trip, equipment rinseate, and method blanks. Contamination during sampling or analysis, if not discovered, results in false-positive data.

Blanks will be evaluated against quantitation limit goals as specified in Appendix A unless specified differently in the task-specific Work Plan. Analytical method blanks should be below these levels. Field, trip, and equipment rinseate blanks will be evaluated against these levels for most analytes. Background counts are determined periodically for radiological testing.

Laboratory Control Samples - The LCS serves as a monitor of the overall performance of the analytical process, including sample preparation, for a given set of samples. Evaluation of this standard provides confidence in or allows qualification of results based on a measurement of process control during each sample analysis.

Laboratory Replicates - Laboratory replicates are sample pairs generated by homogenizing a single sample and splitting it into two portions. Replicate analysis results provide a measure of the precision of the sample preparation and testing process. Replicates are analyzed for inorganic parameters (elements and wet chemical parameters) as well as radiological parameters at a rate of at least 1 in 20 or 1 per batch, whichever frequency is greater.

MS/MSD Samples - Matrix spike and matrix spike duplicate (MS/MSD) samples are prepared from an individual field sample that is split into three portions. Two of the three portions are spiked with the method analytes at concentrations approximately three to five times the expected background levels. MS/MSDs are analyzed for organic analytes. A matrix spike sample only (and laboratory replicates) are analyzed for inorganic and radiological testing. MS/MSD and MS results provide a measure of method accuracy. See Section 4.4.2.1 of this QAPP for additional details.

Performance Evaluation Samples - Testing of performance evaluation samples by USACE laboratories may be part of a laboratory performance audit. The performance evaluation program may also include a maximum of two blind PE samples (provided by the USACE) for each matrix and analysis. PE samples provide an on-going assessment of laboratory precision and accuracy. The analytical results of the analysis of performance evaluation samples are evaluated by USACE Kansas City District to ensure that laboratories maintain an acceptable performance.

Surrogate Recovery - System monitoring/surrogate compounds are added to every sample, blank, matrix spike, MS, MSD, and standard for organic analyses only. They are used to evaluate extraction, cleanup, and analytical efficiency by measuring recovery on a sample-specific basis. Poor system performance as indicated by low surrogate recoveries is one of the most common reasons for data qualification. Evaluation of surrogate recovery is critical to the provision of reliable sample-specific analytical results.

Sample Specific Chemical Recovery - Isotopic tracers are utilized to evaluate and compensate for sample-specific influences and preparation aberrations on the radionuclide quantification. They are evaluated to radioelement-specific percent recovery and are used for alpha spectrometry tests only. For example, a decrease or increase in tracer recovery for a given isotope error may be attributed to sample matrix interferences or preparation processes. Because quantitative determination of many radionuclides is based on the use of tracers, evaluation is critical to the provision of reliable analytical results.

Peak Energies (alpha)/Radionuclide Energies (gamma) - For alpha spectroscopy test results, the validator will check to see if the energy of the peak of interest is within 40 keV of the theoretical energy of the radionuclide of interest. For gamma spectroscopy test results, the validator will verify that the target radionuclide energy is within 2 keV of the observed peak.

Matrix Density - In gamma spectroscopy, since analyte signal is dependant to some extent on sample density, this evaluation criterion takes into account the impact of variations in sample density. The sample density of the dried and ground sample must be within 70 - 130% of the density of the calibration standard.

Minimum Detectable Activity (MDA) and Practical Quantitation (or Reporting) Limits (PQL) - The intent of evaluating this quality indicator is to ensure that the MDA or PQL is accurate and that it meets the project requirements for MDA or PQL. The PQLs should be lower than their corresponding regulatory action levels. The MDA should be as low as required by **Table A-1**, which is located in Appendix A of this CDQMP QAPP

Calibration - The purpose of initial and continuing calibration verification analyses is to verify the linear dynamic range and stability of instrument response. Relative instrument response is used to quantitate the analyte results. If the relative standard deviation of the average relative response factor (RF) of the initial calibration, or the %D between the initial calibration average RF and continuing calibration RF (for organics) is outside acceptable limits, the data quantitation is uncertain and requires appropriate qualification. For inorganics, initial and continuing calibration results for ICP analysis (one standard) must fall within 90 to 110%. For mercury (five standards and a blank to establish calibration curve), the results must fall within 80 to 120%, and for cyanide (three standards to establish curve), the results must fall within 85 to 115%. For mercury and cyanide, the correlation coefficient must be greater than 0.995. If these requirements are not met, data must be qualified according to the USACE Data Quality Evaluation Guidance or EPA Region II SOPs, as appropriate.

Sample Reanalysis - When instrument performance-monitoring standards indicate that an analysis is out of control, the laboratory is required to reanalyze the sample. If the reanalysis does not solve the problem (i.e., surrogate compound recoveries are outside the limits for both analyses), the laboratory is required to submit data from both analyses. An independent review is required to determine which is the appropriate sample result.

Secondary Dilutions - When the concentration of any analyte in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and reanalyzed. The laboratory is required to report data from both analyses. When this occurs, an independent review of the data is required to determine the appropriate results to be used for that sample. An evaluation of each analyte exceeding the calibration range must be made, including a review of the dilution analysis performed. Results chosen in this situation may be a combination of both the original results (i.e., analytes within initial calibration range) and the secondary dilution results.

Serial Dilutions - Serial dilutions are required to be performed when an inorganic analyte result is greater than 25 times its Method Detection Limit. The purpose of the serial dilution is to check the linearity of the analyte response at higher concentrations. The validator will verify that serial dilutions were performed when required, and that the diluted result is within 10% of the original determination. If not, the method of standard additions (MSA) must be conducted.

Post-digestion Spike Sample Recovery - The post-digestion spike sample test is conducted as a corrective action if the spike sample run result does not meet acceptance criteria. The purpose of the post-digestion

spike run is to help distinguish between sample matrix effects and instrumental problems. The spike level should be between 10 and 100 times the instrumental detection limit. If the post-digestion spike sample recovery is within acceptance criteria of 75-125%, the matrix is the probable cause of the errant recovery in the original spike sample run. If the post-digestion spike sample recovery is outside of acceptance limits, instrument performance is suspect.

Method of Standard Additions (MSA) - If a serial dilution result is not within 10% of the original determination, MSA should be run. The MSA helps counter matrix effects that result in either depression or enhancement of the signal. The acceptance criteria is that the slope of the linear regression analysis curve must be within 20% of the standard curve.

Laboratory Case Narratives - Analytical laboratory case narratives are reviewed for specific information concerning the analytical process. This information is used to direct the data validator to potential problems with the data.

In addition, checks will be made of how results were obtained from the raw data (only for those data being validated using Region 2 protocols) to verify proper calculation and transcription of results (EPA, 1999 and 2002). Data review will verify PQLs to be the same as those agreed upon in the CDQMP (see references EPA 1999 and 2002 for data review guidelines; PQLs shall be obtained from the current subcontract laboratory and compared to the Project Action levels in Appendix A).

The data validation will review field notes to confirm that correct sampling and excavation decisions were made based on screening and on-site testing data.

Shaw will perform statistical treatment tests to determine the degree of attainment of DQOs and potential elimination of outliers as per Section 3.1.3.

6.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

The primary criterion for satisfying DQOs is to maximize the number of analyte PQLs that are below applicable cleanup action levels. This will give us confidence that we can detect contaminants of concern below the action levels. Cleanup levels for radiological contaminants are discussed in the Section 2.3. Standard laboratory radiochemical techniques and in situ gamma spectroscopy can easily attain minimum detectable levels, which are significantly less than the cleanup criteria. Screening levels for chemical contaminants of concern are taken from the New Jersey cleanup criteria in Appendix A. If standard methods cannot produce PQLs that are less than screening levels, the methods may need to be modified or non-standard methods should be utilized if possible. Even using modified or substitute methods, there may be analytes with screening levels that fall between the PQL and MDL, or below the MDL. These analytes are indicated in footnotes at the end of **Table A-1** of Appendix A. For these analytes, there will likely be negotiations with stakeholders and regulators to agree upon a satisfactory approach to test for these analytes.

For each task (Field Demonstration, groundwater remedial investigation, remediation of a given property, etc.), sample results will be grouped according to matrix and action level cleanup categories. For example, if the soil cleanup action levels differ depending on depth, separate groupings of sample results will be made according to depth. All test results for samples within a given category will be compared to the appropriate action level. If the results are all below the action level, no further action will be required. If one or more results are above the action level, the mean and standard deviation of the sample grouping will be calculated and compared to the analogous background results. If the comparison, using an appropriate statistical technique, indicates that the two sample populations are indistinguishable, then no further action will be required. If the comparison indicates that the sample grouping is higher than the

background population, then remedial action will be undertaken. For Final Status Surveys of property soils, MARSSIM (EPA, 2000b) will be employed.

7.0 REFERENCES

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APPENDIX A

COMPARISON OF ACTION LEVELS WITH TYPICAL METHOD DETECTION LIMITS

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Table A-1
Analytical Parameters, Action Levels, and Laboratory PQLs for the
FUSRAP Maywood Superfund Site Investigation (a)

Parameters	Water Action Level (µg/L, unless noted otherwise)	STL PQLs (µg/L, unless noted otherwise)	Soil [b] Action Level (µg/kg, unless noted otherwise)	STL PQLs (µg/kg, unless noted otherwise)
Volatile Organic Compounds (VOC) (g)				
Acetone	700	2	100,000	10
Benzene	0.2	0.08	1,000	1
2-Butanone	300	0.6	50,000	6
Carbon tetrachloride	0.4	0.2	(e)	NA
Chlorobenzene	4	0.06	(e)	NA
Chloroform	6	0.06	(e)	NA
1,2-Dichloroethane	0.3	0.08	(e)	NA
1,1-Dichloroethene	1	0.4	(e)	NA
1,2-Dichloroethene (total)	10	0.4	(e)	NA
1,2-Dichloropropane	0.5	0.1	(e)	NA
Ethylbenzene	700	0.2	(e)	NA
Methylene Chloride (dichloromethane)	2	0.6	1,000	2
1,1,2,2-Tetrachloroethane	2	0.2	(e)	NA
Tetrachloroethene	0.4	0.2	(e)	NA
Toluene	1,000	0.08	500,000	0.8
1,1,1-Trichloroethane	30	0.2	(e)	NA
1,1,2-Trichloroethane	3	0.2	(e)	NA
Trichloroethene	1	0.2	(e)	NA
Vinyl chloride	5	0.2	(e)	NA
Semivolatile Organic Compounds [c] (SVOCs)				
Benzo(a)pyrene	NA	0.8	660	32
Benzo(b)fluoranthene	NA	2	900	76
Benzo(k)fluoranthene	NA	0.6	900	78
Bis(2-Chloroethyl) ether	10	0.8	660	200
Chrysene	NA	1.2	9,000	34
Dibenzo(a,h)anthracene	NA	1	660	36
Indeno(1,2,3-cd)pyrene	(e)	NA	900	36
N-nitroso-di-n-propylamine	20	0.8	660	28
N-nitroso-diphenylamine	20	1	100,000	32
Pentachlorophenol (h)	1	6	6,000	86
Pesticides [c]				
PCBs				
Aroclor-1242	0.5 (d)	0.14	(e)	NA
Aroclor-1248	0.5 (d)	0.12	(e)	NA
Aroclor-1254	0.5 (d)	0.18	(e)	NA
Aroclor-1260	0.5 (d)	0.16	(e)	NA
Herbicides (TCLP only)	Action Level (mg/L in leachate)		Action Level (mg/L in leachate)	
2,4-D	(e)	NA	10	0.04 mg/L
2,4,5-TP (Silvex)	(e)	NA	1	0.01 mg/L
Metals				
Aluminum, Total	200	167	NA	NA
Antimony, Total	20	12	14 mg/kg	2.4 mg/kg
Arsenic, Total [h]	8	14	20 mg/kg	2 mg/kg
Barium, Total	2,000	2.2	700 mg/kg	0.6 mg/kg

Table A-1
Analytical Parameters, Action Levels, and Laboratory PQLs for the
FUSRAP Maywood Superfund Site Investigation (a)

Parameters	Water Action Level (µg/L, unless noted otherwise)	STL PQLs (µg/L, unless noted otherwise)	Soil [b] Action Level (µg/kg, unless noted otherwise)	STL PQLs (µg/kg, unless noted otherwise)
Beryllium, Total	20	2	2 mg/kg	1.0 mg/kg
Cadmium, Total [h]	4	2.6	39 mg/kg	2 mg/kg
Chromium, total	100	3	NA	NA
Copper, Total	1,000	2.8	600 mg/kg	1.0 mg/kg
Iron, Total	300	171	NA	NA
Lead, Total	10	6.8	400 mg/kg	2 mg/kg
Lithium, Total	NA	50	NA	6.5 mg/kg
Manganese, Total	50	2.4	NA	0.6
Nickel, Total	100 (soluble salts)	3.8	250 mg/kg	1.0 mg/kg
Selenium, Total	50	14	63 mg/kg	3.2 mg/kg
Silver, Total	NA	2.8	110 mg/kg	0.6 mg/kg
Sodium, Total	50,000	145	NA	19 mg/kg
Thallium, Total	10	32	2 mg/kg	6 mg/kg
Zinc, Total	5,000	32	1,500 mg/kg	4.8 mg/kg
Mercury, Total	2	0.2	14 mg/kg	0.1 mg/kg
Miscellaneous Analytes				
Amenable Cyanide	200	2	NA	0.1 mg/kg
Methane, dissolved	NA	0.005	NA	NA
Sulfate	250,000	24	NA	
Sulfide	NA	340	NA	
Ammonia Nitrogen	NA	48	NA	
Nitrate, nitrogen	10,000	4	NA	
Phosphorous, ortho	NA	0.05 mg/L	NA	NA
Grain Size	NA	NA	NA	NA
Total Suspended Solids (T.S.S.)	See Table A-2	5 mg/L	NA	NA
Total organic carbon	NA	0.5 mg/L	NA	NA
Total Recoverable Phenolics	See Table A-2	0.004 mg/L	(e)	NA
Total Recoverable Petroleum Hydrocarbons (TRPH)	See Table A-2	0.32 mg/L	(e)	
BTEX Degradars	NA	300 cfu/ml (i)	(e)	NA
BOD-5	See Table A-2	0.47 mg/L	(e)	NA
Oil & Grease	See Table A-2	0.86 mg/L	(e)	NA
Total heterotrophs	NA	300 cfus/ml (i)	(e)	NA
Specific heterotrophs	NA	300 cfus/ml (i)	(e)	NA
Reactivity	NA	NA	NA	NA
Corrosivity (pH)	For TCLP test, > 2 and < 12; for water treatment samples, see Table A-2	NA	NA	NA
Ignitability	NA	NA	NA	NA
Radiochemical Parameters [f]				
Gamma Emitters	(e)	NA	See Ra-226 and Uranium isotope entries	
Thorium 228, 230, 232	none	0-0.6 (Th-228); 0-0.3 (Th-230); 0-0.2(Th- 232)	see Ra-226	0.1 – 0.2 for Th-232
Uranium 234, 235, 238	Total Uranium 50 pCi/L	0-0.3(U-234); 0- 0.3(U-235); 0-0.2(U- 238)	50 pCi/g U-238; 100 pCi/g total U	1.0 – 2.0 for U-238

Table A-1
Analytical Parameters, Action Levels, and Laboratory PQLs for the
FUSRAP Maywood Superfund Site Investigation (a)

Parameters	Water Action Level (µg/L, unless noted otherwise)	STL PQLs (µg/L, unless noted otherwise)	Soil [b] Action Level (µg/kg, unless noted otherwise)	STL PQLs (µg/kg, unless noted otherwise)
Gross Alpha and gross beta	15 pCi/L for alpha; 50 pCi/L for beta	0.5-1.0 for gross alpha 1.5-3.0 for gross beta	NA	NA
Radium 228	See Ra-226	0.5 - 1.0	NA	0.0 – 0.3
Radium 226	5 pCi/L (w/ Ra-228)	0.2 – 0.4	5 pCi/g (w/ Th-232)	0.0 – 0.4

Notes:

NA = Not Available for this Constituent, if shown in an Action level column; Not Applicable if shown in a PQL column since samples do not need to be analyzed for this parameter, or the parameter does not have a PQL, such as Grain Size

TBP = To be provided

- a. Soil chemical action levels are the most stringent (lowest) of the 3 soil action levels; namely, nonresidential direct contact, residential direct contact, and soil impact to groundwater cleanup criteria from the NJDEP proposed rule, Cleanup Standards for Contaminated Sites, N.J.A.C. 7:26D, dated February 3, 1992, last revised July 11, 1996. Parameter specific notes shall be added to these footnotes. Water action levels are the more stringent of the NJ Groundwater Quality Criteria and the Maximum Contaminant Level (MCL) for groundwater as taken from the NJDEP Ground Water Quality Standards, N.J.A.C. 7:9-6. These values are provided for comparison to detection and quantitation limits. Additional ARAPS are discussed in the Environmental Protection Plan (Stone & Webster 1999)
- b. All solids will be reported on a dry weight basis, with the associated sample percent moisture reported separately.
- c. Soxhlet extraction must be used during the sample preparation step on clay or clay-like soils.
- d. PCB action level is for total PCBs.
- e. Samples do not need to be analyzed for this parameter for the matrix indicated.
- f. Present soil action level is 5 pCi/g for combined Ra-226 plus Th-232; and 50 pCi/g for U-238. Instead of PQLs, the radionuclide minimum detectable activities (MDAs) for low level activity samples are provided in pCi/g for soil and pCi/L for water.
- g. Volatile organic analyses for aqueous samples is performed using a 25 ml purge
- h. These compounds have action levels that are lower than their corresponding PQLs.
- i. These PQLs are for biological tests that are being performed by New Jersey Analytical, not STL

Table A-2
Analytical Parameters, and Action Levels for Water Treatment
Samples

Parameters	STL PQLs (mg/L)	Project Action Levels [a] Water Discharge Limit (mg/L)
Volatile Organic Compounds (VOC)		
Acetone	0.002	---
Acrolein	0.0002	0.3
Acrylonitrile	0.0008	8.4
Benzene	0.00008	0.85
Bromodichloromethane	0.00008	---
Bromoform	0.0002	1
Bromomethane	0.0004	---
2-Butanone	0.0006	---
Carbon disulfide	0.0006	---
Carbon tetrachloride	0.0002	0.15
Chlorobenzene	0.00006	10.6
Chloroethane	0.0008	21.5
Chloroform	0.00006	1.75
Chloromethane	0.0004	---
Dibromochloromethane	0.0002	---
1,1-Dichloroethane	0.00008	19.4
1,2-Dichloroethane	0.00008	5
1,1-Dichloroethene	0.0004	1
cis1,2-Dichloroethene	0.00004	---
Trans1,2-Dichloroethene	0.0004	17
1,2-dichlorobenzene	0.00008	21.6
1,4-dichlorobenzene	0.00004	26.3
1,2-Dichloropropane	0.0001	21.2
Cis-1,3-dichloropropene	0.00006	---
Trans-1,3-dichloropropene	0.0002	---
Ethylbenzene	0.0002	9.3
2-Hexanone	0.0002	---
4-Methyl-2-pentanone	0.0002	---
Methylene Chloride (dichloromethane)	0.0006	17
Styrene	0.00008	---
1,1,2,2-Tetrachloroethane	0.0002	3.85
Tetrachloroethene	0.0002	1.8
Toluene	0.00008	8.1
1,1,1-Trichloroethane	0.0002	65
1,1,2-Trichloroethane	0.0002	8.6
Trichloroethene	0.0002	3.3
Trichlorofluoromethane	0.0004	6.25
Vinyl chloride	0.0002	0.005
TAL Metals		
Aluminum	0.17	---
Antimony	0.012	---
Arsenic	0.014	---
Barium	0.0022	---
Beryllium	0.002	---
Cadmium	0.0026	---
Calcium	0.106	---

Table A-2
Analytical Parameters, and Action Levels for Water Treatment Samples

Parameters	STL PQLs (mg/L)	Project Action Levels [a] Water Discharge Limit (mg/L)
Chromium	0.003	---
Cobalt	0.003	---
Copper	0.0028	1
Iron	0.171	---
Lead	0.0068	---
Magnesium	0.023	---
Manganese	0.0024	---
Mercury	0.00036	---
Nickel	0.0038	---
Potassium	0.246	---
Selenium	0.014	---
Silver	0.0028	---
Sodium	0.145	---
Thallium	0.032	---
Vanadium	0.0026	---
Zinc	0.032	---
Cyanide	0.002	0.5
Miscellaneous Analytes		
BOD-5 day	0.47	350
Total Recoverable Phenolics	0.004	0.771
Total Recoverable Petroleum Hydrocarbons (TRPH)	0.32	100
Total Suspended Solids	5.0	350
Corrosivity (pH)	NA	5.5 – 9.5
Oil & Grease	0.86	200

Notes:

--- - Not Applicable

NA – Not Available

a. Discharge limits are from the Bergen County Publicly owned treatment works (POTW)
discharge permit

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APPENDIX B

DATA QUALITY OBJECTIVES

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Table B-1
Required Precision and Accuracy

QC Parameter	Spiking Compounds	Severn Trent Laboratories			
		Accuracy (%R)		Precision (RPD)	
		Water	Soil	Water	Soil
SW8260B Volatile Organic Compounds					
Surrogate Spike	1,2-Dichloroethane	75-124	49-134	--	--
	4-Bromofluorobenzene	64-126	36-133	--	--
	Toluene-d8	70-127	51-137	--	--
	Dibromofluoromethane	60-130	60-130	--	--
MS/MSD[1]	1,2-dichlorobenzene [1]	60-140	NE	20	20
	1,2-Dichloroethene (total)	60-140	57-127	20	20
	acrylonitrile [1]	52-180	NE	20	20
	Benzene	60-140	66-126	20	20
	Chlorobenzene	60-140	74-114	20	20
	Toluene	60-140	72-113	20	20
	Trichloroethene	60-140	62-117	20	20
LCS	Acetone	60-140	10-331	--	--
	Acrolein [2]	60-140	NA	--	--
	Acrylonitrile [2]	60-140	NA	--	--
	Benzene	60-140	66-126	--	--
	Bromodichloromethane [2]	60-140	NA	--	--
	Bromoform [2]	60-140	NA	--	--
	Bromomethane [2]	60-140	NA	--	--
	2-Butanone	60-140	13-242	--	--
	Carbon disulfide [2]	60-140	NA	--	--
	Carbon tetrachloride	60-140	62-135	--	--
	Chlorobenzene	60-140	74-114	--	--
	Chloroethane [2]	60-140	NA	--	--
	Chloroform	60-140	68-128	--	--
	Chloromethane [2]	60-140	NA	--	--
	Dibromochloromethane [2]	60-140	NA	--	--
	1,1-Dichloroethane [2]	60-140	NA	--	--
	1,2-Dichloroethane	60-140	62-138	--	--
	1,1-Dichloroethene	60-140	61-133	--	--
	cis1,2-Dichloroethene [2]	60-140	NA	--	--
	Trans1,2-Dichloroethene [2]	60-140	NA	--	--
	1,2-Dichloroethene (total) [3]	60-140	57-127	--	--
	1,2-dichlorobenzene [2]	60-140	NA	--	--
	1,4-dichlorobenzene [2]	60-140	NA	--	--
	1,2-Dichloropropane	60-140	62-126	--	--
	Cis-1,3-dichloropropene [2]	60-140	NA	--	--
	Trans-1,3-dichloropropene [2]	60-140	NA	--	--
	Ethylbenzene	60-140	74-117	--	--
	2-Hexanone [2]	60-140	NA	--	--
	4-Methyl-2-pentanone [2]	60-140	NA	--	--
	Methylene Chloride (dichloromethane)	60-140	55-126	--	--
	Styrene [2]	60-140	NA	--	--
	1,1,2,2-Tetrachloroethane	60-140	59-124	--	--
	Tetrachloroethene	60-140	66-122	--	--
	Toluene	60-140	72-113	--	--
	1,1,1-Trichloroethane	60-140	63-130	--	--
	1,1,2-Trichloroethane	60-140	63-123	--	--
	Trichloroethene	60-140	62-117	--	--

**Table B-1
Required Precision and Accuracy**

QC Parameter	Spiking Compounds	Severn Trent Laboratories			
		Accuracy (%R)		Precision (RPD)	
		Water	Soil	Water	Soil
	Trichlorofluoromethane [2]	60-140	NA	--	--
	Vinyl chloride	60-140	58-145	--	--
SW8270C Semivolatile Organics					
Surrogate Spike	Nitrobenzene-d5	38-113	25-120	--	--
	2-Fluorobiphenyl	43-116	32-131	--	--
	Terphenyl-d14	10-119	35-140	--	--
	2-Fluorophenol	21-97	25-113	--	--
	Phenol-d5	18-97	27-122	--	--
	2,4,6-Tribromophenol	29-126	24-150	--	--
	2-Chlorophenol	33-110	20-130	--	--
	1,2-Dichlorobenzene	16-110	20-130	--	--
MS/MSD	Indeno(1,2,3-cd)pyrene	66-124	58-118	30	40
	Benzo(a)pyrene	71-116	69-111	30	40
	N-Nitroso-di-n-propylamine	54-116	56-110	38	38
	Pentachlorophenol	46-130	18-102	50	47
LCS	Benzo(a)pyrene	70-125	72-116	--	--
	Benzo(b)fluoranthene	64-126	60-126	--	--
	Benzo(k)fluoranthene	70-137	72-129	--	--
	Bis(2-Chloroethyl) ether	56-118	55-109	--	--
	Chrysene	76-123	73-118	--	--
	Dibenzo(a,h)anthracene	71-128	68-117	--	--
	Indeno(1,2,3-cd)pyrene	69-129	67-116	--	--
	N-nitroso-di-n-propylamine	57-122	64-107	--	--
	N-nitroso-diphenylamine	73-118	67-116	--	--
	Pentachlorophenol	22-139	13-118	--	--
SW8081A/8082 Pesticides/PCBs					
Surrogate Spike	DCB	29-156	25-159	--	--
	TCX	53-144	24-154	--	--
MS/MSD	Aldrin	58-127	39-137	22	43
	Dieldrin	75-142	63-142	18	38
	Heptachlor	57-137	58-132	20	31
	Aroclor 1260	52-118	50-128	27	50
LCS	Aldrin	58-127	39-137	--	--
	alpha-Chlordane	49-173	48-128	--	--
	Gamma-Chlordane	66-131	64-127	--	--
	Dieldrin	75-142	63-142	--	--
	Heptachlor	57-137	58-132	--	--
	Heptachlor epoxide	68-131	64-123	--	--
	Arochlor-1242	NA	NA	--	--
	Arochlor-1248	NA	NA	--	--
	Arochlor-1254	NA	NA	--	--
	Arochlor-1260	30-145	60-130	--	--
SW8151A – Herbicides (TCLP only)					
Surrogate Spike	DCAA	8-133			
MS/MSD	2,4-D	31-139	NA	30	NA
	2,4,5-TP (Silvex)	17-155	NA	30	NA
LCS	2,4-D	31-139	NA		
	2,4,5-TP (Silvex)	17-155	NA		

**Table B-1
Required Precision and Accuracy**

QC Parameter	Spiking Compounds	Severn Trent Laboratories			
		Accuracy (%R)		Precision (RPD)	
		Water	Soil	Water	Soil
SW6010B - Metals [5]					
MS/Replicate	Aluminum	75-125	75-125	Note 5	35%
	Antimony	75-125	75-125	Note 5	35%
	Arsenic	75-125	75-125	Note 5	35%
	Barium	75-125	75-125	Note 5	35%
	Beryllium	75-125	75-125	Note 5	35%
	Cadmium	75-125	75-125	Note 5	35%
	Chromium, total	75-125	75-125	Note 5	35%
	Copper	75-125	75-125	Note 5	35%
	Iron	75-125	75-125	Note 5	35%
	Lead	75-125	75-125	Note 5	35%
	Lithium [4]	75-125	75-125	Note 5	35%
	Manganese	75-125	75-125	Note 5	35%
	Nickel	75-125	75-125	Note 5	35%
	Potassium	75-125	75-125	Note 5	35%
	Selenium	75-125	75-125	Note 5	35%
	Silver	75-125	75-125	Note 5	35%
	Sodium	75-125	75-125	Note 5	35%
	Thallium	75-125	75-125	Note 5	35%
	Zinc	75-125	75-125	Note 5	35%
LCS	Aluminum	80-120	80-120	--	--
	Antimony	80-120	80-120	--	--
	Arsenic	80-120	80-120	--	--
	Barium	80-120	80-120	--	--
	Beryllium	80-120	80-120	--	--
	Boron	80-120	80-120		
	Cadmium	80-120	80-120	--	--
	Chromium, total	80-120	80-120	--	--
	Copper	80-120	80-120	--	--
	Iron	80-120	80-120	--	--
	Lead	80-120	80-120	--	--
	Lithium [4]	80-120	80-120	--	--
	Manganese	80-120	80-120	--	--
	Nickel	80-120	80-120	--	--
	Potassium	80-120	80-120		
	Selenium	80-120	80-120	--	--
	Silver	80-120	80-120	--	--
	Sodium	80-120	80-120	--	--
	Thallium	80-120	80-120	--	--
		Zinc	80-120	80-120	--
SW7470A/7471A Mercury					
MS/Replicate	Mercury	75-125	75-125		
LCS	Mercury	80-120	80-120	--	--
			--	--	--
			--		--
			--		--
			--	--	--
			--	--	--

**Table B-1
Required Precision and Accuracy**

QC Parameter	Spiking Compounds	Severn Trent Laboratories			
		Accuracy (%R)		Precision (RPD)	
		Water	Soil	Water	Soil
SW1010.1 Flash Point (Pensky-Martins Closed-Cup method)					
		--	--	NA	--
SM5220 C or D Chemical Oxygen Demand (COD)					
		75-125	--	20	--
			--		--
EPA 150.1 pH Electrometric		--	--	0.2 units	--
		--	--		--
EPA 160.2 Total Suspended Solids		--	--	20	--
EPA 335.1 Amenable Cyanide		75-125	--	20	--
EPA 350.1 Ammonia		75-125	--	20	--
EPA 353.2 or 300.0 Nitrate		75-125	--	20	--
EPA 365.2 or 300.0 Phosphorus, ortho		75-125	--	20	--
EPA 375.3 or 374.4 Sulfate		75-125	--	20	--
SM 4500B-D Dissolved Sulfide		75-125	--	20	--
EPA 405.1 or SM 5210B BOD 5		75-125	--	20	--
EPA 413.1 or SW9070 Oil and Grease		75-125	--	20	--
EPA 415.2/SW 9060 Dissolved organic carbon		75-125	--	20	--
EPA 418.1 or SW8015 mod – TRPH		75-125	--	20	--
EPA 420.2 Phenolics, Total Recoverable		75-125	--	20	--
BTEX degraders		NA	--	31	--
Total heterotrophs		NA		31	
Specific heterotrophs		NA		31	
Grain Size		NA	--		--
RSK 175 Dissolved Methane					
		70-130	--	30	--

**Table B-1
Required Precision and Accuracy**

QC Parameter	Spiking Compounds	Severn Trent Laboratories			
		Accuracy (%R)		Precision (RPD)	
		Water	Soil	Water	Soil
SW Chapter 7.3 Reactivity (Cyanide / Sulfides)					
		NA for cyanide; 0-200 for sulfide	--	127(CN) 200(S2-)	--
DOE Ga -01-R Gamma Emitters in soil					
LCS/replicate		--	80-120	--	NAD < 1.96or RPD < 35%
Method 4.5.5 (alpha spec) Isotopic Thorium (see Note 6)					
Tracer/ replicate	Th-228	40-110 (80-128)	40-110 (none)	NAD < 1.96 or RPD < 25%	NAD < 1.96or RPD < 35%
	Th-230	40-110 (80-130)	40-110 (70-130)	NAD < 1.96 or RPD < 25%	NAD < 1.96or RPD < 35%
	Th-232	40-110 (80-122)	40-110 (none)	NAD < 1.96 or RPD < 25%	NAD < 1.96or RPD < 35%
DOE U-02, U-04 or EPA 00-07 or 908.1 Isotopic Uranium in water (see Note 6)					
Tracer/replicate	U-234	40-110 (70-123)	--	NAD < 1.96 or RPD < 25%	--
	U-235	40-110 (none)	--	NAD < 1.96 or RPD < 25%	--
	U-238	40-110 (76-120)	--	NAD < 1.96 or RPD < 25%	--
DOE U-02 (alpha spec) or U-04 (fluorometry) Isotopic Uranium in Soil (see Note 6)					
Tracer/replicate	U-234	--	40-110 (70-120)	--	NAD < 1.96or RPD < 35%
	U-235	--	40-110 (none)	--	NAD < 1.96or RPD < 35%
	U-238	--	40-110 (70-125)	--	NAD < 1.96or RPD < 35%
EPA 900, 00-01, or 00-02 Gross alpha and gross beta activity in water (Note 6)					
MS/replicate		75-125 (63-130 for GA; 80-120 for GB)	--	NAD < 1.96or RPD < 25%	--
LANL MLR-100 modif or equiv or SW9310 - Gross alpha and gross beta activity in soil (Note 6)					
MS/replicate		--	70-130 (none)	--	NAD < 1.96or RPD < 35%
Modified EPA 903.1 or 903.0 or Ra-04 or Ra-03 - Ra-226 in water (Note 6)					
Tracer/ replicate	Ra-226	40-110 ((62-130)	--	NAD < 1.96or RPD < 25%	--
EPA Ra-04 Ra-226 in soil (Note 6)					
Tracer/ replicate	Ra-226		40-110 (60-140)	--	NAD < 1.96or RPD < 35%
Modified EPA 904.0 or Ra-05 Ra-228 in water (Note 6)					
Tracer/ replicate	Ra-228	40-110 (60-140)	--	NAD < 1.96or RPD < 25%	--

**Table B-1
 Required Precision and Accuracy**

QC Parameter	Spiking Compounds	Severn Trent Laboratories			
		Accuracy (%R)		Precision (RPD)	
		Water	Soil	Water	Soil
SW9320 Ra-228 in soil (Note 6)					
Tracer/ replicate	Ra-228	--	40-110 (60-140)	--	NAD < 1.96or RPD < 35%

Notes:

1. The compounds acrylonitrile and 1,2-dichlorobenzene are only required for water treatment samples.
2. These VOAs are only on the LCS compound list for water treatment samples.
3. These VOAs are required to be analyzed for all Maywood samples except water treatment samples.
4. The element lithium shall be added to the elements parameter list for groundwater samples only.
5. For metals, the acceptance criterion for precision of aqueous replicate pairs is a RPD of less than 20% when sample results are greater than 5 times the PQL; when one or both results are less than 5 times the PQL, the absolute difference between the two replicate results must be less than the PQL.
6. The acceptable tracer or MS recovery range is shown first with the laboratory acceptance limits for LCS shown in parentheses

NA – not applicable; NE – not established

APPENDIX C FORMS

Note: The Sample Receipt Checklist shown in this Appendix is typical of an off-site lab checklist. The USACE FUSRAP Maywood laboratory has a Sample Receiving Log shown as Attachment 22.1 of SOP 641.

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Field Change Request (FCR)

Section 1 through 4 to be filled out by Shaw Environmental (Shaw), Section 5 to be filled out by USACE

PROJECT: FUSRAP Maywood Superfund Site	OFS No:	Field Change Request: FCR # Rev #

To: _____ Dept: _____ Location _____ Date _____

Re: ☐ Drawing No. _____ Title _____
☐ Spec. No. _____ Title _____
☐ Other _____

1. DESCRIPTION (Items involved, submit sketch if applicable) _____

2. REASONS FOR CHANGE (If from disposition of nonconformance report, list report number) _____

3. RECOMMENDED DISPOSITION

- ☐ Technical Clarification (COR approval required)
☐ Out of Scope (COR/ACOR approval required)
☐ Cost of Growth
☐ ROM Estimate (If Applicable) _____ \$ _____
☐ Schedule Impact _____

Shaw Initiator (Signature/Title):	Date

4. Shaw Project Manager (Signature)	Date	Site Manager Concurrence (Signature)	Date

5. USACE DISPOSITION

- ☐ Approved per recommended disposition
☐ Not approved (give reason)
☐ Approved with modification(s) [describe below]

Technical Mgr. (Signature)	Date

COR Concurrence (Signature)	Date	ACOR Concurrence (Signature if required)	Date

COR Approval (Signature)	Date	ACOR Approval (Signature if required)	Date

Engineer signs and transmits to Project Engineer with copies to:

Project Manager

Contract Manager

Quality Control Representative

Project Engineer
Cost (WVN & ATP)
Doc Control File:Q1.5.1

[illegible]

SAMPLE RECEIPT CHECKLIST

CLIENT:

Purchase Order/Project:

DATE:

SAF# / SOW# / Release #:

Laboratory SDG #:

NOTE: ALL ENTRIES MARKED "NO" MUST BE EXPLAINED IN THE COMMENT SECTION

1. Custody seals on coolers or shipping container intact, signed and dated?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
2. Outside of coolers or shipping containers are free from damage?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
3. Airbill # recorded?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
4. All expected paperwork received (coc and other client specific: historical data, alpha/beta or other screening data as applicable)? (paperwork sealed in plastic bag and taped to inside lid)	☐ Yes	☐ No	☐ N/A	☐ see Comment #
5. Sample containers are intact?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
6. Custody seals on sample containers intact, signed and dated?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
7. All samples on coc received?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
8. All sample label information matches coc?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
9. Laboratory QC samples designated on coc? (QC stickers placed on bottles?)	☐ Yes	☐ No	☐ N/A	☐ see Comment #
10. Shipment meets LvLI Sample Acceptance Policy? (identify all bottles not within policy. See reverse side for policy)	☐ Yes	☐ No	☐ N/A	☐ see Comment #
11. Where applicable, bar code labels are affixed to coc?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
12. coc signed and dated?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
13. coc faxed or emailed to client?	☐ Yes	☐ No	☐ N/A	☐ see Comment #
14. Project Manager/Client contacted concerning discrepancies? (name/date)	☐ Yes	☐ No	☐ N/A	☐ see Comment #

Cooler # / temp and Comments:

Laboratory Sample Custodian:

Laboratory Project Manager:

APPENDIX D*

LABORATORY STANDARD OPERATING PROCEDURES

*Note: * Due to its size, Appendix D is contained electronically on CD-ROM*

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APPENDIX E*

SEVERN TRENT LABORATORIES QUALITY ASSURANCE PROGRAM

*Note: * Due to its size, Appendix E is contained electronically on CD-ROM*

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APPENDIX F

USACE RADIONUCLIDE DATA QUALITY EVALUATION GUIDANCE

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**USACE RADIONUCLIDE DATA QUALITY
EVALUATION GUIDANCE FOR ALPHA AND GAMMA
SPECTROSCOPY MODIFIED FOR
THE MAYWOOD PROJECT**

July 18, 2003

INTRODUCTION

This document is designed to offer guidance in laboratory data quality evaluation of radioanalytical data and is based on SAIC's laboratory validation guidelines (ref. 9). In some aspects, it is equivalent to a standard operating procedure (SOP). In more subjective areas, only general guidance is offered due to the complexities and uniqueness of data relative to specific samples.

Four terms are used throughout this document: shall indicates a requirement for the data validator, must indicates a requirement for the data, should indicates a recommendation, and may indicates an acceptable practice (neither a requirement nor a recommendation).

All mention of uncertainty in this document refers to the laboratory reported uncertainty.

Those areas where specific SOPs are possible are primarily areas in which definitive performance requirements are established. These requirements are concerned with specifications that are not sample dependent; they specify performance requirements on matters that should be completely under a laboratory's control. These specific areas include blanks, calibration standards, calibration verification standards, laboratory control standards, and interference check standards. In particular, mistakes such as calculation and transcription errors must be rectified by submission of corrected data sheets. All numeric QC criteria specified in this guidance shall be superseded by the corresponding criteria specified in the project's Quality Assurance Project Plan.

In instances where a decision on the quality/acceptability of the data is difficult after implementation of this guidance, the reviewer is expected to request data in addition to the data specifically mentioned in this guidance.

As an aid in obtaining good quality data, the lab will undergo a Corps audit and/or Corps certification. During the course of environmental sampling, it is highly recommended that a certain percentage of samples be split 3-ways with two of these splits sent to the contractor's laboratory and one to an outside laboratory. The two splits sent to the contractor's laboratory should be labeled such that the laboratory is unaware that the samples are splits. Inspection of the results of these QA/QC samples will aid the reviewer in assessing the quality of the contractor's laboratory's data. It is recommended that one out of every 10 field samples be split in this fashion. It is the policy of the Kansas City District and St. Louis District to follow these procedures.

At times, there may be an urgent need to use data that do not meet all contract requirements and technical criteria. Use of these data does not constitute either a new requirement standard or full acceptance of the data. Any decision to utilize data for which performance criteria have not been met is strictly to facilitate the progress of projects requiring the availability of the data. A laboratory submitting out-of-specification data shall be required to perform corrective actions (unless the client waives this requirement) and rerun or resubmit data depending on the nature of

the corrective action even if the previously submitted data have been utilized due to urgent program needs. Data for which corrective actions were required and performed but failed to correct the problem are considered acceptable, regardless of their usability. The overriding concern is to obtain data that are technically valid and legally defensible.

This document is to be used as an aid in assigning data qualifiers. The usability of the data will be addressed in the final report document.

RADIONUCLIDE PROCEDURE

The requirements to be checked in validation are listed below. Contractual requirements for these items are not always the same as the data review criteria.

1. Holding times and preservation (Lab holding times only)
2. Calibration
 - Initial
 - Continuing
3. Blanks
4. Sample specific chemical recovery
5. Laboratory control sample
6. Matrix spike
7. Laboratory replicate analysis samples
8. Field replicate analysis
9. Radionuclide quantitation and detection limits
10. Chemical separation specificity
11. Target radionuclide list identification
12. Matrix density variability

I. HOLDING TIMES and PRESERVATION

A. Objective

The objective is to ascertain the validity of results based on the holding time of the sample from time of collection to time of analysis.

Note: The holding time is based on the date of collection (rather than verified time of sample receipt) and date of digestion/distillation. It is a technical evaluation rather than a contractual requirement

B. Criteria

The following technical requirements for sample holding times and preservation have only been established for water matrices. Due to limited information concerning holding times for soil samples, it is left to the professional judgment of the data reviewer whether to apply water holding time criteria to soil samples.

1. Tritium solutions: 6 months, with no preservative and stored in glass.
2. Iodine solutions: 6 months, with no preservatives.
3. Radon-222: 4 days, cool to 4°C and stored in glass with Teflon-lined septum.
4. Cesium: 6 months, when preserved to pH <2 in hydrochloric acid.
5. Plutonium: 6 months, when preserved in 2M nitric acid.
6. Other radionuclides: 6 months, when preserved to pH <2 in nitric or hydrochloric acid.

C. Evaluation Procedure

Actual holding times are established by comparing the sampling date on the sample traffic report with the dates of analysis found in the laboratory raw data (digestion logs and instrument run logs). Examine the digestion and/or distillation logs to determine if samples were preserved at the proper pH. Note: Physical characteristics and half-lives must also be considered when evaluating holding times (e.g., Tc-99 is volatile, or Rn-222 has a 4 day half-life).

Analyte Holding Times (days) = Analysis Date - Sampling Date

D. Action

1. If criteria for holding times and preservation are not met, qualify all results based in professional judgement.

2. If holding times are exceeded, the reviewer shall use professional judgment to determine the reliability of the data and the effects of additional storage on the sample results. The expected bias would be low.
3. Due to limited information concerning holding times for soil samples, it is left to the professional judgment of the data reviewer whether to apply water holding time criteria to soil samples. If the data are qualified when water holding time criteria are applied to soil samples, it shall be clearly documented in the review.

II. CALIBRATION

A. Objective

Initial and continuing calibrations are required to assure the instrument has not drifted which would result in imprecise and inaccurate results.

B. Criteria

Initial and continuing calibrations are to be performed at the frequency established by the project contract. For alpha spectroscopy, an Energy and Efficiency calibration is performed weekly. Pulser checks are performed daily to verify full width at half maximum (FWHM), peak centroid, and peak energy. For gamma spectroscopy, a Full Energy and Shape Calibration and Efficiency Calibration are performed initially and then only after hardware replacement or significant instrument repairs. Calibration checks are performed daily during those time periods when samples are being counted.

C. Evaluation Procedure

Verify that the initial and continuing calibrations have been performed at the frequency established by the project contract.

D. Action

1. If the initial and continuing calibration frequency is less than specified, check the results of any samples that have been split with an outside lab for the affected batch. If there is agreement (see below on “REPLICATE ANALYSIS SAMPLES”), data shall not be qualified as a result of calibration.
2. If there is not agreement between the lab results and the outside lab results, qualify all data in the affected batch according to the action in “REPLICATE ANALYSIS SAMPLES”).
3. If split results cannot be used, verify from the laboratory that the calibration has not shifted.
4. If the laboratory cannot verify that the calibration has not shifted, or if the results of a continuing calibration have indicated a shift has occurred, reject all

data resulting from the last continuing calibration check unless the action described in item 1 applies.

III. BLANKS

A. Objective

Blank analysis results are assessed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks applies to any blank associated with the samples. If problems with any blank exist, all data associated with the case shall be carefully evaluated to determine whether or not there is an inherent variability in the data for the case, or if the problem is an isolated occurrence not affecting other data.

B. Criteria

At least one blank must be analyzed for every matrix, every batch, or for every 20 samples (5% of samples), whichever is more frequent. The result of all blanks must be reported along with the sample results and must be plotted on a QC chart. Acceptable tolerances must be based on system performance and analytical requirements. Tolerance limits of ± 3 standard deviations are recommended.

C. Evaluation Procedures

Review the blank results and evaluate the blank control charts if available as well as the raw data for all blanks. Verify that the results were accurately reported and that tolerance limits were not exceeded.

D. Action

If the blank QC results fall outside the appropriate tolerance limits, the following equation should be used in determining the effect of possible blank contamination on the sample results

$$\text{Normalized absolute difference}_{\text{MethodBlank}} = \frac{| \text{Sample} - \text{Blank} |}{\sqrt{(U_{\text{Sample}})^2 + (U_{\text{Blank}})^2}}$$

Where:

U_{Sample} = uncertainty of the sample
 U_{Blank} = uncertainty of the blank
 Sample = concentration of isotope in sample
 Blank = concentration of isotope in blank

Normalized absolute difference	Qualification
> 2.58	None
$1.96 > x < 2.58$	J
$x < 1.96$	J*

*= Minimally the result should be qualified as estimated, J; however, if other quality indicators are deficient the validator may determine the result should be qualified as rejected, R

IV. SAMPLE SPECIFIC CHEMICAL RECOVERY

A. Objective

Laboratory performance on individual samples subject to chemical process and separation is established by means of spiking with tracer quantities of other radioisotopes of the same element or carrier quantities of the inactive isotope of the same or a chemically similar element. All samples are spiked prior to sample preparation

B. Criteria

1. Sample specific recoveries of 40-110% are considered acceptable. Each chemical tracer percent recovery (CT %R) must be recorded and should be plotted on a QC chart for each radionuclide and method and fall within the prescribed limits.
2. The quantity of tracer material used must be adequate to provide a maximum uncertainty as specified by the SOW at the 95% confidence level in the measured recovery using the following equation:

$$2\sigma_{uncertainty} = \frac{1.96\sqrt{(C_s/t_s) + (C_b/t_b)}}{ExVol \times Rx2.22}$$

Where:

C_s	=	Sample count rate, cpm
C_b	=	Background count rate, cpm
t_s	=	Sample count time, minutes
t_b	=	Background count time, minutes
E	=	Counting efficiency
Vol	=	Volume of sample (liters or grams)
R	=	Radiochemical recovery
2.22	=	Conversion factor from dpm to pCi
X	=	Multiplication Symbol

C. Evaluation Procedure

1. Verify that sample specific recoveries fall within the control limits.
2. Check the raw data to verify that sample specific recoveries are accurately reported. Recalculate up to 10% of the sample specific recoveries (CT %R) using the following equation:

$$CT \%R = (CT_{Found}/CT_{True})100$$

Where:

CT_{Found} = concentration (in pCi/L for aqueous; pCi/kg for solid) of each analyte measured in the analysis of LCS solution.

CT_{True} = concentration (in pCi/L for aqueous; pCi/kg for solid) of each analyte in the LCS source.

3. Check spike levels to verify that sufficient concentrations are used to provide adequate precision for recovery determination.
4. Evaluate recovery to verify that limits specified in SOW are met.

D. Action

1. For sample specific recoveries, qualify results for the appropriate radionuclides in all associated samples as follows:
 - a. 40 – 110%, data is acceptable
 - b. 20 – 40% or 110 – 150%, qualify the data estimated J after corrective actions; otherwise R
 - c. <20% or > 150%, qualify rejected (R)
2. If significant errors are noted in the calculations, flag all affected results, specific to that sample, (R).

V. LABORATORY CONTROL SAMPLE (applies to α spectroscopy except where noted)

A. Objective

The laboratory control sample (LCS) serves as a monitor of the overall accuracy and performance of all steps in the analysis, including the sample preparation. For the following limits to apply, the LCS must contain greater than 10 times the radionuclide's detection limit activity.

B. Criteria (for alpha and gamma)

1. At least one LCS must be analyzed for every matrix, every batch, or for every 20 samples (5% of samples), whichever is more frequent
2. All aqueous and solid LCS results must fall within the laboratory-derived control limits or within the default control limits of 70-130% recovery of the standard value for alpha spectroscopy and within laboratory derived limits of ± 3 sigma around the mean of the measured standard for gamma spectroscopy.
3. All gamma spectroscopy LCS results must be recorded and should be plotted on a QC chart according to sample type and radionuclide and fall within the prescribed limits.

C. Evaluation Procedure

1. Review and verify that results fall within the control limits.

2. Check the raw data (counter printout, strip charts, bench sheets, etc.) to verify the reported recoveries. Recalculate a few of the LCS percent recoveries (LCS %R).

E. Action

For alpha and gamma spectroscopy, qualify all samples associated with the LCS as follows:

1. Aqueous LCS (alpha spectroscopy only)
 - a. If the LCS %R for any analyte falls outside the laboratory derived range but is still within the range of 50-150%, qualify results for that radionuclide in all associated samples as estimated (J).
 - b. If LCS %R are <50% or >150%, qualify results for that radionuclide in all associated samples as unacceptable (R).
 - c. If the upper end of the LCS laboratory derived range is <50% or if the lower end is >150%, qualify all %R falling outside the laboratory derived range as rejected (R).
2. Solid LCS (alpha spectroscopy)

Action same as for aqueous LCS.
3. Solid LCS (gamma spectroscopy)

If any result falls outside 3 sigma, the lab will take corrective action that will ensure acceptable LCS results. Any samples counted on that day prior to the failed LCS would then have to be recounted after obtaining the successful LCS. If an acceptable LCS result cannot be generated, all sample results associated with the faulty LCS shall be rejected.

VI. MATRIX(SPIKE SAMPLE ANALYSIS (not applicable in γ -spectroscopy)

A. Objective

The matrix spike sample (MSS) analysis provides information about the effect of each sample matrix on the digestion and measurement methodology. MSSs are required when sample specific chemical recovery mechanisms are not available and the samples undergo a chemical process.

B. Criteria

1. At least one MSS must be analyzed for every matrix, every batch, or for every 20 samples (5% of samples), whichever is more frequent, when sample specific chemical recovery mechanisms are not available and the samples undergo a chemical process

2. Samples identified as field blanks must not be used for spiked sample analysis.
3. Matrix spike sample percent recovery (MSS %R) must be within the limits of 75-125% for aqueous matrix and 70-130% for solid matrix samples
4. The MSS %R of the matrix spike must be recorded and should be plotted on a QC chart and fall within the prescribed limits.

C. Evaluation Procedure

1. Verify that results fall within the specified limits.
2. Check raw data and recalculate, at a minimum, 10% of the %R using the following equation to verify that the results were correctly reported.

$$MSS\%R = \frac{(SSR - SR)}{SA} * 100$$

Where:

SSR = Spiked Sample Result
 SR = Sample Result
 SA = Spike Added

3. Verify that the field blank was not used for spike analysis.

D. Action

Same as Section IV.

VII. LABORATORY REPLICATE ANALYSIS SAMPLES

A. Objective

Replicate analyses are indicators of laboratory precision based on each sample matrix.

B. Criteria

1. Samples identified as field blanks must not be used for replicate sample analysis
2. At least one replicate must be analyzed for every matrix, every batch or for every 20 samples (5% of samples) whichever is more frequent.
3. The RPD (relative percent difference) replicate analyses results must be within $\pm 35\%$ for solid samples and $\pm 25\%$ for water samples or the NAD (Normalized Absolute Difference) as defined in the equation below must be less than 1.96 for replicate analysis results to be considered in agreement. This criteria will be used also when one value is below the MDA and the other is above. The NAD must be recorded and should be plotted on QC charts with a control limit set at 1.96.

$$\text{Normalized absolute difference}_{\text{Duplicate}} = \frac{| \text{Sample} - \text{Re plicate} |}{\sqrt{(U_{\text{Sample}})^2 + (U_{\text{Re plicate}})^2}}$$

Where:

Sample= Concentration in first sample (original),

Replicate = Concentration in second sample (replicate),

U_{Sample} = Uncertainty of the sample

U_{Replicate} = Uncertainty of the replicate

C. Evaluation Procedure

1. Verify that NAD results are less than 1.96.
2. Check one or more of the replicate results and recalculate the NAD values or RPD if these calculations are in doubt.
3. Use the above equation to verify that NAD results have been correctly reported.
4. Verify that the field blank was not used for replicate analysis.

D. Action

1. If the NAD for a particular radionuclide is ≤ 1.96 , the replicate results are satisfactory. If the NAD for a particular radionuclide is greater than 1.96 check to see if the RPD is within criteria according to VII B. 3 above. If RPD is within criteria the replicate results are satisfactory. If the RPD is greater than 35% and equal to or less than 65% for soils or greater than 25% and equal to or less than 50% for water, qualify the results as estimated. If the RPD is greater than 65% for soils or 50% for water, the results should be rejected unless professional judgment dictates otherwise. When both values are less than the MDA, no action is necessary.
2. If the field blank was used for replicate analysis, all other QC data shall be carefully checked and professional judgment exercised when evaluating the data.

VIII. FIELD REPLICATE ANALYSIS

A. Objective

Field replicate samples shall be taken and analyzed as an indication of overall precision. Field replicates shall be blind to the lab. The replicate shall be prepared

by thoroughly homogenizing the sample. The sample is then split and the splits sent to the lab, with one of the splits labeled such that it cannot be determined from which sample it was split. The replicate is prepared in the same fashion as the laboratory prepares a replicate.

B. Criteria

There are no specific review criteria for field replicate analyses comparability. The degree of agreement between these replicates is to be used in conjunction with all of the remaining quality control results as an aid in the decision as to the overall quality of the data. Data are not to be qualified due to field replicates alone. To determine the level of agreement between the replicates, the following guidelines have been established:

- a. For all analyses in water matrices, data should be considered in agreement if results are within a factor of two of each other. Data between a factor of two and three of each other should be considered as a minor discrepancy and data greater than a factor of three should be considered a major discrepancy.
- b. For soil analyses, data should be considered in agreement if results are within a factor of four of each other. Data between a factor of four and five of each other should be considered as a minor discrepancy, and data greater than a factor of five should be considered a major discrepancy. Note that the comparison criterion for soil samples is based on samples homogenized in the field.

C. Evaluation Procedures

Samples that are field replicates should be identified using sample field sheets.

D. Action

The lack of agreement between the sample and its replicate should only be used as a verification that a quality problem exists as evidenced by at least one other QC indicator. Any evaluation of the field replicates should be provided with the validator's comments. In certain cases, professional judgement may be used to qualify the data.

IX. RADIONUCLIDE QUANTITATION AND DETECTION LIMITS

A. Objective

The objective is to ensure that the reported quantitation results are accurate and that the required detection limits have been met. When detection limit requirements are not met, the data quality objectives may not have been met. All results shall be evaluated relative to the uncertainty associated with the analysis and the sample reports shall report the uncertainty.

B. Criteria

1. Radionuclide quantitation must be calculated according to the appropriate procedures specified in the contractual SOW.
2. Detection limits specified in the specific procedures must be met unless other detection limits are specified in the SOW.
3. Analytical uncertainties must be reported with all results in order to qualify the data. Results and uncertainties as reported by the lab must be reported for all required analyses regardless of the size or sign of the result. The reported uncertainty must include all uncertainties associated with the analysis. An example calculation of the total propagated uncertainty or error must be provided to the data validator if requested.

C. Evaluation Procedures

1. The raw data shall be examined to verify the correct calculation of sample results reported by the laboratory.
 - a. Examine the raw data for any anomalies (i.e., omissions, legibility, etc.). Recalculate a few of the results if there is a suspicion the results have not been calculated properly. If calculation errors are found, (e.g., if sample results cannot be reproduced through manual calculations), contacting the laboratory may be necessary to resolve the problem. Qualifiers should be placed using professional judgment.
 - b. Verify that all analytical uncertainties have been propagated and reported or otherwise documented.
2. Verify that uncertainties have been reported for all results.
3. If a sample result is less than its uncertainty (or indistinguishable from background) or if it falls between its uncertainty and its MDA, the uncertainty multiplied by 1.65 should be less than or equal to the MDA.

D. Action

1. When significant errors are found in the calculations, flag all affected results as rejected, R.

2. For net negative results that have uncertainties smaller than their absolute value, flag the data as rejected (R). This is an indication of improper blank subtraction or background shift.
3. For negative results that have uncertainties greater than the absolute value of the result, qualify the result U. In situations where the reported uncertainty $\times 1.65$ is greater than the reported MDA, the result is reported (UJ) indicating that the MDA may be reported too low.
4. If the uncertainty $< \text{result} < \text{MDA}$, or if the $\text{MDA} < \text{result} < \text{uncertainty}$, and the uncertainty multiplied by 1.65 is greater than the MDA, flag the result as UJ.
5. If the uncertainty $< \text{result} < \text{MDA}$, and its uncertainty multiplied by 1.65 is less than its MDA, flag the result estimated J.
6. If the result is less than the uncertainty and also less than the MDA, qualify the result U, unless the uncertainty times 1.65 is greater than the MDA in which case one would qualify the result UJ.
7. When analytical uncertainties cannot be obtained from the lab, flag the results rejected, R.

If any discrepancies are found, the laboratory may be contacted by the designated representative to obtain additional information that could resolve any differences. If a discrepancy remains unresolved, the reviewer may determine that qualification of the data is warranted based on the reviewer's professional judgment.

X. CHEMICAL SEPARATION SPECIFICITY

A. Objective

Chemical separation specificity is the contract laboratory's ability to separate various radionuclides by chemical separation techniques. The chemical separation specificity can be verified for alpha spectroscopy measurements by observation of the alpha energy spectrum.

B. Criteria

The energy of the radionuclide of interest must be within 40 keV of the observed peak energy. This criteria does not apply for isotopes present at values less than the MDA.

C. Evaluation

Randomly check that the energy of the observed peak of interest is within 40 keV of the energy for the radionuclide of interest.

D. Action

If the energy of the peak of interest is more than 40 keV from the energy for the radionuclide of interest, qualify the results as unusable (R)

XI. TARGET RADIONUCLIDE LIST IDENTIFICATION (Gamma Spectroscopy)

A. Objective

The target radionuclide list (TRL) contains those radionuclides for which a quantitative analysis is required. Therefore, net quantitation with uncertainties must be provided for all TRL radionuclides (whether or not the radionuclide is identified in the peak search and identification). This is accomplished by determining the net area in the region associated with the radionuclide when the radionuclide is not detected by the computerized peak search routine. When a peak is detected for the radionuclide, positive identification is achieved using the following criteria.

B. Criteria

The target radionuclide energy must be within 2 keV of the observed peak. This criteria does not apply for isotopes present at a value less than the MDA.

C. Evaluation Procedure

1. Check that the peak search algorithm of the instrument is set at 2 keV of the standard library energy for the identified radionuclide.
2. Compare isotope concentrations with equilibrium concentrations. Unless enrichment is suspected, these concentrations should be comparable.

D. Action

Qualify the data according to the following:

For TRL radionuclide peaks that are detected but fail to meet the positive identification criteria, flag the data as rejected (R).

If any discrepancies are found, the laboratory may be contacted by the designated representative to obtain additional information that may resolve any differences. If a discrepancy remains unresolved, the reviewer shall decide which value is the best value. Under these circumstances, the reviewer may determine whether qualification of data is warranted.

XII. MATRIX DENSITY VARIABILITY (gamma spectroscopy)

A. Objective

Matrix densities vary from sample to sample. Since analyte signal is dependant to some extent on sample density, this evaluation criterion takes into account the impact of variations in sample density.

B. Criteria

The sample density of the dried and ground sample must be within 70 – 130% of the density of the calibration standard.

C. Evaluation Procedure

Calculate each sample density by dividing the weight of the dried and ground sample by the volume of the sample can.

D. Action

If the density of any sample is not within 70 – 130% of the density of the calibration standard, qualify the results for that sample as estimated J.

GLOSSARY A

Data Qualifier Definitions

- J - The associated numerical value is an estimated quantity.
- UJ - The associated minimum detectable activity (MDA) is estimated
- R - The data are unacceptable (radionuclide may or may not be present or quantitation is in serious doubt). Resampling and reanalysis is necessary for verification.
- U - Not Detected at the Detection limit listed.

GLOSSARY B

Additional Terms

Calibration Curve - An analytical curve based on the pulse energy, detector efficiency, energy absorbance or other measured characteristic obtained from standard sources and a reagent blank.

Calibration Source - A radionuclide source counted daily to verify the calibration of a counting system.

Case - A finite (usually predetermined) number of samples collected over a given time period for a particular site. A case consists of one or more sample delivery group(s).

Chemical Tracer - A trace quantity of a different radioisotope of the same element or a carrier quantity of an inactive isotope of the same or a chemically similar element

Critical Level (CL) - The net count rate that must be exceeded before there is a specific degree of confidence that the sample contains any measurable radioactive material above background.

Laboratory Replicate - Two aliquots taken from a homogenized sample and analyzed as individual samples. These are used to determine the precision of the method.

Field Blank - A sample of radionuclide-free media which is taken to the field in sealed containers and transferred from one vessel to another at the sampling site and preserved with the appropriate reagents. This serves as a check on reagent and environmental contamination. These blanks are treated as actual samples but may not be used for matrix spikes or sample replicates.

Field Replicate - A sample that is collected in the field, homogenized, and split into two separate samples, which are then sent to the laboratory as blind splits, or field replicates. These samples are useful for determination of the precision of the sample collection and preparation processes, as well as the analytical testing process.

Full Width at Half Maximum (FWHM) - the width of the distribution at a level that is half the maximum ordinate of the peak.

Holding Times - The time between the date of collection of sample and the date of sample analysis.

Laboratory Control Sample (LCS) - A control sample of known composition. Aqueous and solid laboratory control samples are analyzed using the same sample preparation, reagents and analytical methods employed for the unknown samples being analyzed. The results from

the analysis of the controls are plotted and compared to control limits to determine the usability of the data.

Matrix Spike Sample (MSS) - An aliquot of sample spiked with a known concentration of target radionuclide(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix. (Some Federal Regulations require that data be corrected for spike recovery prior to reporting. Environmental Protection Agency recommends a minimum of 10 times the method detection Limit or 2 to 4 times the measured quantity.)

Method Blank - A radionuclide-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process and should not be used for matrix spikes or sample duplicates.

Method Detection Limit (MDL) - The minimum concentration of a radionuclide that can be measured and reported with a specific degree of confidence that the radionuclide's activity is greater than zero and is determined for analysis of a sample in a given matrix type. MDL is equivalent to LLD, MDA, etc.

Percent Recovery (%R) - The fractional amount of the known activity of the radionuclide of interest that was obtained in the analysis.

Quality Control (QC) - An aggregate of activities designed to ensure adequate quality of analytical data.

QC Chart - A graphic representation on which the values obtained on the analysis of backgrounds, blanks, calibrations, and laboratory control samples are plotted sequentially. The chart usually consists of a central line and two control limit lines parallel to the central line. The distribution of the plotted values with respect to the control limits provides valuable visual and statistical information on the quality of the analyses.

Standard Operating Procedure (SOP) - Established or prescribed methods to be followed routinely for the performance of design area operations or in designated situations.

Statement of Work (SOW) - A detailed description of work to be performed by a contracted laboratory or facility.

Target Radionuclide List (TRL) - A listing of radionuclides for which a quantitative analysis is required. Net quantitation with uncertainties must be provided for all TRL radionuclides whether or not the radionuclide is identified in the computerized peak search and identification routine.

REFERENCES

- 1 American Society for Testing and Materials (ASTM), "Establishing a Quality Assurance Program for Analytical Chemistry Laboratories Within the Nuclear Industry," American Society for Testing and Materials C 1009-83. Philadelphia, PA, 1986.
- 2 Bleyler, Ruth, comp., Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses, (Draft), Hazardous Site Evaluation Division of the U.S. Environmental Protection Agency, 1988.
- 3 Bleyler, Ruth, comp., Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, (Draft), Hazardous Site Evaluation Division of the U.S. Environmental Protection Agency, 1988.
- 4 Drinking Water Laboratory Certification Implementation Work Group, Manual for the Certification of Laboratories Analyzing Drinking Water, EPA-570/9-82-002, U.S. Environmental Protection Agency, Washington DC, October 1982.
- 5 National Primary Drinking Water Regulations; Radionuclides - Notice of Proposed Rulemaking, 40 CFR Parts 141, 142. U.S. Environmental Protection Agency. Federal Register, Volume 56, Number 138, July 18, 1991.
- 7 Institute of Nuclear Power Operations. Quality Control Program for Chemistry Instrumentation, INPO 83-016 (Revision 01) (CY-701), Institute of Nuclear Power Operations. Atlanta, GA, January 1986.
- 8 Lochamy, Joseph C., The Minimum Detectable Activity Concept. proceedings of the National Bureau of Standards 75th Anniversary Symposium. and EG&G Ortec System Applications Studies, PSD No.17, September 1981.
- 9 Rucker, Thomas L. and Johnson, C. Martin, Jr., Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyses, Science Applications International Corporation (SAIC), Revision 05, 31 December 1992.

CENWK-EC-EF Data Quality Evaluation Guidance
July 26, 1999

This guidance is to be used for all chemical data quality evaluations performed by this district. It is based on criteria presented in SW-846 and provides guidance concerning data quality in areas not specifically covered by that publication. Finally, this guidance provides stricter adherence to criteria than does SW-846.

The specific order of review is not absolute. The reviewer may choose the order which is most useful. Although some review items may require that a sample result not be usable, the reviewer must complete all items in his analysis of a sample result.

The review checklists may be used for sample delivery groups, individual samples, or some other grouping.

Separate sections are presented for inorganic and organic analysis.

Applicability. This Guidance is to be used for all Kansas City District evaluation of chemical data quality. The criteria for acceptable data and usable data will be defined in both the Scope of Work (SOW) and the Quality Assurance Project Plan (QAPP). This Guidance is designed for determination of acceptability of the data, not for usability. Usability will be a separate determination. These terms are defined in the next section and in the SOW.

Purpose. The number and diverse backgrounds of all chemists involved in data evaluation tends to result in conflicting conclusions about the acceptability of the data. This standard was therefore necessary and was developed through agreement of all District chemists. It is the purpose of this standard to reduce variability in data quality evaluation and allow all organizations associated with this District to understand the basis this District uses in evaluating data quality.

Data shall be evaluated based on criteria listed in the SW-846 methods. For non-SW-846 methods, data shall be evaluated according to the criteria specified in the QAPP. Data shall be rejected if any part of these criteria have not been met, and no documented corrective actions as described in the QAPP have been taken. If the corrective action(s) corrected the problem, all data generated under the corrected conditions may be reported without qualification. If appropriate corrective actions have been taken, but QC criteria still could not be met, data shall be flagged (provided that the corrective action taken was that described in the SW-846 methodology or the QAPP). Such data

shall be considered acceptable data. Quality data is data obtained in a sample batch for which all quality control criteria were met. Data will be further evaluated by comparing the A-E's data to duplicate data which will be available from the USACE QA laboratory.

It should be noted that corrective actions are required for each failure to meet established QC criteria. When such corrective action is not described in the data package, the following alternatives should be selected (listed in order of preference):

- a. Contact the lab to determine why no corrective action was taken.
- b. Reject the batch if the QC exceedence is batch QC or the particular sample if the exceedence is sample-specific (i.e., surrogates, detection limit, etc.). USACE may accept batch if, in the reviewer's judgement, the exceedence is minimal.
- c. Make a comment in the data review that the data package is missing corrective actions and the necessary review cannot be completed without it.

It should also be noted that this Guidance does not evaluate all the quality control checks listed in the attached tables. Additional QC data will be evaluated when a decision on the data quality is in doubt.

NOTE: The criteria for determining the acceptability of the data as described in this Guidance are subject to exceptions. Specific circumstances may permit a determination that some data are acceptable or not acceptable even though the literal interpretation of the Guidance would indicate otherwise. Such circumstances must be clearly and completely documented.

Explanation of Terms

Acceptable Data. Acceptable data are the best data the laboratory is able to produce within the confines of the Scope of Work and the approved QAPP. Acceptable data will be contract-compliant and not subject to further laboratory work. Under this definition, acceptable data may still be subject to rejection.

Estimated Data. Data that failed to meet quality control criteria even after corrective actions have been taken. If, in the chemist's judgement this failure is sufficiently severe, this data may actually be rejected.

Quality Data. Data that has met all of the quality control criteria.

Rejected Data. Reported analytical data which the chemist believes does not reliably reflect the actual amount of analyte in the sample and / or it does not fit the definition of acceptable data.

Usable Data. Data which are considered usable for the project. Only under rare circumstances would rejected data be considered usable. The determination of the usability of the data is not considered in the implementation of this Guidance.

Organic Data Evaluation

Refer to Organic Data Evaluation Checklist and Attached QC Criteria Tables

1. Chain-of-Custody. Determine if chain-of-custody (CoC) form is present and properly signed. Inspect to determine if any problems were noted with the form, by the laboratory, upon receipt of the samples. Problems, which cast doubt on the identity of certain samples, will result in an automatic rejection of those samples from the same cooler, unless all sample results appear below detection limits.
2. Preservation. Determine if cooler receipt form is present and signed by the laboratory. Determine if sample is preserved and sample integrity has been maintained according to the QAPP. Samples which were improperly preserved may be rejected. Qualify as estimated (J code) any samples requiring cooling as part of their preservation whose temperature was in the range of 6-9 °C.
3. Requested Analysis. Determine if the CoC-requested analyses were performed.
4. Holding Times. Determine if extraction and analysis holding times for samples were met. If a holding time is missed, then samples will be rejected.
5. Blanks. For aqueous volatile organic samples, make sure that an associated trip blank was present and analyzed in the same manner as the samples. Field sample results will be qualified as undetected (U) if the concentration in the sample is less than five times the concentration in the associated laboratory method blank, instrument blank, rinsate blank, or trip blank, with the detection limit reported the same as the analytical result. For common laboratory compounds such as methylene chloride, acetone, 2-butanone, and common phthalate esters (or additional / different contaminants as indicated from laboratory's data), a result will be qualified as described above, if the sample concentration is less than ten times the concentration in the laboratory blank, with the detection limit reported as the analytical result for that sample. Analytical results above these limits will be reported as is. Alteration of sample analytical results due to blank concentrations is not permissible.
6. Review LCS / LCSD percent recoveries and relative percent differences (RPD). The LCS and LCSD should contain only the analytes used for the matrix spikes or the analytes of interest for the site. If outside of accuracy and precision limits set by the laboratory (below LCL (lower control

limit) or above UCL (upper control limit), then reject data for that batch. If MS / MSD criteria are met and the LCS / LCSD are not, the analytical data for that sample (with the MS / MSD results) only is acceptable.

7. Review blind field quality control (QC) duplicates. The degree of agreement between these duplicates is to be used in conjunction with all of the remaining quality control results as an aid in the decision of the overall quality of the data. Data are not to be qualified due to QC duplicates alone. To determine the level of agreement between the duplicates, the following guidelines have been established:
 - a. For all analyses in water matrices, data should be considered in agreement if results are within a factor of two of each other. Data between a factor of two and three of each other should be considered as a minor discrepancy, and data greater than a factor of three should be considered a major discrepancy.
 - b. For soil analyses, data should be considered in agreement if results are within a factor of four of each other. Data between a factor of four and five of each other should be considered as a minor discrepancy, and data greater than a factor of five should be considered a major discrepancy. Note that the comparison criterion for soil samples is based on samples homogenized in the field.
8. Review surrogate results. Recoveries in each field sample and laboratory QC sample will be examined to see if they are within acceptable range. For surrogates <LCL or >UCL for which corrective actions have been performed, the associated analytes in that sample will be "J" qualified, if:
 - a. Two base / neutral, two acid-extractable, or two pesticide / PCB surrogates are outside above criteria in a SVOC sample
 - b. One surrogate from any other organic sample is outside above criteria

If no required corrective actions have been performed, the corresponding sample(s) will be rejected. If surrogate recoveries, as described in this section "Organic Data Evaluation", "Review surrogate results", are equal to or less than 10%, sample results will be rejected (R).

9. Review the matrix spike / matrix spike duplicates (MS / MSD). If the recovery and / or RPD values are out of range and corrective actions solved the problem, all data generated under the corrected conditions can be accepted without qualification. If the recovery and / or RPD values

are out of range and corrective actions did not solve the problem, then sample results should at least be flagged as estimated (J). If corrective actions were not taken, sample results should be rejected for associated analytes in the batch.

10. Examine sample quantitation limits to determine if project-required quantitation limits are met. Make note if out of range. Laboratory must supply cause(s) as to why QLs are above criteria. If causes are uncorrectable, no further action is necessary. If correctable (such as sample cleanup as recommended in the method, or running undiluted samples), resampling and reanalysis may be required.
11. When available, the data comparison tables in the QAR (Quality Assurance Report from MR lab) are checked for comparability of the QA splits with the contractor's samples. Discrepancies are judged in the same manner as the blind duplicates (see par. 7 in this section).

If the QAR is not available and a data judgement must be made, the QA analytical results (this is not the QAR) should be matched with the contractor's corresponding sample. If sample numbers don't match, the contractor should be contacted for the matching sample numbers.

12. For situations where an obvious judgement on data quality cannot be made, the following minimum alternatives could be used:
 - a. Ask the lab for additional data, such as chromatograms, calibration curves, etc. needed for the decision. The SOW normally states that such a request can be made. If the SOW has no such statement, rely on the lab's spirit of cooperation to get the needed information.
 - b. For questions where one of the questionable data points includes a sample which was split to the QA lab, the QA lab should be requested to contact the primary (QC) lab. The project chemist should be part of the discussion between the contractor lab and the QA lab.

Inorganic Data Evaluation

Refer to Inorganic Data Evaluation Checklist and Attached QC Tables.

A. Graphite Furnace and Cold Vapor 7000 Series Methods

Follow steps 1 through 4 in the Organic Data Review section.

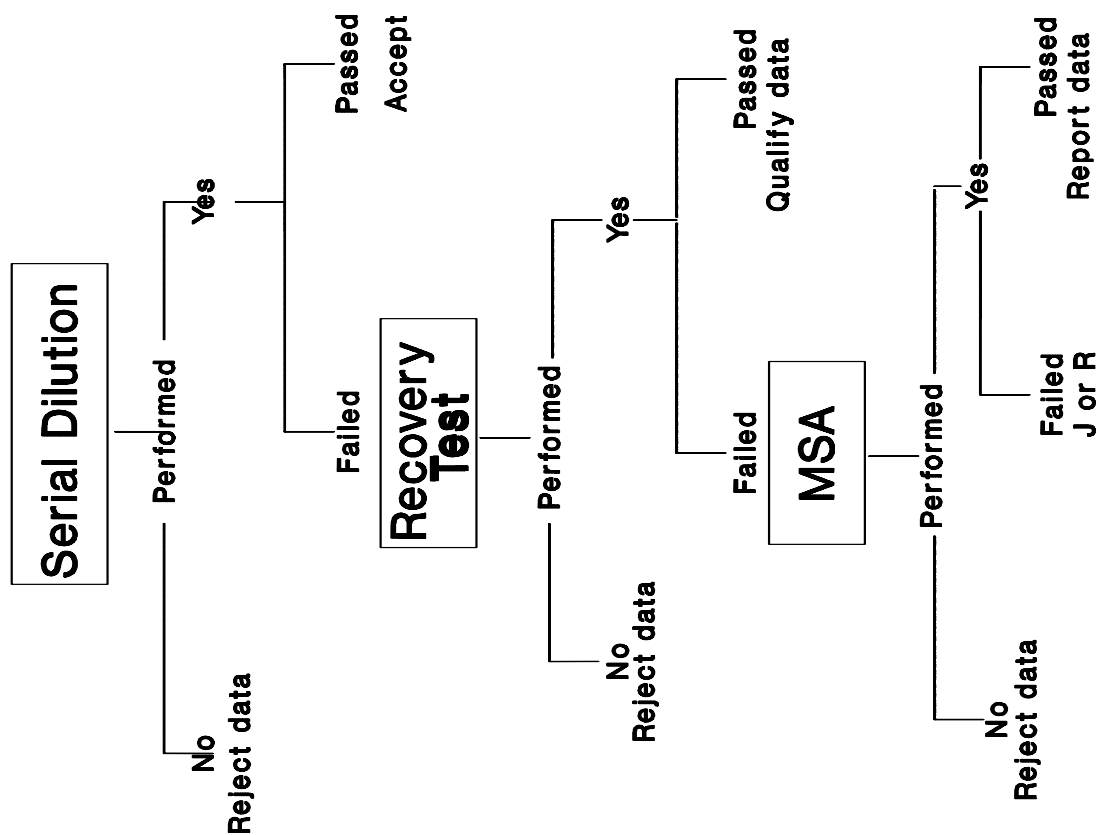
5. Review LCS (and LCSD percent recovery if available). If outside of accuracy limits, reject data for the corresponding analytes in that batch. If MS is within criteria, accept that analyte for only that sample in the batch.
6. Blanks. Field sample results will be qualified as undetected (U) if the concentration in the sample is less than five times the concentration in the associated laboratory method blank, instrument blank, reagent, calibration, or rinsate blank with the detection limit reported numerically equal to the analytical result. Analytical results above these limits will be reported as is. Alteration of sample analytical results due to blank concentrations is not permissible.
7. Review blind field quality control (QC) duplicates. The degree of agreement between these duplicates is to be used in conjunction with all of the remaining quality control results as an aid in the decision as to the overall quality of the data. Data are not to be qualified due to QC duplicates alone. To determine the level of agreement between the duplicates, the following guidelines have been established:
 - a. For all analyses in a water matrix and analysis in soil, data should be considered in agreement if results are within a factor to two of each other.
 - b. Data between a factor of two and three of each other should be considered as a minor discrepancy and data greater than a factor of three should be considered a major discrepancy.
 - c. Note that the comparison criteria for soil samples are based on samples homogenized in the field.
8. Review matrix spike / matrix duplicate (MS / MD) data. If the recovery is outside criteria all corresponding analytes are qualified as at least "J" if corrective actions have been taken but recovery is still outside criteria; otherwise data are rejected (see attached tables).

9. Examine sample method detection limits to determine if project required method detection limits are being met. Make note if out-of-range. Laboratory must supply cause(s) as to why QLs are above criteria. If causes are uncorrectable, no further action necessary. If correctable (such as sample cleanup, as recommended in method), reanalysis and, possibly resampling and reanalysis are required.
10. Interference Tests. Serial dilution (SD), recovery test, and method of standard additions (MSA) are all inter-related. The flow chart in Figure 1 indicates under which circumstances the data should be rejected, qualified as estimated, or accepted without qualification. If the QAPP provides an acceptable equivalent to the interference tests described in the next section, the methods of evaluating the substituted test(s) will be determined at that time.

If %D between diluted value and the original value is $>\sqrt{10}\%$, recovery test and / or MSA (Method of Standard Additions) must meet criteria. Accept data with qualification if recovery test or MSA meets criteria. If one or both of these procedures fail criteria, professional judgement will be used based on the extent of the failure(s). Generally, if MS (matrix spike) is acceptable, the analyte(s) for all other samples in the batch are acceptable and professional judgement is required only on the sample that failed the serial dilution. If MS also failed for the analyte(s), said analyte(s) will be rejected for all samples in that batch. If procedures were not run, results for that analyte are rejected for that batch. This, and the following two steps, describes what the chart is stating.

- a. Serial Dilution. Should be run on sample which will theoretically be 5 times above method detection limit after a 5-fold dilution.
- b. Recovery Test. Should be run only on sample that either failed dilution test or on samples where the dilution test is not applicable¹, after sample is spiked at approximately 5 times the original concentration or 20 times the MDL. If not run and MSA not run, analyte(s) will be rejected for that batch. Percent recovery should be $>85\%$ AND $<115\%$ for results to be acceptable.

¹ Seldom will a single sample contain all the metals of concern at 5 X detection level or above. Therefore, although the dilution test was conducted, it was not applicable for those metals. Regardless, recovery test should be run on that sample for those metals.



- c. Method of Standard Additions. If MSA run and met criteria, results of the MSA will be given as the analytical result with no qualification. If recovery test passes, result for that analyte will be "J" qualified for all samples in that batch. If this test is run because of failure of serial dilution and / or recovery test, MSA failure will call for professional judgement based in the magnitude of the failures. No further corrective action necessary.
- 11. If the reviewer suspects instrument calibration errors, then calibration information should be reviewed in-depth. Consult QAPP for details of review. Acceptability of data should be reconsidered if uncorrected calibration errors occurred.
- B. Inductively Coupled Argon Plasma - Method 6010
- Follow steps 1 to 4 in sec. A of the Inorganic Data Review.
- 5. Blanks. See Inorganics Data Review, sec. A.6.
 - 6. Review blind field quality control and lab duplicates. See Inorganics Data Review, sec. A.7.
 - 7. Review matrix spike / matrix duplicate (MS / MD) data. If the recovery is outside criteria, all corresponding analytes are qualified as "J" if corrective actions have been taken; otherwise data are rejected (see attached tables).
 - 8. Examine sample detection limits to determine if project-required quantitation limits are met. Make note if out of range. Laboratory must supply cause(s) as to why QLs are above criteria. If causes are uncorrectable, no further action necessary. If correctable (such as sample cleanup as recommended in method), reanalysis and possibly resampling and reanalysis are required.
 - 9. Serial Dilution. If interference is suspected and the five-fold dilution analysis result is $> \sqrt{10}\%$ of the original determination, data for that analyte in that sample only is qualified as estimated or rejected, depending on the extent of the deviation, and the acceptability of the matrix spike for the same analyte(s). If matrix spike was acceptable (recoveries in the range 75% to 125%) and run on the same sample as the serial dilution, the sample result will be qualified as estimated (J). If matrix spike was outside as well (whether or not MS run on the same sample), the affected analyte(s) will be rejected for all samples in that batch or qualified as estimated (J), if corrective action is taken, but is still outside criteria. Although not required by the method, an MSA is highly recommended.

Should an MSA be present, the flow chart on the previous page will be followed.

10. Intra-element Correction Factors and Interference Check Sample Requirements. If serious interference is suspected, calibration information (ICV, CCV, ICSA, ICSB, etc.) should be reviewed in depth. Contact the laboratory for additional information.

Miscellaneous Methods

As seen in the Organic Data Evaluation Checklist table, there is a large selection of methods that could possibly be used on any site. Though the selection is large, it still will not cover all methods that may be used by USACE. The data evaluation will follow the preceding guidances when similar quality controls are required from the method.

Organic Data Evaluation Checklist

Project Name	
Project Cost Key	
Site	
Laboratory	
Laboratory Report Number	
Analysis Type	
Sample Matrix	
Date Review Initiated / USACE Chemist's Initials	
Date Review Completed / USACE Chemist's Initials	

Review Item	NA	Reviewed	Qualified	Comments
Chain-of-Custody				
Cooler Receipt Form—Sample Temperature / Preservation				
Requested Analyses Completed				
Holding Times				
Trip Blanks				
LCS Results				
Method Blanks				
Equipment Rinsate Blanks				
Field Duplicates				
Surrogates				
MS / MSD REC Results				
MS / MSD RPD Results				
Project Quantitation Limits				

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Inorganic Data Evaluation Checklist

Project Name	
Project Cost Key	
Site	
Laboratory	
Laboratory Report Number	
Analysis Type	
Sample Matrix	
Date Review Initiated / USACE Chemist's Initials	
Date Review Completed / USACE Chemist's Initials	

Review Item	NA	Reviewed	Qualified	Comments
Chain-of-Custody				
Cooler Receipt Form—Sample Temperature / Preservation				
Requested Analyses Completed				
Holding Times				
LCS Results				
Method Blanks				
Equipment Rinsate Blanks				
Field Duplicates				
MS / MD REC Results				
MS / MD RPD Results				
Project Quantitation Limits				

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SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 160.1 160.2	Total Suspended Solids	FIELD QC: Duplicate	1 for every 10 field samples collected	% RPD # 35%	Review lab QC data to determine if they are in control. If not, qualify data. Use data to evaluate proper collection procedures were followed. If not, determine further corrective action.
	Total Dissolved Solids	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		LABORATORY QC: Calibration of the instrument	According to the instrument service manual	All measures must be accurate.	Check balance maintenance, qualify data.
		Method Blank	1 per batch of 20 samples	Less than reported detection limits	Reanalyze all samples greater than MDL but less than 10x blank concentration.
		Duplicates	1 per batch of 20 samples	RPD # 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a.b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 7060A 7421 7471A 7740 7841 7041	Total Arsenic	<u>FIELD QC:</u>			
	Total Lead	Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
	Total Mercury				Qualify data.
	Total Selenium				
	Total Thallium				
	Total Antimony	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		ICV / CCV	ICV - prior to analysis CCV - after every 10 samples or end of analytical batch, whichever is more frequent. *	Initial calibration each day - 3 stds plus blank. Verification measured value within 10% of true value using 1 blank & 1 mid-range. If samples >10, CCV within 20% of true.	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
		ICB / CCB	ICB - after initial calibration verification CCB - after every 10 samples or end of analytical batch, whichever is more frequent. *	Absolute value < PQL	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
		Method Blank	1 per batch of samples, minimum of 1 per 20 samples	Absolute value < PQL *	Redigest and reanalyze all samples less than 10X the PQL.*
		Matrix Spike	1 per batch of samples, minimum of 1 per 20 samples	75-125% recovery (unless sample conc. is greater than 4x spike concentration). Spike 5X above background at minimum.	Determine cause, then respike.* If uncorrectable, correct for bias if recovery is <80%.
		Matrix Spike Duplicate	1 per batch of samples, minimum of 1 per 20 samples	20% RPD for samples greater than 5x PQL; if < 5x PQL, absolute difference between samples must be < PQL; no criteria if < PQL; (for Hg, RPD = 25% for aqueous samples and 35% for solid samples). *	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		LCS	1 per batch of samples, minimum of 1 per 20 samples.	75-125% recovery: waters Manufacturer's Limits: soil / sed. *	Rerun. If still out of control, solve problem and reanalyze batch.
		Serial Dilution	1 per batch of samples, minimum 1 per 20 samples (for ICP only)	Diluted values must be < 10% of the original value	Perform recovery test (see below)
		Recovery Test	When results from dilution test fail. Test is run on the failed sample.	85-115% recovery	Run Method of Standard Additions (MSA)
		MSA	For each analyte where matrix interference is suspected or when recovery test fails	Slope within 20% of standard curve.	Qualify all associated data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a.b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 6010A Inductively Coupled Argon Plasma (ICAP)	Total Metals	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Qualify data.
		<u>LABORATORY QC:</u>			
		Initial (ICV) and Continuing (CCV) Calibration Verification	ICV - prior to sample analysis and reanalysis of high standard. CCV - after every 10 samples and end of analytical batch	ICV - 4 pt. calibration (3 STDs and a blank); high standard within 5% of true value. CCV - midpoint range standard within 10% of true value.	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
		High Mixed Calibration Standard	Before beginning of sample run	Agree within 10% of expected value	Follow recommendation of inst. manufacturer
		Continuing (CCB) Calibration Blank	CCB - after every 10 samples and end of analytical batch	Agree within $\sqrt{3}\sigma$ of mean blank value	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.*
		Method Blank	1 per batch of samples, minimum 1 per 20 samples	Absolute value # PQL*	Redigest and reanalyze all samples greater than the PQL but less than 10x the blank concentration.
		Serial Dilution	First encounter of new or unusual matrix	1:4 dilution agree within $\sqrt{10}\%$ of original determination.	Flag as chemical or physical interference.
		Matrix Spike	1 per batch of samples, minimum 1 per 20 samples	75-125% recover (unless sample is greater than 4x spike concentration). Minimum 10X detection limit.	Determine cause (if possible), correct, and respike. If cause cannot be determined, flag.
		Duplicate	1 per batch of samples, minimum 1 per 20 samples	20% RPD for samples greater than 5x PQL; if 5x PQL absolute difference between samples must be < PQL; no criteria if < PQL*	Determine cause (if possible), correct, and respike. If cause cannot be determined, flag..
		Interference Check	Beginning and end of run or per 8 hour shift	80-120% recovery	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good ICS.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 9012	Cyanide	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		ICV / CCV	ICV - prior to sample analysis CCV - after every 10 samples and end of analytical batch	5 pt. calibration: Measured value within 15% of true value. Coefficient of correlation > 0.995	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCV.
		ICB / CCB	ICB - after initial calibration verification CCB - after every 10 samples and end of analytical batch	Absolute value # MDL	Terminate analysis, solve problem, recalibrate and reanalyze samples analyzed since last good CCB.
		Prep Blank	1 per batch of samples, minimum 1 per 20 samples	Absolute value # MDL	Redigest and reanalyze all samples greater than the MDL but less than 10x the blank concentration.
		Spike	1 per batch of samples, minimum 1 per 20 samples	75-125% recovery (unless sample is greater than 4x spike concentration).	Perform a post-digestion spike and qualify data appropriately.
		Duplicate	1 per batch of samples, minimum 1 per 20 samples	20% RPD for samples greater than 5x MDL; if < 5x MDL, absolute difference between samples must be < MDL; no criteria if < MDL	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		LCS	1 per batch of samples, minimum 1 per 20 samples	80-120% recovery: waters Manufacturer's Limits: soil / sed.	Rerun. If still out of control, solve problem and reanalyze batch. (Not applicable to mercury according to EPA Region II guidelines)

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 130.2	Hardness	<u>FIELD QC:</u>			
		Duplicates	1 for every 10 field samples collected	% RPD # 25%	Review lab QC data to determine if they are in control. If not, qualify data. Use data to evaluate proper collection procedures were followed. If not, determine further corrective action.
		Rinsates (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Standardization of standards and reagents	At the beginning and end of the sample run	Standards must be ∇ 1.0% of the true value.	Check standards and reagents and prepare new if necessary.
		Method Blank	1 per batch of 20 samples	Less than reported detection limits	Reanalyze all samples greater than MDL but less than 10x blank concentration.
		Duplicate	1 per batch of 20 samples	% RPD # 20%	Qualify data.
		Matrix Spike	1 per batch of 20 samples	See laboratory control limits	Reanalyze, qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 9310	Gross Alpha and Gross Beta	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u> Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
		Duplicate	1 for every 20 samples or extraction batch	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data.
		LCS	1 for every 20 samples or extraction batch	Within current control limits established by the laboratory	Rerun samples. If still out of control, reanalyze samples. Qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 7196	Chromium, Hexavalent	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u> Method Blank	MS / MSD Continuing Calibration	1 for every 10 samples or extraction batch	Less than reporting detection limit	Document and report to client.
			1 for every 10 samples	See Appendix M for control limits	Document and report to client.
			1 for every 15 samples	Within current control limits	Terminate analysis, solve problem. Recalibrate and reanalyze samples analyzed from last good continuing calibration.
					Terminate analysis, solve problem.
	LCS / LCS/D Duplicate		1 for every 10 samples	80-120% Recovery, RPD # 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
			1 for every 10 samples	Above 10x detection limit, % RPD must be less than the control limits: Aqueous samples - RPD # 30% Non-aqueous samples - RPD # 40%	

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
NYS-DOH: APC 44	Glycols	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	% RPD must be # 25%	Review lab QC data to determine if they are in control. If not, qualify data. Use data to evaluate proper collection procedures were followed. If not, determine further corrective action.
		Rinsates (c)	1 for every 10 field samples collected	Less than reported method detection limits	Qualify data.
	<u>LABORATORY QC:</u>				
		Initial Calibration	At the beginning of the run	3 pt. calibration; Coefficient of correlation must be # 0.995	Terminate analysis, solve problem. Recalibrate and reanalyze samples.
		Continuing Calibration	After every 10 samples	Results must be $\geq$ 10% of the true value	Terminate analysis, solve problem. Recalibrate and reanalyze samples analyzed from last good continuing calibration.
		Preparation Blank	1 per batch of samples, minimum 1 per 20 samples	Value must be less than reported detection limit.	Reanalyze all samples greater than MDL but less than 10x blank concentration.
		MS / MSD	1 per batch of samples, minimum 1 per 20 samples	Recovery must be 75-125% % RPD must be # 20%	Rerun. If still out of control, reanalyze. Qualify data.
		Duplicate	1 per batch of samples, minimum 1 per 20 samples	Recovery must be 75-125% % RPD must be # 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a.b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8140	Organo-phosphorus Pesticides	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>	Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; the average response factor can be used if %RSD is # 20% or use a calibration curve	Recalibrate instrument.
		Continuing Calibration	Daily	CCC's response factor # 15% difference from the midpoint standard	Rerun continuing calibration. If still out of control, recalibrate instrument.
		Method Blank	One per extraction batch	Compounds must be below respective PQLs	Reextract batch.
	MS / MSD	Surrogate Spike	All blanks, standards, QC samples, field samples	1,3-dimethyl-2-nitrobenzene Waters: 60-120 Soils: 50-120	Reextract that sample.
			1 per every 20 samples	See method for control limits.	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		LCS	1 per every 20 samples	See method for control limits.	Reextract batch.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8150	Herbicides	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>				
		Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; the average response factor can be used if %RSD is # 20% or use a calibration curve	Recalibrate instrument.
		Continuing Calibration	Daily	CCC's response factor # 15% difference from the midpoint standard	Rerun continuing calibration. If still out of control, recalibrate instrument.
		Method Blank	One per extraction batch	Compounds must be below respective PQLs	Reextract batch.
		Surrogate Spike	All blanks, standards, QC samples, field samples	2,4-dichlorophenyl acetic acid (DCAA) Waters: 60-120 Soils: 50-120	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		MS / MSD	1 per every 20 samples	See laboratory limits.	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		LCS	1 per every 20 samples	See laboratory limits.	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8080A	Pesticides / PCBs	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected 5% (wipe samples)	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limit	Qualify data.
		Field Blanks	(wipe samples only) 2 from each category	Less than reported detection limit	Qualify data.
	<u>LABORATORY QC:</u> Initial Calibration		Prior to analysis and when continuing calibration fails criteria	5 pt. calibration: the average response factor can be used if %RSD is # 20% or use a calibration curve	Recalibrate instrument.
		Continuing Calibration	Daily and after every 10 samples	Response factor # 15% difference from midpoint standard	Rerun continuing calibration. If still out of control, recalibrate instrument.
		Endrin and DDT Breakdown	Each initial calibration	Must not exceed 20%	Reanalyze breakdown standard. If still out of control, clean injection port, change septae, replace first few inches of packing in column.
	Combined Endrin and DDT Breakdown		Each initial calibration	Must not exceed 30%	Reanalyze breakdown standard. If still out of control, clean injection port, change septae, replace first few inches of packing in column.
		Method Blank	1 for every 20 samples or extraction batch	Less than PQL	Reanalyze blank. If second blank exceeds criteria, clean analytical system. Qualify the data.
		Surrogate Recovery	Every sample	See Table 3 and 4 in method	Rerun sample. If still out of control, reextract, reanalyze, qualify data.
	MS / MSD		1 for every 20 samples	See Table 3 and 4 in method	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		LCS	1 for every 20 samples	See Table 3 and 4 in method	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8260A	Volatile Organic Compounds	<u>FIELD QC:</u> Trip Blank	1 for each batch of samples shipped to laboratory	No more than 4 target compounds, each with a concentration exceeding 3 times the method detection limit can be present.	Review lab QC data to determine if there is a laboratory problem. If not, and same compounds are found in field samples at similar concentrations, resample entire batch.
		Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 30% Non-aqueous samples - RPD < 40%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported PQL	Qualify data.
		<u>LABORATORY QC:</u> Hardware tune with BFB	At beginning of analytical sequence and every 12 hours of operation thereafter	Ion abundance criteria, see method	Tune instrument; repeat.
		Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration: SPCCs ≤ 0.300 ; 1,1,2,2-TCA ≤ 0.200 ; bromoform ≤ 0.100 . RSD <30% for RF for CCCs.	Recalibrate instrument.
	Continuing Calibration		Every 12 hours of operation	SPCCs ≤ 0.300 , except 1,1,2,2-TCA ≤ 0.200 & bromoform ≤ 0.100 . RSD <25% FOR avg RF for CCCs.	Rerun continuing calibration. If still out of control, recalibrate instrument.
	Method Blank		1 for every 20 samples or every day	Less than PQL	Call AE chemist for further evaluation or, Reanalyze blank. If contamination still exists, qualify all associated data.
	Surrogate Recovery		Every sample	See Method	1. Check for errors during analysis. If found, recalculate. 2. Check instrument performance. Correct problem and reanalyze. 3. If no problem found, re-extract and re-analyze sample. If problem persists, flag data.
	MS / MSD		1 for every 20 samples	See Method	Analyze LCS. If more than 30% of either MS or MSD is outside tolerance, perform corrective actions as detailed above. Call AE chemist for guidance.
	LCS		1 for every 20 samples	See Method	Reanalyze LCS. If out, correct problem. If problem cannot be corrected, reject data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8100	Polynuclear Aromatic Hydrocarbons	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 30%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. Qualify data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	
		<u>LABORATORY QC:</u> Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration; % RSD must be < 20 % for all analytes	
	Continuing Calibration	Continuing Calibration	Daily	Response factor must be < 15% from average of initial calibration	Recalibrate instrument. Rerun continuing calibration. If still out of control, recalibrate instrument.
		Method Blank	Daily	Compounds must be below respective detection limits	Step 1: Reanalyze Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		Surrogate Spike	All blanks, standards, QC samples, field samples	See Appendix M for current control limits	Step 1: Reanalyze Step 2: If recovery still outside control limits, re-extract and reanalyze.
	MS / MSD		1 per every 20 samples	See Appendix M for current control limits	Rerun samples. If still out of control, qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8040	Phenols	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 30%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>	Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration, % RSD must be < 20% for all analytes	Recalibrate instrument.
		Continuing Calibration	Each day of operation	Response factor must be < 15% from average of initial calibration	Rerun continuing calibration. If still out of control, recalibrate instrument.
		Method Blank	Each day of operation	Compounds must be below respective detection limits	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		Surrogate Spike	All blanks, standards, QC samples, field samples	See Appendix M for current control limits	Step 1: Reanalyze. Step 2: If recovery still outside control limits, re-extract and reanalyze.
	MS / MSD		1 per every 20 samples	See Appendix M for current control limits	Rerun samples. If still out of control, qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8270B GC / MS	Base / Neutral / Acid Extractable Organics	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	Above 10x detection limit, % RPD must be less than current control limits: Aqueous samples - RPD < 20% Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples collected	Less than reporting limit	Qualify data.
		<u>LABORATORY QC:</u>			
		Sensitivity Check with DFTTP	At beginning of each analytical run & beginning of each 12 hr period	Ion abundance criteria; see method	Tune instrument; repeat. If cannot be corrected, reject data.
		Mass Calibration*	Every 24 hours & at beginning of each analytical sequence	See Method SW846	Tune instrument; repeat.
		Initial Calibration	Before analysis and when continuing calibration fails criteria	5 pt. calibration; SPCCs exceed 0.050; CCCs response factor deviates < 30% from average	Correct problem (inj. liner, column). Recalibrate instrument. Reject if problem not solved.
		Continuing Calibration	Every 12 hours of operation	SPCCs 0.050; CCCs; 30% from standard concentration. RT of IS; 30 sec over 12 hours & EICP area changes within -50% to +100%.	Correct problem and rerun continuing calibration; if still out of control, recalibrate instrument. Reanalyze samples. Reject if problem not solved.
		Method Blank	1 for every 20 samples or extraction batch	Less than PQL. Phthalate esters less than 5x the reporting limit.*	Reanalyze blank, then reextract if necessary if holding time and sample volume allows. Qualify all associated data. If HT and sample volume precludes reanalysis, contact AE chemist.
		Surrogate Recovery	Every sample	See Method. Recovery for at least 2 of 3 acid surrogates and at least 2 of 3 BN surrogates must be within tolerance.	Call A-E chemist, or 1. Check calculations & instrument performance 2. If problem found, correct and recalculate and / or reanalyze extract. 3. If problem not found, re-extract & re-analyze sample. 4. If still out, flag data as estimated.
		MS / MSD	1 for every 20 samples	See Method	Run LCS. If LCS not within Table 6, see below. If LCS is good, and assignable, cause is found for poor MS / MSD, correct and redo MS / MSD (see text). * Otherwise, flag data.
	LCS		1 for every 20 samples or extraction batch	See Method	Reextract batch if MS / MSD also out of control.*

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 120.1	Specific Conductance	<u>INSTRUMENT QC:</u> Calibration	Prior to trip	✓ 25 umhos / cm	1. Check system as per manufacturer's instructions. 2. Check standard. 3. Replace instrument.
		Calibration Stability	At beginning and end of day	✓ 25 umhos / cm	1. Check standard. 2. Check system as per manufacturer's instructions. 3. Replace instrument.
		<u>SAMPLE QC:</u> Duplicate	1 per day	✓ 50 units	1. Analyze 3rd aliquot of sample. 2. Flag Data.
		Rinsate (c)	1 per day	# detection limit	Flag Data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 150.1	pH	<u>INSTRUMENT QC:</u> Calibration	1 per day at two levels	✓ 0.1 units	1. Check system as per manufacturer's instructions. 2. Check standard. 3. Replace instrument.
		Calibration Stability	1 per hour at two levels	✓ 0.2 units	1. Check standard. 2. Check system. 3. Recalibrate.
		<u>SAMPLE QC:</u> Duplicate	1 per day	✓ 0.5 units	1. Analyze 3rd aliquot of sample 2. Flag data.
	Rinsate (c)		1 per day	# detection limit	Flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 180.1	Turbidity	<u>INSTRUMENT QC:</u> Calibration	1 per day	✓ 25 NTU	Check system as per manufacturer's instructions. Check standards. Replace Instrument.
		Calibration Stability	1 per hour	✓ 25 NTU	Check standards. Check system as per manufacturer's instructions. Recalibrate.
		<u>SAMPLE QC:</u> Duplicate	1 per day	✓ 50 NTU	1. Analyze 3rd aliquot of sample. 2. Flag data.
	Rinsate (c)				
			1 per day	# detection limit	Flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 9060	TOC	<u>FIELD QC:</u>			
		Duplicate	Every 20 samples	RPD: <35%	Flag data.
		Rinsate (c)	Every 20 samples	# detection limit	Flag data.
		<u>LABORATORY QC:</u>			
	Calibration	Calibration	At start of analysis	see method	1. Check standard solution. 2. Check system as per manufacturer's instructions. 3. Perform appropriate instrument maintenance.
		Calibration Stability	At end of analysis	√ 1 mg / L	1. Check standard solution. 2. Check system. 3. Recalibrate and reanalyze samples.
	Method Blank	Method Blank	1 per batch of samples analyzed together, minimum 1 per 20 samples	# 3x detection limit	1. Check system. 2. Check blank. 3. Flag data.
			Minimum 1 per 20 field samples	RPD: <30%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
	Duplicate	Duplicate			

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 600 4-83-043	Asbestos	<u>FIELD QC:</u>			
		QC Sample	1 for every 20 field samples	No significant difference (detect vs. non-detect, different type of asbestos) from reference sample	Reject sample and reinspect / retest corresponding area.
		<u>LABORATORY QC:</u>			
		Duplicate	1 for every 20 samples	2 analysts identify sample with no significant difference	Review by Senior Engineer and both analysts.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 906.0	Tritium	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
		Duplicate	1 for every 20 samples or extraction batch	Above 10x detection limit, % RPD must be less than current control limits established by the laboratory	Review lab QC data to determine if they are in control. If not in control, flag data.
		LCS	1 for every 20 samples or extraction batch	Within current control limits established by the laboratory	Rerun samples. If still out of control, reanalyze samples. Qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
ANL-Eichrom	Strontium-90	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
		Duplicate	1 for every 20 samples or extraction batch	Above 10x detection limit, % RPD must be less than current control limits established by the laboratory	Review lab QC data to determine if they are in control. If not in control, flag data.
		LCS	1 for every 20 samples or extraction batch	Within current control limits established by the laboratory	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 903.1	Radium-226	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
		Duplicate	1 for every 20 samples or extraction batch	Above 10x detection limit, % RPD must be less than current control limits established by the laboratory	Review lab QC data to determine if they are in control. If not in control, flag data.
		LCS	1 for every 20 samples or extraction batch	Within current control limits established by the laboratory	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 901.1	Gamma-emitting Radionuclides	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u> Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
		Duplicate	1 for every 20 samples or extraction batch	Above 10x detection limit, % RPD must be less than current control limits established by the laboratory	Review lab QC data to determine if they are in control. If not in control, flag data.
		LCS	1 for every 20 samples or extraction batch	Within current control limits established by the laboratory	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 904.0	Radium-228	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
		Duplicate	1 for every 20 samples or extraction batch	Above 10x detection limit, % RPD must be less than current control limits established by the laboratory	Review lab QC data to determine if they are in control. If not in control, flag data.
		LCS	1 for every 20 samples or extraction batch	Within current control limits established by the laboratory	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 908.0	Total Uranium	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples	Above 10x detection limit, % RPD must be less than current control limits	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Method Blank	1 for every 20 samples or extraction batch	Less than reporting detection limit	Document and report to client.
		Duplicate	1 for every 20 samples or extraction batch	Above 10x detection limit, % RPD must be less than current control limits established by the laboratory	Review lab QC data to determine if they are in control. If not in control, flag data.
		LCS	1 for every 20 samples or extraction batch	Within current control limits established by the laboratory	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 350.2	Ammonia Nitrogen	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples	The % RPD must be < 20	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u> Method Blank	1 for every 20 samples or extraction batch	Less than reported detection limit	Document and report to client.
		Lab Duplicate	1 for every 20 samples	RPD must be < 20	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		Calibration	Prior to analytical run	Coefficient of correlation must be > 0.995	Check standard solutions. Qualify data.
		Continuing Calibration	1 per 10 sample and at the end of the run	∇ 0.10 mg / L	Check standard solutions. Recalibrate. Reanalyze affected samples. Qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 340.1	Total Fluoride	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples	RPD: <20%	Flag data
		Rinsate (c)	One for every 10 field samples	# detection limit	Flag data
		<u>LABORATORY QC:</u>			
		Calibration	At start of analysis	Coefficient of correlation must be > 0.995	1) Check standard solution 2) Prepare standard again
		Calibration Stability	Every 10 samples and at end of analysis	∇ 1 mg / L	1) Check standard solution 2) Recalibrate and reanalyze samples
		Method Blank	1 per batch of samples analyzed together, minimum 1 per 20 field samples	# detection limit	1) Check blank 2) Flag data
	Duplicate		Minimum 1 per 20 field samples	RPD: <20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 425.1	Linear Alkyl Benzene Sulfonate	<u>FIELD QC:</u> Duplicate	See Table 5-1	RPD: <20%	Flag data
		Rinsate (c)	See Table 5-1	# detection limit	Flag data
		<u>LABORATORY QC:</u>			
		Calibration	At start of analysis	Coefficient of correlation must be > 0.995	1) Check standard solution 2) Prepare standard again
		Calibration Stability	Every 10 samples and at end of analysis	✓ 1 mg / L	1) Check standard solution 2) Recalibrate and reanalyze samples
		Method Blank	1 per batch of samples analyzed together, minimum 1 per 20 field samples	# detection limit	1) Check blank 2) Flag data
		Duplicate	Minimum 1 per 20 field samples	RPD: <20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 300.0	Nitrate / Sulfate	<u>FIELD QC:</u>			
		Duplicate	See Table 5-1	RPD: <20%	Flag data
		Rinsate (c)	See Table 5-1	# detection limit	Flag data
		<u>LABORATORY QC:</u>			
		Calibration	At start of analysis	Coefficient of correlation must be > 0.995	1) Check standard solution 2) Prepare standard again
		Calibration Stability	Every 10 samples and at end of analysis	✓ 1 mg / L	1) Check standard solution 2) Recalibrate and reanalyze samples
		Method Blank	1 per batch of samples analyzed together, minimum 1 per 20 field samples	# detection limit	1) Check blank 2) Flag data
	Duplicate		Minimum 1 per 20 field samples	RPD: <20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 377.1	Sulfite	<u>FIELD QC:</u>			
		Duplicate	See Table 5-1	RPD: 20%	Flag data
		Rinsate (c)	See Table 5-1	# detection limit	Flag data
		<u>LABORATORY QC:</u>			
		Calibration	At start of analysis	Coefficient of correlation must be > 0.995	1) Check standard solution 2) Prepare standard again
		Calibration Stability	Every 10 samples and at end of analysis	✓ 1 mg / L	1) Check standard solution 2) Recalibrate and reanalyze samples
		Method Blank	1 per batch of samples analyzed together, minimum 1 per 20 field samples	# detection limit	1) Check blank 2) Flag data
		Duplicate	Minimum 1 per 20 field samples	RPD: <20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 330.5	Total Residual Chlorine	FIELD QC:			
		Calibration	At start of analysis	Coefficient of correlation must be > 0.995	1) Check standard solution 2) Prepare standard again
		Method Blank	1 per batch of samples analyzed together, minimum 1 per 20 field samples	< detection limit	1) Check blank 2) Flag data
		Duplicate	1 per batch of samples analyzed together, minimum 1 per 20 field samples	RPD: < 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		Rinsate (c)	1 per batch of samples analyzed together, minimum 1 per 20 field samples	# detection limit	Flag data

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 524.2	Purgeable Organic Compounds	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. Qualify data. Qualify data.
		Field Reagent Blank	1 per cooler	Less than reported PQL	
		Rinsate (c)	1 for every 10 field samples collected	Less than reported PQL	
		<u>LABORATORY QC:</u>			
	Continuing Calibration	Initial Calibration	Prior to analysis and when continuing calibration criteria fail	4 pt. calibration; RSD of mean < 20% or 2nd order regression	Recalibrate instrument.
			Every 8 hours of operation	70-130% of true value. Absolute areas of quantitation ions of the internal and surrogate standards must not have decreased by more than 30% from areas in the most recent continuing calibration check or by more than 50% from the areas in the initial calibration.	Run continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	Every 8 hours of operation	Less than reported PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
	Sensitivity Check with BFB Mass Calibration Laboratory Fortified Blank - Full Method Analyte List		Every 8 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
			Every 8 hours of operation	See method	Tune instrument; repeat.
			1 per 20 or 1 per sample set	LFB: 80-120%R Except: 70-130%R on 1,2-dibromo-3-chloropropane Hexachlorobutadiene Naphthalene 1,2,3-Trichloropropane 2,2-Dichloropropane Advisory: 60-140%R on additional special compounds (nonroutine) by 524.2	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 524.2 (Continued)	Purgeable Organic Compounds	Laboratory Fortified Blank Duplicate	Quarterly	RPD < 20%; %R same as LFB	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Surrogate Spike	All blanks, standards, QC samples, field samples	See method for surrogate spiking compounds control limits	Step 1: Reanalyze Step 2: If recovery still outside control limits, qualify the data.
		MS / MSD	1 per every 20 samples	See method for control limits	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a.b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 525.1	Organic Compounds	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per set of field samples	Less than PQL	Qualify data.
		Rinsate (c)	1 for every 10 field samples collected	Less than PQL	Qualify data.
		<u>LABORATORY QC:</u>			
		Initial Calibration	Prior to analysis and when continuing calibration criteria fail	6 pt. calibration: RSD of mean < 30% or use first-degree fit. Anthracene and phenanthrene should be separated by baseline. Benz[a]anthracene and chrysene should be separated by a valley whose height is less than 25% of the average peak height of these two compounds. The GC / MS / DS peak identification software should be able to recognize a GC peak in the appropriate retention time window for each of the compounds in calibration solution, and make correct tentative identifications. Examine a plot of the abundance of m / z 67 in the region of 1.05-1.3 of the retention time of endrin. This is the region of elution of endrin aldehyde, a product of the thermal isomerization of endrin. Confirm that the abundance of m / z 67 at the retention time of endrin aldehyde is <10% of the abundance of m / z 67 produced by endrin.	Recalibrate instrument. If the valley between benz[a]anthracene and chrysene exceeds 25%, the GC column requires maintenance. If more than 10% endrin aldehyde is observed, system maintenance is required to correct the problem.
		Continuing Calibration	Every 8 hours of operation	Response factors deviate < 30% from average of initial calibration. Absolute areas of quantitation ions of the internal and surrogate standards must not have decreased by more than 30% from areas in the most recent continuing calibration check or by more than 50% from the areas in the initial calibration.	Rerun continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	One per 20 samples or extraction batch	Less than PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 525.1 (Continued)	Organic Compounds	QC Check Standard (External Source)	Quarterly	%R = 70-130 RSD < 30%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Sensitivity Check with DFTpp	Every 8 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
		Mass Calibration	Every 8 hours of operation	See method	Tune instrument; repeat.
		Laboratory Fortified Blank - Full Method Analyte List	1 per 20 or 1 per sample set	See method	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action and qualify the data.
		Laboratory Fortified Blank Duplicate	Quarterly	See method	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action and qualify the data.
		Internal Standard	All blanks, QC samples, field samples	Recovery > 70% of standard response	Step 1: Reanalyze. Step 2: If recovery still outside control limits, qualify the data.
	Surrogate Spike		All blanks, standards, QC samples, field samples	See method for surrogate spiking compounds control limits	Step 1: Reanalyze. Step 2: If recovery still outside control limits, qualify the data.
		MS / MSD	1 per every 20 samples	See method or laboratory controls	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a.b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 507	Nitrogen- and Phosphorus-Containing Pesticides by GC / NPD	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	LABORATORY QC:	Field Reagent Blank	1 per cooler	Less than reported detection limits	Qualify data.
		Initial and Continuing Calibration	Prior to analysis and every 8 hours of operation	Single-point calibration (Sect. 9) within 20% of sample response	N / A
		Laboratory Reagent Blank	One per 20 samples or extraction batch	Less than PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
	QC Check Standard (External Source)		Quarterly	%R = 70-130	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action.
		Laboratory Fortified Blank with full method analytes list.	1 per 20 or 1 per sample set (all samples extracted within 24 hours)	See method or laboratory controls	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action and qualify data.
		Surrogate Spike	All blanks, standards, QC samples, field samples	%R = 70-130	Step 1: Reanalyze Step 2: If recovery still outside control limits for samples, qualify the data.
		MS / MSD	1 per every 20 samples or 1 per set	See method or laboratory controls	Reanalyze MS / MSD. If still out of control, qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 549	Diquat / Paraquat HPLC Method	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Qualify data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u> Initial Calibration	Prior to analysis and when continuing calibration criteria fail	3 pt. external standard method calibration - use calibration curve or average RF if %RSD # 20%; or use single-point calibration	Recalibrate instrument.
		Continuing Calibration	Every 8 hours of operation (two standards)	Response factors deviate # 20% from midpoint standard.	Run continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	1 for each set of extracted samples	Less than reported detection limit	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Laboratory Fortified Blank	1 per 20 or 1 per sample set (all samples extracted within 24 hours)	%R Diquat = 58-124 Paraquat = 34-115	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Laboratory Fortified Blank Duplicate	Quarterly	%R Diquat = 58-124 Paraquat = 34-115	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		MS / MSD	1 per every 20 samples	%R = 80-120 %RSD = 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 515.1	Chlorinated Acids and Herbicides by GC / ECD	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Qualify data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		<u>LABORATORY QC:</u>			
		Initial and Continuing Calibration	Prior to analysis and every 8 hours of operation	Single-point calibration (Section 9) within 20% of sample response	Correct problem. Reanalyze all affected samples.
		Laboratory Reagent Blank	One per 20 samples or extraction batch	Less than PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD # 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		Laboratory Fortified Blank - Full Method Analyte List	1 per 20 samples or extraction batch	See method or laboratory controls	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		Surrogate Spike	All blanks, standards, QC samples, field samples	See method or laboratory controls for surrogate spiking compounds control limits	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		MS / MSD	1 per every 20 samples	See method or laboratory controls.	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 504	EDB & DBCP by GC / ECD	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Quality data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Quality data.
		<u>LABORATORY QC:</u>			
		Initial Calibration	Prior to analysis and when continuing calibration criteria fail	3-5 pt. or single-point calibration; RSD of mean < 20%	Recalibrate instrument.
		Continuing Calibration	Daily	60-140% of expected	Rerun continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	1 for each batch of extracted samples	Less than PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD < 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		Laboratory Fortified Blank	10% of samples	%R = 60-140 RSD < 40%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		MS / MSD	1 per every 20 samples	See method or laboratory control %R = 60-140	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 548.1	Endothall by GC / FID	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Qualify data.
	<u>LABORATORY QC:</u>	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		Initial Calibration	Prior to analysis and when continuing calibration criteria fail	4 pt. calibration; if RSD of RF # 30%, use average RF or single-point calibration	Recalibrate instrument.
		Continuing Calibration	Every day	Response factors deviate $\geq$ 30% from initial calibration standard.	Run continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	One per 20 samples or extraction batch	Less than PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
	QC Check Standard (External Source)	Quarterly		%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
				%R = 57-107	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
				%R = 57-107 %R = 70-130% Advisory	Reanalyze samples. If still out of control, qualify data. Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Qualify data.
	Laboratory Fortified Blank		1 per sample set or 20 samples		
	MS / MSD		1 per every 20 samples		
	Internal Standard		All blanks, QC samples, field samples		

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 547	Glyphosate by HPLC	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Quality data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Quality data.
	<u>LABORATORY QC:</u>				
		Initial Calibration	Prior to analysis and when continuing calibration criteria fail	3 pt. calibration - use calibration curve or average RF; if %RSD # 20%; or use single-point calibration	Recalibrate instrument.
		Continuing Calibration	Each working day	Response factors deviate # 20% from midpoint standard.	Run continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	For each batch of samples or each day run	Less than reported detection limit	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Laboratory Fortified Blank	1 per sample set, or all samples analyzed within 24 hours	%R = 70-130	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		MS / MSD	1 per every 20 samples	%R = 80-120 RSD = 20%	Reanalyze samples. If still out of control, qualify data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 531.1	Carbamate Pesticides by HPLC	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Qualify data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>				
		Initial Calibration	Prior to analysis and when continuing calibration criteria fail	3 pt. calibration - use calibration curve or average RF; if %RSD # 20%; or use single-point calibration	Recalibrate instrument.
		Continuing Calibration	Each day of operation	Response factors deviate # 20% from midpoint standard.	Run continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	Each set of samples	Less than PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD # 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Laboratory Fortified Blank with full method analyte list	Every 8 hours of operation	%R = 30-170	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		MS / MSD	1 per every 20 samples	%R = 80-120 RSD = # 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 508	Pesticides by GC / ECD	FIELD QC:			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Qualify data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		LABORATORY QC:			
		Initial and Continuing Calibration	Every 12 hours of operation and prior to analysis	Single-point calibration (Section 9) within 20% of sample response	N / A
		Laboratory Reagent Blank	One per 20 samples or per batch	Less than PQL	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action.
		Laboratory Fortified Blank with full method analytes list	1 per 20 or 1 per sample set	See method or laboratory controls	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action and qualify data.
		Surrogate Spike	All blanks, standards, QC samples, field samples	See method or laboratory controls.	Step 1: Reanalyze Step 2: If recovery still outside control limits, qualify the data.
		MS / MSD	1 per every 20 samples	See method or laboratory controls.	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		Individual Endrin and DDT Breakdown	Daily	Must be < 20%	Perform and document remedial action. Qualify if corrective actions unsuccessful.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 508 (Continued)	Pesticides by GC / ECD	Combined Endrin and DDT Breakdown	Daily	Must be < 30%	Perform and document remedial action. Qualify if corrective actions unsuccessful..

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 8021	Volatile Organics by GC / FID / ELCD	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Qualify data.
	<u>LABORATORY QC:</u>	Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
		Initial Calibration	Prior to analysis and when continuing calibration criteria fail	5 pt. calibration: RSD of mean < 20%	Recalibrate instrument.
		Continuing Calibration	Daily	Response factors deviate < 20% from average of initial calibration.	Run continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	Daily	Less than reported detection limit	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
	QC Check Standard (External Source)		Quarterly	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Laboratory Fortified Blank	1 per 20 or 1 per sample set	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Surrogate Spike	All blanks, standards, QC samples, field samples	See method or laboratory controls for surrogate spiking compounds control limits	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
	MS / MSD		1 per every 20 samples	%R = 80-120 RSD = < 20%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 1613	Dioxin	<u>FIELD QC:</u>			
		Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed.
		Field Reagent Blank	1 per cooler	Less than reported detection limit	Qualify data.
		Rinsate (c)	1 for every 10 field samples collected	Less than reported detection limits	Qualify data.
	<u>LABORATORY QC:</u>				
		Initial Calibration	Prior to analysis and when continuing calibration criteria fail	5 pt. calibration; RSD of mean < 20%	Recalibrate instrument.
		Continuing Calibration	Every 12 hours	Response factors deviate < 20% from average of initial calibration.	Rerun continuing calibration. If still out of control, take remedial action and recalibrate instrument.
		Laboratory Reagent Blank	Each sample set	Less than reported detection limit	Step 1: Reanalyze. Step 2: If second blank exceeds criteria, clean the analytical system. Step 3: Document the corrective action taken and qualify all associated data.
		QC Check Standard (External Source)	Quarterly	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Sensitivity Check	Every 8 hours of operation	Ion abundance criteria; see method	Tune instrument; repeat.
		Mass Calibration	Every 8 hours of operation	See method	Tune instrument; repeat.
		Laboratory Fortified Blank	Every 8 hours of operation	%R = 80-120 RSD < 20%	Step 1: Reanalyze. Step 2: If still out of control, perform and document remedial action. Step 3: Reanalyze.
		Surrogate Spike	All blanks, standards, QC samples, field samples	Laboratory specified surrogate spiking compounds and control limits	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		MS / MSD	1 per every 20 samples	%R = 80-120 and RSD = < 20% for isotope dilution; or %R = 65-135 and RSD = < 35% for Internal Standard method	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
EPA 632	Fluometuron	<u>FIELD QC:</u>			
		Duplicate	Every 20 samples	RPD: 35%	Flag data.
		Rinsate (c)	Every 20 samples	# detection limit	Flag data.
		<u>LABORATORY QC:</u>			
		Calibration	At start of analysis	5 pt., average RF can be used if RSD # 10% or use calibration curve.	1. Check standard solution. 2. Check system as per manufacturer's instructions. 3. Perform appropriate instrument maintenance.
		Calibration Stability	At end of analysis	CCC response factor # 10% difference from the midpoint standard	1. Check standard solution. 2. Check system. 3. Recalibrate and reanalyze samples.
		Method Blank	1 per batch of samples analyzed together, minimum 1 per 20 samples	# PQL	1. Check system. 2. Check blank. 3. Flag data.
		Laboratory Fortified Blank		%R = 77-123	1. Reanalyze. 2. If still out of control, perform and document remedial action.
		MS / MSD		%R = 77-123	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.
		Duplicate	Minimum 1 per 20 field samples	RPD: # 30%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8330	Explosives	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	Water Samples - RPD < 20% Soil Samples - RPD < 50%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. Qualify data.
		Rinsate (c.)	1 for every 10 field samples collected	Less than reported detection limits	
		<u>LABORATORY QC:</u> Initial Calibration	Prior to analysis and when continuing calibration fails criteria	5 pt. calibration, % RSD must be < 20% for all analytes	
		Continuing Calibration	Daily	Response factor must be < 15% from average of initial calibration	Recalibrate instrument Rerun continuing calibration. If still out of control, recalibrate instrument Step 1: Reanalyze Step 2: If second blank exceeds criteria, clean the analytical system Step 3: Document the corrective action taken and qualify all associated data.
		Method Blank	Daily	Compounds must be below respective detection limits	
		Surrogate Spike	All blanks, standards, QC samples, field samples	See laboratory controls	
		MS / MSD	1 per every 20 samples	Recovery 25-134%; RPD < 40%	Determine cause (if possible), correct and reanalyze. If cause cannot be determined, flag data. Step 1: Reanalyze extract Step 2: If still out, respike and reanalyze. Step 3: If still out, run LCS. If LCS is good, qualify data. If not, stop analyses until problem corrected.

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

ANALYTICAL METHOD (a,b)	PARAMETER	QUALITY CONTROL CHECK	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION
SW846 8290 GC / MS	High resolution PCDDs (dioxins) and PCDFs	<u>FIELD QC:</u> Duplicate	1 for every 10 field samples collected	Above 10X detection limit, % RPD must be less than current control limits: Aqueous samples- RPD < 20%; Non-aqueous samples - RPD < 35%	Review lab QC data to determine if they are in control. If not in control, flag data. Use data to evaluate whether proper collection procedures were followed. If not, determine further corrective action.
		Rinsate (c)	1 for every 10 field samples	Less than reporting limit	Qualify data.
		<u>LABORATORY QC:</u> Tune with PFK	At beginning of each analytical run and every 12-hour period during analyses.	Tune to conditions as shown in Table 6 of Method.	Tune instrument; repeat. If cannot correct, reject affected samples.*
		Initial Calibration	5 pt. calibration for each compound in Table 5 of Method.	1. %RPD of mean RRF for unlabeled stds. # $\forall$ 20% and # $\forall$ 30% for unlabeled. 2. S / N for GC signals in SICP ≥ 10 . 3. Ion abundance criteria from Table 8 of Method must be met.	Correct, if possible. If not possible, contact USACE.
		GC Column Performance Check Solution	During initial calibration and at end of every 12-hour shift	1. Chrom. separation between 2,3,4,8-TCDD & other unlabeled TCDD isomers resolved with valley of # 25%. 2. 10 seconds or greater tolerance for absolute RT for all components	Corrective action. Reanalyze extracts of positive samples. Reject sample data if not completed.
		Continuing (Routine) Calibration	At end of every 12-hour shift.	%RPD of mean RRF for unlabeled stds. # $\forall$ 20% and # $\forall$ 30% for unlabeled. Ion abundance criteria in Table 8 of Method must be met.	Correct, if possible. If not possible, contact USACE. If new ave. RFs are needed as per par. 8.3.2.4 of Method, recalibrate, otherwise reject data.
		Static Resolving Power	Beginning and end of each 12-hour shift.	Power at least 10,000 (10% valley definition)	Implement corrective action. Reanalyze extracts of positive samples. Reject otherwise.
		Method Blank (d)	1 for every 20 samples or extraction batch.	Less than PQL. *	Re-analyze blank. Qualify data appropriately.
		Duplicate	1 per 20 samples or batch.	#25% RPD.	1. Check instrument performance. 2. Check errors in weighing. 3. Review analytical procedures. 4. If problem not located, professional judgement.
		MS / MSD	1 per 20 samples or batch	40-135% recovery. * #20% RPD.	If an assignable cause, correct and respoke. *
	% Recovery of IS		Each sample.	40-135%	Monitor and correct if further deterioration is noted. *

SUMMARY OF INTERNAL QUALITY CONTROL PROCEDURES AND QC ACCEPTANCE CRITERIA

NOTES:

- * Not specifically found in written method.
 - (a) Reference: Methods for the Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised, March 1983 or Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA 600/4-82-057, July 1982.
 - (b) Reference: Test Methods for Evaluating Solid Waste, USEPA SW846, 3rd Edition, November 1986, with Updates II and IIA.
 - (c) Rinsates will not be collected if dedicated sampling equipment is used. Rinsates are not applicable for non-aqueous matrices.
- Additional QC may be implemented per manufacturer's instructions.

CDQMP Volume 2, Field Sampling Plan

**New York District
Formerly Utilized Sites Remedial Action Program
Maywood Superfund Site**

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**US Army Corps of Engineers - Kansas City District
Formerly Utilized Sites Remedial Action Program
Contract No. DACW41-99-D-9001**



**US Army Corps
of Engineers®**

September 2003, Revision 01

**CHEMICAL DATA QUALITY MANAGEMENT PLAN
VOLUME 2 - FIELD SAMPLING PLAN**

**FUSRAP MAYWOOD CHEMICAL SUPERFUND SITE
MAYWOOD, NEW JERSEY**

**SITE-SPECIFIC ENVIRONMENTAL RESTORATION
CONTRACT No. DACW41-99-D-9001
TASK ORDER 10041
WAD 01 WBS 01**

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September 2003
Revision 01

Volume 2

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ABBREVIATIONS AND ACRONYMS

°C	Degrees Centigrade
CDQMP	Chemical Data Quality Management Plan
CFR	Code of Federal Regulations
CO	Contracts Officer
COC	Chain of Custody
CQAB	Chemical Quality Assurance Branch
DCGL	Derived Concentration Guideline Level
DOT	Department of Transportation
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
EE/CA	Engineering Evaluation / Cost Analysis
EM	Engineering Manual
EMP	Environmental Monitoring Program
EPA	U.S. Environmental Protection Agency
FMSS	FUSRAP Maywood Superfund Site
FSP	Field Sampling Plan
FSS	Final Status Survey
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	gram
GEPP	General Environmental Protection Plan
I-80W	Interstate 80 Westbound
IDW	investigation-derived waste
ISOCs®	In-Situ Object Counting System
L	liter
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MD	matrix duplicate
MHT&D	Materials Handling, Transport, and Disposal
MISS	Maywood Interim Storage Site
mL	milliliter
MS	Mass Spectrometry
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NaI	Sodium Iodide
NJDEP	New Jersey Department of Environmental Protection
oz	ounces
PCB	Polychlorinated biphenyl
PDI	Pre-Design Investigation
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPT	Radiation Protection Technician
RSO	Radiation Safety Officer

SD	Sediment
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SVOC	semi-volatile organic compound
TRPH	Total Recoverable Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
μR/hr	micro-Roentgen per hour (either abbreviation is acceptable)
USACE	U. S. Army Corps of Engineers
UST	Underground Storage Tank

1.0 SAMPLE TYPES

Field screening and sampling activities at the Formerly Utilized Sites Remedial Action Program (FUSRAP) Maywood Superfund Site (FMSS) may involve the sampling of soils, backfill materials, building materials, air, groundwater, sediments, surface waters, and wastewater. Task-specific Work Plans are developed for each task that involves sampling or analysis of samples. The task-specific Work Plan details the number and types of samples to be collected.

In addition to regular field samples, quality control (QC) and quality assurance (QA) samples will be collected. Field QC sample types include trip blanks, field blanks, temperature blanks, equipment rinsate blanks, and duplicates. Matrix spike / matrix spike duplicates (MS/MSD) for organics and matrix spike / matrix duplicate (MS/MD) for inorganics are laboratory QC samples which will be collected in the field. The only field requirement for samples designated for MS/MSD (organic) analysis is that extra volume must be collected for aqueous samples (the quantity collected for soil or solid materials is typically more than adequate for meeting the required amount for MS/MSD). MS/MSD samples are further discussed in Sections 2.8, 4.4.2.1, and 6.2 of the Quality Assurance Project Plan (QAPP). QA samples will also be collected and analyzed by the U.S. Army Corps of Engineers (USACE) QA laboratory (the Chemical Quality Assurance Branch (CQAB) Laboratory or one of its subcontractor laboratories). QA samples are collected and analyzed to assess comparability.

Trip blanks accompany all volatile organic sample shipments. Volatile organic trip blanks consist of vials containing demonstrated organic-free water (water for which the concentration of organics is less than the method detection limit). These trip blanks are used for both soil and water field samples. The aqueous vials are filled with zero headspace in the laboratory. The trip blank vials are shipped to the site, and then shipped back with the other volatile organic analysis (VOA) sample vials. The trip blank provides an indication of any contamination source arising from the vial itself or the trip back and forth to the lab. Trip blanks are only employed for samples to be analyzed for volatile organic compounds. There must be at least one trip blank in each shipping container that has volatile samples.

Field blanks are collected when dedicated equipment is used to determine whether the equipment is contributing contamination to the sample. A collection frequency of once per equipment lot is adequate for field blank samples. If a rinsate blank is already being collected, and the rinsate water comes into contact with the dedicated equipment, the field blank is not necessary.

Temperature blanks are water-filled bottles supplied by the Contract Laboratory for use in measuring the temperature of the samples upon arrival at the laboratory. For those samples required to be maintained at 4°C, a temperature blank must be included in each cooler shipped from or picked up at the FMSS.

Equipment rinsate blanks are samples of analyte-free water (water for which the concentration of all analytes is less than the method detection limit). The water is used to rinse sampling equipment after the equipment has been decontaminated, and then the water is added to the sample container. Equipment rinsate blank test results provide information on the efficiency of the decontamination process. Equipment rinsate blanks must be collected each day that sampling occurs or each decontamination event, whichever is less, per matrix per parameter per field crew, per equipment type (assuming reusable sampling equipment is used). As a minimum, one rinsate blank will be collected daily per crew during groundwater sampling activities, unless disposable bailers are used. If disposable bailers are used, no rinsate blanks will be collected; however, a field blank shall be collected for each lot of bailers. Rinsate blanks for soil sampling will be collected every day that soil sampling is conducted. Where possible, the

rinsate blank should be collected following the decontamination of equipment used to sample at the location suspected to be the most highly contaminated.

Field duplicates are two samples collected from the same location (immediately adjacent to each other) at the same time in the same manner. Field duplicate test results provide a measure of overall sampling and test method precision as well as sample heterogeneity. Field duplicate samples must be identified or numbered so that the laboratory does not know the samples are duplicates (thus the term “blind duplicates”), thus eliminating potential bias in the test measurement. Field duplicate samples must represent no less than 10% of the total number of samples per matrix per parameter per area of study.

QA samples are split samples that are submitted to the CQAB Laboratory or one of its subcontractor laboratories. Split samples are two portions of a sampled matrix that has been thoroughly homogenized. These samples are used to evaluate the performance of the Shaw Environmental, Inc. (Shaw, formerly Stone & Webster, Inc., A Shaw Group Company) field crew and interlaboratory variability. QA and Contract Laboratory results will be used in preparing the Chemical Quality Assurance Report by the CQAB. QA samples shall be collected at approximately 10% of the total number of samples per matrix per parameter per area of study.

For the purpose of calculating the appropriate number of QC or QA samples, soil, sediment, groundwater, surface water, and building materials should be considered as separate matrices. Every attempt should be made to associate QC samples with field samples of similar matrix. This will only serve to improve the quality of the data obtained from QC sample test results.

2.0 ONSITE OPERATIONS

Maywood site investigations and remedial actions will require use of a variety of sampling methods. The pre-design investigation, soil acquisition, remedial action tasks, groundwater remedial investigation, materials handling, and transportation / disposal will require soil, water, and / or building materials sampling. Procedures describing typical sampling methods, such as surface and shallow subsurface soil sampling, soil borings and sampling, concrete core sampling, building materials sampling and wipe sampling are provided in Appendix A of this Field Sampling Plan (FSP). When individual tasks involve a type of sampling or other field data collection activity that is not addressed by the procedures in Appendix A, these additional procedures will be presented in the task-specific Work Plan.

Each task-specific Work Plan will provide a general description of the sample collection procedures to be followed as well as the task specific details that distinguish these procedures from the ones presented in this FSP. For each sampling method, the necessary support facilities will be identified. The discussion will focus on the procedures for addressing failures in the sampling system and the responsibilities for corrective action. A table, similar to **Tables 3-1** and **3-2** of this FSP, will be included which details the bottle requirements, preservation, and holding times to extraction and / or analysis for all analytical parameters and matrices.

The following sections discuss the proposed activities that are currently anticipated to require sampling.

2.1 RADIOLOGICAL FIELD SCREENING AND SOIL SAMPLING

2.1.1 Remedial Action Support Survey

The objective of the remedial action support survey is to detect the presence of residual activity at or below the derived concentration guideline level (DCGL) or cleanup level. Instruments shall be selected based on the detection capabilities for the contaminants and the DCGLs to be achieved. Remedial action support surveys are performed under the direction of the Site Radiation Safety Officer.

A walkover survey and subsurface measurements may be used to define the boundaries of the excavation. Initial walkover surveys will be performed using instruments capable of detecting elevated contamination levels under normal background conditions (5 to 9 micro-Roentgens per hour [$\mu\text{R/hr}$]). Examples include, but are not limited to the Bicon MicroREM meter, the Ludlum 12s, and the Ludlum 2221 mated to a Ludlum 44-10 Sodium Iodide (NaI) detector. The radionuclides at the FMSS, when present at elevated concentrations in surface and near surface soil, are capable of being detected with these instruments. For subsurface measurements, soil samples shall be collected using a direct push soil probe or hand auger technique. Downhole gamma logging will be accomplished, where feasible, using a NaI detector suspended down the soil probe, following collection of extracted soils. The depth of the soil probes will be dependent on existing site data and downhole gamma logging. Collected soils are packaged for transport to a designated location at the Maywood Interim Storage Site (MISS) for additional screening, sample collection, isotopic analysis and shipping / archiving, as required. Samples collected to meet formal Data Quality Objectives (DQOs) (e.g., Final Status Survey samples) are analyzed in a USACE / NJ Department of Environmental Protection (NJDEP) certified laboratory with 10% submitted to a QA lab for confirmatory analysis. Appendix A, Standard Operating Procedure (SOP) 509, "Soil Probe Investigation," provides details of this activity.

Prior to excavation activities, land survey personnel will establish and stake the excavation boundaries based on the pre-design investigation data generated by Shaw.

During excavation, area gamma field scans will be performed and remedial support soil samples will be collected by Radiation Protection Technicians (RPTs). Remedial support surveying and sampling is performed under the direction of the Site Radiation Safety Officer (RSO). These data will be used to adjust the initial excavation boundaries and evaluate if an area is ready for Final Status Survey (FSS). Informal action levels for field instruments are established during the excavation by the RPT and the RSO. Action levels are considered guidance and based on area background conditions, “shine” from unexcavated contaminated soils, established DCGLs (Derived Concentration Guidance Levels), and process knowledge. Action levels are modified by the RPT with concurrence from the RSO as necessary, based on an evaluation of remedial support soil samples data from the on-site isotopic laboratory against established DCGLs and gamma field scan readings. RPTs typically use spray paint, pin flags, or verbal direction to Construction personnel to identify areas where additional excavation is required to satisfy clean-up goals. Gamma scans are used to determine bias locations for collection of remedial support soil samples. These samples are then collected and analyzed in the on-site lab to determine if an area is ready for final status survey. This process is referred to as “guiding the excavation.”

SAFETY NOTE: RPTs will not guide excavations greater than 5 feet deep unless appropriate protective systems are in place. Alternate monitoring techniques using long-reach sampling and gamma scanning devices may be used to limit personnel entry into deep excavations. Personal safety shall not be compromised for the performance of radiological surveys.

2.1.2 Final Status Surveys

Final Status Surveys are designed to demonstrate that the concentration of radionuclides of concern in soil are compliant with the commercial use or residential use cleanup criteria, as appropriate. Final Status Surveys shall be performed according to the requirements established in the *Master Final Status Survey Plan* (USACE 2001) and property-specific addenda. The Master FSS Plan is based on methodologies established in Environmental Protection Agency (EPA) document 402-R-97-016, the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (EPA 2000).

2.2 MONITORING

Monitoring is necessary to evaluate possible changes in site conditions and track the potential risks to site workers and the adjacent population. An environmental monitoring program is conducted annually. The key elements of this program are:

- Measurement of external gamma radiation.
- Measurement of radon gas concentrations in air (from both radon-220 and radon-222).
- Sampling and analysis of streambed sediment for radioactive constituents and metals.
- Sampling and analysis of surface water for radioactive constituents and metals.
- Sampling and analysis of groundwater for radioactive constituents, metals, and volatile organic compounds.

Radon monitoring is conducted within the structures over inaccessible soils. This radon monitoring is conducted in accordance with SOP 306, “Radon Sampling” (see Appendix A), or as specified in Radiation Protection Program implementing procedure PP-8-803, “Measurement of Airborne Radioactivity,” located in the FMSS *Site Safety and Health Plan* (SSHP), Appendix C (USACE 2002). Additional monitoring, including meteorological monitoring and personal and area air particulate and organic vapor monitoring, is employed to track the potential risks to site workers and the adjacent population. Perimeter monitoring is further discussed in the General Environmental Protection Plan (GEPP) and the FMSS SSHP (USACE 1999c & 2002). Monitoring data is used to calculate maximum

doses from external gamma radiation and inhalation of radioactive particulates and radon gas. Guidance on monitoring use and monitoring methods for health and safety monitoring (work zone and breathing zone) are provided in the FMSS SSHP (USACE 2002).

2.3 GROUNDWATER SAMPLING

Additional groundwater sampling was necessary to further characterize the FMSS. To date there have been two phases of groundwater sampling, called a groundwater remedial investigation (GWRI), conducted to determine the possible impact of site contaminants. The results of that investigation have shown principally the presence of a benzene plume and arsenic / lithium plumes in bedrock. Small plumes of limited dimensions have been identified in bedrock groundwater. Additional sampling to better characterize the source and extent of the benzene plume occurred during the summer of 2002 and winter of 2003.

Groundwater samples will be collected from existing and newly installed monitoring wells. Prior to sample collection, a synoptic round of groundwater level measurements will be obtained from selected wells. Samples of the well evacuation discharge water will be collected and analyzed for disposal purposes.

Groundwater samples will be collected using either of the following sampling equipment: submersible pump or Teflon® (or Teflon®-lined) bailer. In those instances, where the volume of water present in the well is insufficient to collect a sample using the aforementioned sampling apparatus, a peristaltic pump will be used to collect the sample. The collected groundwater samples will be analyzed as specified in the RI Addendum – Proposed Source and Plume Delineation Work Plan. In accordance with the EPA Region II Low Stress (Low Flow) Sampling and Purging Procedure, March 1998, groundwater samples will be collected after field parameters stabilize. The parameters required for monitoring and applicable criteria are outlined in procedure 304 within Appendix A of the FSP, Purging and Sampling of Monitoring Wells.

2.4 WASTE SAMPLING

During the course of this project, various types of wastes may require sampling for characterization, including investigation-derived waste (IDW), soil or debris designated for offsite disposal, excavation groundwater, decontamination wastewater, stormwater, and dewatering effluent. Final disposition of these wastes will depend on the results of the sampling and analyses performed, relative to the permanent disposal facilities' waste acceptance criteria. Other wastes may also be encountered or generated such as building materials, rags, batteries, oily waste, Toxic Substances Control Act (TSCA) waste, and other special waste. The task-specific Work Plans will detail the types of wastes anticipated to be generated and how they will be handled. The following subsections discuss several common categories of waste anticipated for this project.

2.4.1 Investigation-Derived Waste (IDW)

During site investigations, IDW in the form of personal protective equipment (PPE), drill cuttings from well installations and purge and decontamination water are generated. Every effort will be made to minimize waste generated. All IDW will be containerized in approved containers. Soils, waters, and other materials will be containerized separately and the contents identified with weather-resistant labels affixed to each container's exterior. This IDW will be transported to the MISS, and sampled and tested as necessary prior to disposal to determine a proper disposal method. Techniques for sampling IDW in drums can be found in Appendix A, SOP 313, "Drum Sampling."

Off-site laboratory analysis of the waste will be conducted as necessary to both characterize the waste and meet the requirements of the designated disposal facility. Wastes will be managed and transported for disposal in accordance with Shaw's Materials Handling, Transport, & Disposal (MHT&D) Plan and Appendix A, SOP 505, "Cuttings and Fluids Management" (USACE 1999b).

2.4.2 Soils and Debris Sampling Prior to Offsite Transport

All project solid, hazardous, and radiological waste will be disposed of in an offsite licensed / permitted disposal facility in accordance with local, state, and federal regulations. Radiologically contaminated soils and debris will be transported by rail to a permitted radiological disposal facility. The USACE at the present time has an existing contract and agreement with Envirocare related to other FUSRAP projects. Consequently, Shaw will use any existing profile information relating to analytical data to properly manage and ship the waste soils from the Maywood Superfund Site.

Should additional characterization be required, materials will be sampled prior to transport to a selected landfill facility. The procedures for sampling these soils and debris will be Appendix A, SOP 315, "Railcar Sampling" and SOP 311, "Building Materials Sampling," with minor modifications. The tests performed on the sampled materials will depend on the selected landfill's regulatory requirements for accepting the materials.

Soils being shipped to a USACE-approved facility must be tested according to the MHT&D Plan, Appendix A, which describes a typical Waste Acceptance and Management Plan (USACE 1999b).

2.4.3 Decontamination Wastewater

Wastewater will be generated from decontamination processes for personnel and equipment. Shaw will manage decontamination wastewater in accordance with the GEPP, Section 3 (USACE 1999c).

Truck and equipment decontamination facilities will be curbed and sloped to drain into a collection sump for decontamination water. Decontamination and rinsate water from the facility will be contained, analyzed, and if necessary, treated to sanitary district release standards. Excess soil will be mechanically removed from tires and then the tires will be brushed or pressure washed. Decontamination of equipment is primarily addressed in the SSHP (USACE 2002).

A limited amount of potentially contaminated water will be accumulated from decontamination stations. This water will be dispositioned based on analyses and consideration of any surfactants that will be used. This water may be combined with vehicle and equipment decontamination water, shipped offsite to a Publicly Owned Treatment Works (POTW), or discharged to the sanitary sewer system. Care will be taken to ensure that decontamination water containing surfactants is stored separately from other decontamination water. Water containing surfactants will not be put through water treatment without demonstrating that it will not impact the system.

2.4.4 Stormwater

Stormwater will occur as run-on, uncontaminated and contaminated incidental rainfall run-off from undisturbed areas, and contaminated run-off from disturbed areas. Shaw will manage stormwater run-off in accordance with the GEPP (USACE 1999c). Potential surface water run-on from areas outside of the construction limits will be diverted using berms, sandbags or plastic sheeting. Stormwater generated as a result of rainfall on undisturbed ground will be collected and routed to a sedimentation basin using ditches. Ditches which carry storm water to the sedimentation basin will contain erosion protection to minimize sediment loading on the basin. Stormwater generated as a result of rainfall on disturbed ground

will be pumped and transferred to a holding tank as soon as possible to minimize contact time with exposed contaminated soil. This water will be tested and, if necessary, treated to meet regulatory requirements (see Section 2.4.5 for a discussion of the treatment system). If testing shows that the water meets release limits, the water will be discharged. Sampling of stormwater will be conducted in accordance with 40CFR122.21(g)(7) and 40CFR122.26(d)(2).

2.4.5 Dewatering Effluent

Dewatering effluent will consist of excavation water or effluent that results from a dewatering system such as use of a well point system. Shaw will manage dewatering effluent in accordance with the GEPP (USACE 1999c).

A dewatering system may be required for some remedial action areas. Excavating below the water table will require the lowering of the water table to promote stability; prevent sloughing of the excavation slopes; and to create a dry, firm working condition. Blowouts may occur where the excavation lies below the piezometric surface because of excessive uplift pressure. A properly designed and constructed dewatering system will lower the water table or piezometric surface adequately to permit safe and dry excavation conditions.

Excavation water refers to groundwater, contaminated and uncontaminated incident water, and saturated soil drainage. Incident water will enter excavations as a result of precipitation. Incident water in the excavations will be directed to sumps for pumping to holding tanks. This water will be tested and, based on the test results, will either be treated or discharged. The water treatment system consists of three stages: flocculation / coagulation, sedimentation, and (if necessary) filtration. If dissolved radiological constituents are present above acceptable levels, the water can be treated using ion exchange. At least one sample is collected from each holding tank prior to discharge of the water to the Bergen County POTW.

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3.0 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

When handling samples in the field and in the laboratory, care should be taken to ensure the integrity of the samples is maintained at all times. Samples must be collected, transported, and received under strict chain of custody protocols consistent with procedures established by the EPA for litigation-related materials. Each task-specific Work Plan will provide a general description of the provisions for sample handling, as determined based on the nature of the samples and the maximum allowable holding times. The following subsections discuss general procedures for handling samples both in the field and in the laboratory.

3.1 FIELD PROCEDURES

The following subsections describe the steps to be taken in the field when collecting samples and preparing them for shipment to the analytical laboratory.

3.1.1 Sample Homogenization

Samples for all parameters except volatile organics will require homogenization after collection. For soil samples, the soil will be homogenized upon removal from the ground or waste pile. Water samples will be collected in such a way so as to be most representative of the source water. Homogenization ensures that all samples from a given area will have similar textures or characteristics, thus reducing potential biases from physical sample characteristics. The correct homogenization techniques, including sample handling and mixing and potential problems, are provided in the USACE Engineering Manual (EM) 200-1-3 Section E-2, which is provided in Appendix B of this FSP. These techniques shall be used on the Maywood project.

3.1.2 Compositing Samples

Compositing techniques such as flow-proportioned and time composites (for sampling flowing surface waters, if required), and aerial and vertical composites, to be used for compositing soil samples for radiological and chemical analysis, are described in Appendix B (EM 200-1-3 Section E-3). Compositing ensures that samples are representative. It also can reduce analytical costs. It is important that all composite samples be collected in the same way to avoid sampling bias. Compositing shall only be considered for off-site disposal purposes. Air sample filters may be composited according to methodologies established in the FMSS SSHP (USACE 2002).

3.1.3 Field Preservation

Depending on the analyses proposed for the samples collected, chemical field preservation may be required. This preservation will be conducted in accordance with the requirements of SW-846 (EPA 1986). The preservative will be noted both on the sample labels and on the respective chain-of-custody for the sample. When field preservation is required for samples collected during a particular task, this effort will be further detailed in the task-specific Work Plan. Sample preservation techniques for all sampling and test methods that may be employed on this project are provided in **Tables 3-1 and 3-2**.

As a minimum, all samples being analyzed for chemical analyses will be placed on ice immediately following collection. The temperature and trip blanks as required will be placed in the coolers at the same time as the ice (i.e., at the start of the sampling event) to ensure they receive adequate cooling and are

representative of the temperature of the samples prior to transferring custody of the samples to the analytical laboratory.

3.1.4 Equipment Decontamination

Maywood field personnel will follow the requirements in Appendix A, SOP 506, “Decontamination”; and Appendix B, EM 200-1-3 Section E-5 for decontamination of sampling equipment. The goal of decontamination is to eliminate cross-contamination resulting from the use and reuse of sampling equipment. Decontamination waste will be managed in accordance with Appendix A, SOP 505, “Cuttings and Fluids Management” and the MHT&D Plan (USACE 1999b).

3.1.5 Packaging and Shipping

Each sample bottle will be identified with a separate identification label. Labels may be pre-printed and / or augmented by notations made in indelible / waterproof ink. Entry errors will be crossed out with a single line, dated, and initialed. Each securely fixed label will include the following:

- Project identification
- Sample identification
- Preservatives added
- Type(s) of analysis(es) to be performed
- Date and time of collection

Table 3-3 details the sample numbering format to be used for the project. Each sampling task or area will have a separate designation.

A properly completed chain-of-custody form shall accompany all sample shipments. The chain-of-custody description section requires the following:

- Sample identification number
- Container types and preservation techniques
- Date and time of collection
- Analytical test parameters or test parameter method (in Analysis / Remarks Section); e.g., EPA Method 8270. Also indicate lab QC sample, if applicable; e.g., MS/MSD, rinseate blank or RB, etc. This is very important so that the laboratory does not accidentally select the wrong sample to represent a QA sample
- Specific instructions to the lab; e.g., unique turnaround times, specific analytes or other special instructions for analysis
- Number of containers corresponding to each sample ID number and parameter
- Specific sample collection method (grab or composite)
- Type of matrix
- Names of the sampler(s) and signature of the person shipping the samples
- Date and time that the samples were sealed for delivery
- Signature of the individual receiving the samples at the laboratory (to be filled out at the laboratory)

The original record will accompany the shipment, and copies will be retained by the sampler for return to project management and the project file. A copy of the chain-of-custody form will also be forwarded via facsimile to the USACE Contracts Officer (CO) whenever samples are shipped from the field site. Whenever split samples are collected for comparison analysis by the USACE QA Laboratory or a government agency, a separate chain-of-custody is prepared for those samples and marked to indicate that they are USACE QA samples. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record will document transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to / from a secure storage area. An example of the chain-of-custody (COC) form to be used for these investigations is provided in Appendix C of the QAPP.

Environmental samples will be transported to the Contract Laboratory and QA Laboratory via the most rapid means. If the Contract Laboratory is located within approximately 100 miles of the FMSS, they (the Laboratory) will pick up samples by courier service. Otherwise overnight delivery service will be utilized. Each task-specific Work Plan will detail the transport means to be used for the samples. All shipments of samples will be in compliance with applicable United States Department of Transportation (DOT) regulations.

Shipment of samples on Friday to the Contract Laboratory will be discouraged unless it is absolutely necessary and the laboratory has confirmed that personnel will be present on Saturday to receive and implement any necessary processing within the analytical holding times. No samples shall be shipped for weekend or holiday delivery at the QA Laboratory. Therefore, samples designated for the QA Laboratory that are collected on Friday or during the weekend must be properly preserved and held in the field until they can be shipped to arrive on the next business day (assuming that holding times will not be adversely impacted).

Appendix B, EM 200-1-3 Section F-2 and Appendix A, SOP 504, "Labeling, Packaging, and Shipping Environmental Samples," detail further the requirements for packaging and shipping samples.

Radiological samples will normally be shipped as excepted packages for limited quantities of radioactive materials as defined in 49CFR173.421. Guidelines for shipment of these samples are contained in Appendix A SOP 508, "Procedure for Shipping Radiologically Contaminated Environmental Samples." Chemical samples will be shipped as excepted packages for limited quantities of miscellaneous hazardous materials as defined by 49CFR173.155. Guidelines for shipment of these samples are contained in Appendix A SOP 504, "Labeling, Packaging, and Shipping Environmental Samples."

3.2 LABORATORY SAMPLE HANDLING

The following subsections describe the steps the laboratory must take as part of the process of preparing samples for analysis.

3.2.1 Laboratory Subsamples

The Contract laboratories shall use proper techniques as presented in Section E-4 of EM 200-1-3 (Appendix B) to sample an aliquot or portion of the field sample received into the laboratory. Generally, except for volatile organic samples, field samples should be thoroughly mixed (shaken in the case of water samples) prior to subsampling. Dealing with potential problems caused by multi-layer liquid samples is also discussed.

3.2.2 Laboratory Custody Procedures

Laboratory custody procedures, along with the holding times and sample preservative requirements for samples, will be described in laboratory QA Plans (see the QAPP, Appendix E for an example). These documents will identify the laboratory custody procedures for sample receipt and log-in, sample storage, tracking during sample preparation and analysis, and laboratory storage of data.

3.2.3 Cooler Receipt

The condition of shipping coolers and enclosed sample containers, including the results of all checks for temperature and pH preservation, will be documented upon receipt at the analytical laboratory. This documentation will be accomplished using the Cooler Receipt Checklist presented in Appendix C of the QAPP, or an equivalent checklist. A copy of the checklist will be faxed to the Project Chemist immediately after it has been completed at the laboratory. A copy of the completed checklist will also be transmitted with the final analytical results from the laboratory.

Table 3-1
Container Requirements for Soil Samples for the Maywood Investigations

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time ^a
Volatile Organic Compounds	4 – EnCore Samplers	5 g	Cool, 4°C	48 hrs (extraction) 14 d (analysis)
Semivolatile Organic Compounds	1 - 8 oz glass jar with Teflon [®] -lined cap	150 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
Pesticides / Polychlorinated Biphenyls (PCBs)	Use same container as semi-volatile organic chemicals (SVOCs)	150 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
Herbicides	1 - 4 oz glass jar with Teflon [®] -lined cap	50 g	Cool, 4°C	
Metals, Cyanide, and Rare Earth Elements	1 - 4 oz wide mouth plastic or glass jar	20 g	Cool, 4°C	180 d, Hg at 28 d
Total Recoverable Petroleum Hydrocarbons (TRPH)	2-1 Liter Amber Boston Round	1000 mL	Cool, 4°C HCl	Analyze ASAP
Waste Characteristics	1 - 16 oz wide mouth glass jar with Teflon [®] -lined cap	1000 g	Cool, 4°C	general 14 d
Radiochemical Parameters	1 - 16 oz wide mouth glass jar with Teflon [®] -lined cap	500 g	None	180 d
Grain Size	1 - 8 oz glass jar	350 g	None	None

Notes:

a : Holding times for extractions, and for analyses (for methods without an extraction holding time requirement) are calculated from the time of sample collection. Holding times for analyses, for methods involving an extraction step, are calculated from the time of extraction to the time of analysis

Table 3-2
Container Requirements for Water Samples for the Maywood Investigations

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Volatile Organic Compounds	2 - 40 mL glass vials with Teflon®-lined septum (no headspace)	40 mL	HCL to pH <2 Cool, 4°C	14 d
Semivolatile Organic Compounds	2 - 1L amber glass bottle with Teflon®-lined lid ¹	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Pesticides / PCBs and Herbicides	3 - 1L amber glass bottle with Teflon®-lined lid ¹	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Metals and Rare Earth Elements	1 - L poly bottle	500 mL, metals 200 mL, Hg	HNO ₃ to pH <2	180 d, metals 28 d, Hg
Dissolved Organic Carbon	125 mL poly bottle	50 mL	H ₂ SO ₄ to pH <2 Cool, 4°C	28 d
pH	125 mL poly bottle	50 mL	Cool 4°C	
Cyanide	1 - L polybottle	500 mL	NaOH to pH >10 Cool, 4°C	14 d
TRPH	1 - L glass bottle	1000 mL	H ₂ SO ₄ to pH <2 Cool, 4°C	28 d
Alkalinity/TDS/TSS	1 - L polybottle	100 mL ea.	Cool, 4°C	7 d
Total Recoverable Phenolics	1 - L glass bottle	500 mL	H ₂ SO ₄ to pH <2 Cool, 4°C	28 d
Oil & Grease	1 - L glass bottle	1000 mL	H ₂ SO ₄ to pH <2 Cool, 4°C	28 d
MBA Surfactants	500 mL poly bottle	250 mL	Cool, 4°C	48 h
BOD 5-Day	1 - L glass bottle	1000 mL	Cool, 4°C	48 h
COD	125 mL poly bottle	50 mL	H ₂ SO ₄ to pH <2 Cool, 4°C	28 d
Sulfate	125 mL poly bottle	50 mL	Cool, 4°C	28 d
Dissolved Sulfide	500 mL poly bottle	500 mL	Cool, 4°C add 2 mL zinc acetate plus NaOH to pH > 9	7 d
Ammonia Nitrogen	500 mL poly bottle	400 mL	Cool, 4°C H ₂ SO ₄ to pH <2	28 d
Nitrate	125 mL poly bottle	100 mL	Cool, 4°C	48 h
Ortho Phosphorus	125 mL poly bottle	50 mL	Cool, 4°C H ₂ SO ₄ to pH <2	28 d
Methane	40 mL glass vial	5 mL	Cool, 4°C	14d
Ignitability (flash point)	500 mL boston round	100 mL	None	Analyze ASAP
Reactivity	500 amber boston round	250 mL	Cool, 4°C	Analyze ASAP
BTEX Degradors, total heterotrophs, and specific heterotrophs				
Radiochemical Parameters	2 - 1 gal plastic containers ¹	4 L	HNO ₃ to pH <2	180 d

Notes:

- ¹ One investigative water sample in twenty will require an additional volume for the laboratory to perform appropriate laboratory QC analysis. (i.e., MS/MSD).

Table 3-3
Sample ID System for All Maywood Sites

Site Designator X X X ^{1,2}	Activity Designator AAA ¹	Field Measurement / Sample Collection Designator V V ¹	Station Number N N N	Media mm ¹	Sample Type n ¹	Sequential Sample Number # # # # # ^{1,2}
000 = Laboratories	BKG = Background	DG = Down Hole Gamma	Unique Station No.	BZ = Air Filter (Breathing Zone)	0 = Regular	000001 to 002000 Test Pits
001 = Maywood Site	XBP = Burial Pit	DP = Direct-push		AE = Air Filter (Environmental)	1 = Duplicate	002001 to 019949 PDI
01a = 72 Sidney Street	XDR = Drum	MW = Monitoring Well		GA = Air Filter (General Area)	2 = Spit	019950 to 019999 Asbestos Pile Removal
02a = 100 Hancock Street	EMP = Environmental Monitoring Plan	PP = 4 in. Push-pipe		AB = Aquatic Biota	3 = Trip Blank	020000 to 020499 Swale
02b = 80 Hancock Street	EPP = Environmental Protection Plan	SB = Soil Boring		BM = Building Materials	4 = Equipment Rinsate	020500 to 021999 GWRI
02c = 80 Industrial Road	FSS = Final Status Survey	SG = Surface Grab		GW = Groundwater	5 = Site Source Water Blank	
02d = 8 Mill Street	GWR = Groundwater Remedial Investigation	SI = Surface ISOCSS®		ID = Investigation Derived Waste		022000 to 022077 General Environmental, SWIEC
03a = 170 Gregg Street	PDI = Pre-design Investigation	SP = Soil Probe		RD = Radon Detector		024500 to 024999
04a = 160/174 Essex Street (Bank of NY)	IRAR = Disposal Soil Characterization			SD = Sediment		
04b = 1-80 Westbound ROW	XPT = Pilot Test			SM = Snears (wipes)		022078 to 024499 General Environmental, SEC
04c = 150 Essex Street, L001	XRT = Routine					
04d = 1-80 Eastbound ROW	SWL = Swale					
05a = 99 Essex Street (Muscarelle)	XTL = Test Pit					
05b = 113 Essex Street (Bank of NY)				ST = Storm Water		025000 to 034999 Routine/Health & Safety
05c = 200 NJ Route 17 South				SB = Subsurface Soil		(Not Assigned)
06a = 85-101 NJ Route 17 North				SS = Surface Soil		035000 to 039999 Pilot Demonstration
06b = 137 NJ Route 17 North	WTD Water Treatment and Disposal			SW = Surface Water		040000 to 049999 Soil Remediation
06c = 167 NJ Route 17 North				TB = Terrestrial Biota		(Not Assigned)
06d = 239 NJ Route 17 North				TD = TLDs		(Not Assigned) GWRA
06e = 29 NJ Route 17 North						050000 to 074999 Final Status Survey
07a = 111 Essex Street						075000 to 079999 Disposal
07b = Hackensack & Lodi Railroad						080000 to 089999 Water Treatment
08a = 23 West Howcroft Road						
08b = Block 124 Lot 17 (Borough of Maywood)						
09a = 149-151 Maywood Avenue						
10a = 100 West Hunter (Stepan)						
11a = 205 Maywood Avenue						
11b = 61 West Hunter Avenue						
11c = 50 West Hunter Avenue						
12a = NY, Susquehanna & Western Railway						
12b = 100 West Hunter Avenue (MISS)						
12c = NJ Route 17 ROW						
13a = Transect H & I						
14a = Transect B						
15a = Transect C						
16a = Transect D						
17a = Transect G						
18a = Transect J						
19a = Parkway						
20a = Grove						
21a = Ballod						
22a = Lodi Brook						
22b = Lodi Brook Drainage Basin						
23a = Westerly Brook						
23b = Westerly Brook Drainage Basin						
24a = Saddle River						
25a = Coles Brook						
26a = Saddle River County Park						
27a = BCUA						
Other designators may be added as necessary.	Other designators may be added as necessary.	Other designators may be added as necessary.	Sequential number for based on each site (property).	Other designators may be added as necessary.		Sequential number based on each site (property), and type of activity.

Notes: 1. XXX, AAA, VV, mm, n, ##### = Sample ID legend to be used for database reporting
2. XXX, ##### = Sample ID to be used for sample collection and delivery to lab.

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4.0 FIELD DOCUMENTATION

The following is a summary of the requirements for recording and documenting the conditions of the field work for the project. Emphasis is placed on sample designation and documentation procedures that will be followed during sample collection to ensure that samples collected can be easily tracked.

4.1 SAMPLE INFORMATION DOCUMENTATION

All information relating to collection of field samples, including personnel names, sampling method, location, conditions, date and time, sample numbers, and observations shall be recorded in a bound field notebook. COCs will be filled out in accordance with the FSP Section 3.1.5 and Appendix A, SOP 504. Daily Quality Control Reports (DQCRs) will also be used to document field activities on a daily basis. An example COC and DQCR can be found in the QAPP, Appendix C. Field boring logs and well diagrams, when required for a particular task, are also considered part of the field documentation. Examples of such documentation shall be included in task-specific Work Plans, if it is required for the task activity. Radiological survey maps and geographical information system (GIS) plots generated by the Radiation Protection Group may also be used to document sample locations or activities. An example of this is the final status survey gamma walkover map, which typically identifies the location of bias samples collected. The Contract Laboratory will have an information management system that will track the progress of the sample through the laboratory. The procedure for documentation of laboratory activities is in Section 5.0 of the subcontractor laboratory's Quality Assurance Management Plan (see Appendix E of the QAPP).

4.2 PREPARATION OF FIELD LOGBOOKS

Shaw field logbooks are bound with lined, consecutively numbered pages. Separate field books, as necessary, will be maintained by each field team responsible for sampling and support activities. All pages must be numbered prior to initial use of the logbook. The following information shall be recorded inside the front cover of the logbook:

- Person and organization to whom the book is assigned (with signature), and phone number(s)
- Start Date
- Project Name
- Shaw Job Number
- Field Operations Manager's Name
- Sequential Book Number (if applicable)

All entries to a logbook will be made by the assigned person. Any transfer of the logbook to a different person will require a signature and date from both the original assignee and the new person. Field notes will include identification of field control samples such as duplicates, split samples, MS/MSDs, equipment rinsate blanks, etc. Monitoring instrument readings will also be noted in the logbook. Other specifics regarding logbook entries, corrections, and opinions are discussed in Appendix A, SOP 507. The same requirements will be imposed on all Shaw field subcontractors. Copies of field logs will be kept with their respective analytical data reports and submitted with the reports to the USACE.

4.3 PHOTOGRAPHS

Photographs will be taken of sampled areas in support of the information written into the logbook. The date, time, weather conditions (if applicable), subject, purpose of taking photograph, person taking the photograph, photograph identification number and identifying number from roll will be recorded in the field logbook. This recorded information must be transferred to the back of the photograph after the photographs have been developed. Photographs will become part of the project files and are therefore subject to the documentation requirements of this CDQMP and the Contractor Quality Control Plan (USACE 1999a) for the FMSS. Digital photography may be used if the resolution is sufficient for the project needs.

5.0 SAMPLING EQUIPMENT AND PROCEDURES

The sampling and field measurement procedures that may be used on FMSS investigation and remediation tasks are provided in Appendix A. A list of the procedures is provided at the beginning of Appendix A. The 300-series of procedures in Appendix A describe a variety of soil and water sampling methods. These procedures describe sample types, equipment, and techniques. The 400-series of procedures, also in Appendix A, address different field measurement techniques. The 500 series procedures in Appendix A describe sample custody, decontamination, sample packaging and shipping, and proper use and control of a field notebook. The 600 series pertain to sample receipt, preparation, testing, and overall QC for the Maywood Onsite Laboratory. Procedures governing the operation of field radiological monitoring instruments and the performance of radiological surveys are established in the Radiation Protection Program, FMSS SSHP, Appendix C (USACE 2002). Shaw recognizes that these procedures are subject to the approval of the USACE Project Manager for the FMSS.

Specific details of the application of these techniques to the individual tasks or other procedures that may be required as part of the tasks will be included in the task-specific Work Plans. Any changes to the procedures referenced herein will also be approved by the USACE prior to implementation. If changes are made, the revised procedure will be noted with a revision number and incorporated into the CDQMP along with the approval documentation received from the USACE.

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6.0 REFERENCES

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APPENDIX A FIELD PROCEDURES

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MAYWOOD PROCEDURES LIST

The following is a list of procedures that will be used in conducting field sampling, testing, and associated activities at the Maywood site.

100 SERIES – SURVEYING AND SCREENING

SW-MWD-101-1	SURVEYING
SW-MWD-102-1	DOWNHOLE GAMMA RADIATION LOGGING
SW-MWD-103-0	ROUTINE OPERATIONS PROCEDURE FOR ISOCS MEASUREMENTS OF SURFACE SOIL - DELETED
SW-MWD-104-0	METHOD QC PROTOCOL FOR FIELD MEASUREMENTS USING CANBERRA'S IN-SITU GAMMA SPECTROMETER - DELETED
SW-MWD-105-1	SOIL GAS SURVEYS
SW-MWD-106-0	ISOCS PROCEDURE FOR IMPLEMENTATION OF QC PROTOCOL - DELETED
SW-MWD-107-0	EXPOSURE RATE INSTRUMENTS - <i>MOVED TO RADIATION PROTECTION PLAN</i>
SW-MWD-108-1	GLOBAL POSITIONING SYSTEM (GPS) SURVEY
SW-MWD-110-0	DATA VALIDATION PROTOCOL FOR FIELD DATA COLLECTED USING CANBERRA'S IN-SITU GAMMA SPECTROMETER - DELETED
SW-MWD-112-0	CONTROL OF SEALED RADIOACTIVE SOURCES - <i>MOVED TO RADIATION PROTECTION PLAN</i>

200 SERIES – GEOTECHNICAL

SW-MWD-201-1	AQUIFER TESTING
<i>SW-MWD-202-0</i>	<i>RESERVED</i>
SW-MWD-203-1	ROCK CORING
SW-MWD-204-1	SLUG TESTING
SW-MWD-205-1	PACKER TESTING

300 SERIES – SAMPLING

SW-MWD-301-1	SEDIMENT SAMPLING
SW-MWD-302-1	SURFACE WATER SAMPLING
SW-MWD-303-1	MONITORING WELL INSTALLATION AND DEVELOPMENT
SW-MWD-304-1	PURGING AND SAMPLING MONITORING WELLS
SW-MWD-305-0	RESERVED
SW-MWD-306-1	RADON SAMPLING

SOIL AND BUILDING MATERIALS SAMPLING

SW-MWD-307-1	SURFACE AND SHALLOW SUBSURFACE SOIL SAMPLING
SW-MWD-308-1	SOIL BORINGS AND SAMPLING
SW-MWD-309-1	CONCRETE CORE SAMPLING
SW-MWD-310-0	RESERVED
SW-MWD-311-1	BUILDING MATERIALS SAMPLING
SW-MWD-312-1	WIPE SAMPLING PROCEDURES
SW-MWD-313-1	DRUM HANDLING AND SAMPLING

400 SERIES - FIELD MEASUREMENT PROCEDURES

SW-MWD-401-1	OPERATION OF THE MULTIRAE MULTI-GAS MONITOR
SW-MWD-402-1	OPERATION OF THE TVA-1000 PHOTOIONIZATION/FLAME IONIZATION DETECTOR

SW-MWD-403-1	OPERATION OF THE TSI DUST TRAK™ AEROSOL MONITOR
SW-MWD-404-1	RESERVED
SW-MWD-405-1	CALIBRATION AND MAINTENANCE OF TURBIDIMETER
SW-MWD-406-1	CALIBRATION AND MAINTENANCE OF ORION PLATINUM EH ELECTRODE
SW-MWD-407-1	CALIBRATION AND MAINTENANCE OF IN-SITU HERMIT ENVIRONMENTAL DATA LOGGER
SW-MWD-408-1	CALIBRATION AND MAINTENANCE OF SOLINST INTERFACE METER
SW-MWD-409-1	ON-SITE WATER QUALITY TESTING
SW-MWD-410-1	GROUNDWATER LEVEL MEASUREMENT

500 SERIES – MISCELLANEOUS

SW-MWD-501-1	CONDUCTING FIELD AUDITS
SW-MWD-502-0	<i>RESERVED</i>
SW-MWD-503-1	OVERBURDEN DRILLING METHODS
SW-MWD-504-1	LABELING, PACKAGING, AND SHIPPING ENVIRONMENTAL SAMPLES
SW-MWD-505-1	CUTTINGS AND FLUIDS MANAGEMENT
SW-MWD-506-1	DECONTAMINATION
SW-MWD-507-1	FIELD NOTEBOOK CONTENT AND CONTROL
SW-MWD-508-1	PROCEDURE FOR SHIPPING RADIOLOGICALLY CONTAMINATED ENVIRONMENTAL SAMPLES
SW-MWD-509-1	SOIL PROBE INVESTIGATION

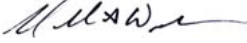
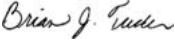
600 SERIES – ONSITE LABORATORY

SW-MWD-601-1	LABORATORY INTERNAL DATA EVALUATION: QUALITY ASSURANCE AND CORRECTIVE ACTION
SW-MWD-602-1	ANALYTICAL DATA MANAGEMENT AND TRACKING
SW-MWD-603-1	RADIOCHEMISTRY LABORATORY DOCUMENT DEVELOPMENT AND CONTROL
SW-MWD-604-1	SAMPLE IDENTIFICATION AND STORAGE
SW-MWD-605-1	SAMPLE CONTAINER CONTROL
SW-MWD-606 THROUGH 609	- <i>RESERVED</i>
SW-MWD-610-1	PREVENTIVE MAINTENANCE PROGRAM
SW-MWD-611-1	LABORATORY CONTAMINATION CONTROL
SW-MWD-612-1	SAMPLE DISPOSAL
SW-MWD-613-1	HAZARDOUS WASTE MANAGEMENT
SW-MWD-614-1	620 - <i>RESERVED</i>
SW-MWD-621-1	CANBERRA GAMMA SPECTROSCOPY SYSTEM OPERATION
SW-MWD-622-1	ORTEC GAMMA SPECTRUM ANALYZER OPERATION
SW-MWD-623-1	OPERATION OF THE PROTEAN WPC-9550 ALPHA-BETA GAS PROPORTIONAL AUTOMATIC PLANCHET COUNTER
SW-MWD-624-1	- 640 - <i>RESERVED</i>
SW-MWD-641-1	- RECEIPT AND PREPARATION OF SOIL SAMPLES FOR ANALYSIS BY GAMMA SPECTROMETRY

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Surveying

APPROVED:

	9/30/2003
Mike Winters	Date
Radiation Safety Officer	
	9/30/2003
Brian Tucker	Date
Project Chemist	
	9/30/2003
Andrew Mills	Date
Project Manager	

1.0 PURPOSE

This Standard Operating Procedure (SOP) - Surveying provides the controls and the responsibilities necessary to perform field surveying activities at the FUSRAP Maywood Superfund Site (FMSS) in an accurate and practical manner.

2.0 SCOPE

This SOP details the equipment and methods common to field surveying activities. This SOP serves as general guidance on proper field surveying methods. Always consult state-specific, program-specific, or project requirements to ensure compatibility of this SOP. Changes to this SOP should be documented within the site-specific Work Plan. Field changes to this SOP shall be discussed with the Project Manager prior to implementation and shall be documented in project field logbooks.

3.0 REFERENCES

None

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for surveying.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Site Manager has been properly briefed and is prepared for the surveying task.

5.3 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting surveying in accordance with the project requirements, this SOP and related SOPs. Assures that all necessary equipment is available and functioning properly before project operations begin. Assures that all necessary personnel are mobilized on time. Maintains daily log of activities each workday.

Coordinates and consults with Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

5.4 SITE PERSONNEL

All employees and subcontractors who are engaging in site activities are required to read and sign the Maywood Health and Safety Plan (SSHP) and to follow the procedures in this SOP, unless superseded by project specific requirements. All surveying activities, including deviations to this SOP, will be recorded in field books during on-site activities.

5.5 SITE HEALTH & SAFETY OFFICER

All field activities must be carried out in accordance with the SSHP. The Site Health and Safety Officer (SHSO), who may also serve as a surveyor, is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met at the

FMSS.

6.0 PROCEDURE

Basic equipment necessary for field surveying activities include:

- Site Map
- SSHP. To be read and signed by all site personnel prior to site activities.
- Field logbook(s)
- permanent landmarks
- known benchmark points
- field traverse
- theodolite
- Electronic Distance Meter (EDM) or conventional steel measuring tape
- transit
- tripod

6.1 GENERAL PROCEDURES

Surveying assignments shall be performed with qualified personnel under the direction of a New Jersey licensed surveyor. All survey drawings supplied by a licensed surveyor should be stamped with the state seal.

A licensed surveyor of Stone & Webster will review surveys performed by a subcontractor. Review will be of a sufficient magnitude to verify that the accuracy stipulated in the contract agreement has been achieved.

6.2 GROUND CONTROL SURVEY PROCEDURES

Ground control surveying practices will follow acceptable methods and techniques currently being used in the industry.

Horizontal Control establishment will be accomplished through a field traverse with control points being set. Control will begin and terminate at known points of reference, or will be a closed geometric loop. Traverse points will be referenced to three permanent landmarks where practical. Reference distances will be measured to the nearest hundredth of a foot. Tie sketches of all control points will be drawn.

Angular measurement will be made with a theodolite capable of reading to the nearest 20 seconds (minimum). The angular measurement will be repeated two times with an average measurement used. The total angular error for primary survey traverse is not to exceed five seconds times the square root of the number of points in the primary traverse. Secondary control survey traverse requires a total angular tolerance error not to exceed ten seconds times the square root of the number of points in the secondary traverse.

Distance measurements will be made with an EDM or by conventional steel measuring tape. Measurement of traverse lines will be made in both directions with the mean measurement used provided the accuracies meet the requirements of the section entitled "Standard of Accuracy for Ground Control Surveys".

Slope distance measurement will require the vertical angle to be made twice; direct and inverted, with the mean measurement used.

Leveling will be by differential leveling methods only (no trigonometric leveling). Benchmark points will be turned on as a part of the level circuit. Only previously adjusted turning points will be used as benchmarks. If no previously adjusted turning points are available, temporary benchmarks will be allowed.

6.2.1 Standard of Accuracy for Ground Control Surveys

Horizontal angular measurement will be repeated two times and will require an average angle within 15 seconds of the initial measurement used. The total allowable angular error for primary survey traverse is five seconds times the square root of the number of points in the primary traverse. Secondary control survey traverse requires a total angular tolerance error of ten seconds times the square root of the number of points in the secondary traverse.

Distance measurements will be taken to the nearest one one-hundredth (0.01) of a foot. An EDM shall be used with the proper adjustment for atmospheric pressure and temperature. Measurement between stations will be recorded from both stations. Both primary and secondary control survey errors are not to exceed 0.005 feet per 100 feet. Topographical surveys may allow greater control survey errors.

Vertical control will be established on transverse points and on benchmarks. The elevations on these points shall be determined through a closed level circuit. Each traverse point shall be a turning point of the circuit and tolerance of closure will not exceed 2.0 mm time the square root of K (where K is kilometer = .62137 miles or 3280.83 feet).

6.3 MONITORING WELL SURVEY PROCEDURES

Monitoring well surveying practices will follow acceptable methods and techniques currently being used in the industry.

Horizontal Control will be located directly off primary or secondary control survey base lines.

Angular measures will be made with a transit or theodolite capable of reading to the nearest 20 seconds. The angular measurement shall be repeated twice and will require an average angle within ten seconds of the first angle.

Distance measurements will be made with an EDM or a steel tape and measured level or with correction made for slope reduction. Stadia distances are not acceptable, unless

approved by the Project Manager.

Wells will be located horizontally from two stations where applicable (practical) to the nearest 0.01 of a foot.

Leveling measurements will be made on well casings as part of a level circuit. Each well casing will be a turning point of the circuit. Turns will be made on the highest point of the exterior of the well casing and marked with paint, unless otherwise specified by the Project Manager.

Stick-up distances from ground elevation shall be recorded to the nearest tenth of a foot.

6.3.1 Standard of Accuracy for Monitoring Well Surveys

Horizontal angle measurement will be repeated twice and will require an average angle within ten seconds of the first angle. Distance measurements will be taken to the nearest 0.01 of a foot.

Elevations will be established on well casings through a closed level circuit. Each casing will be a turning point of the circuit and tolerance of closure will not exceed 0.01 foot for every 1,000 feet.

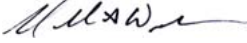
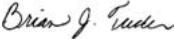
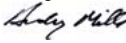
7.0 ATTACHMENTS

None

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Downhole Gamma Radiation Logging

APPROVED:

	9/30/2003
Mike Winters Radiation Safety Officer	Date
	9/30/2003
Brian Tucker Project Chemist	Date
	9/30/2003
Andrew Mills Project Manager	Date

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP)- Downhole Gamma Radiation Logging is to provide guidelines and requirements for collecting measurements of the gamma radiation count rate within a pre-drilled borehole at the FUSRAP Maywood Superfund Site (FMSS) to characterize the presence of subsurface gamma-emitting radionuclides.

2.0 SCOPE

This procedure is applicable to all personnel involved in collecting downhole gamma radiation measurements. The basic procedure described in this SOP is applicable to shallow borehole (approximately five feet in depth) downhole gamma logging only. Boreholes shall be inserted manually with a jackhammer or other equipment. Gross gamma count rate measurements shall be performed with a small (e.g., 3/8 x 3/8 inch) NaI detector.

3.0 REFERENCES

None

4.0 DEFINITIONS

Downhole Gamma Logging as used in this procedure, are a series of measurements collected at six inch intervals within a pre-drilled borehole to quantify the presence of subsurface gamma ray emitting radionuclides.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform downhole gamma radiation logging.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the downhole gamma radiation logging task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a site-specific Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the project manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on conducting downhole gamma radiation logging in accordance with the project requirements, this SOP and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each work day.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

6.0 PROCEDURE

General Guidelines and Requirements:

1. Count rate measurements will be made with a gamma scintillation detector coupled to a Ludlum model 2221 ratemeter / scaler, or equivalent.

2. Personnel performing measurements shall take the necessary precautions to maintain their exposures as low as reasonably achievable. The following precautionary measures should be considered:
 - a. Perform a review of previous surveys (if available) and operations performed in the area to determine the expected radiation exposure rates which will be encountered.
 - b. Ensure instrument operability prior to entering the borehole area.
 - c. Ensure that necessary support equipment is available (recording equipment, watch, bags for contamination control if applicable, etc.) prior to entering the area or surrounding controlled area.
3. If an instrument must be carried through or into a contaminated or potentially contaminated area and is likely to become contaminated, ensure the instrument is enclosed in protective material prior to entering the area.

Equipment:

1. NaI detectors: 3/8 x 3/8 inch for 5 foot boreholes (manually driven boreholes)
2. Portable ratemeter / scaler
3. Indelible ink pens
4. Downhole gamma logging and quality control forms (see attachments)
5. Watch
6. Bags for contamination control
7. String

Gamma Radiation Logging Procedure:

1. Record all required survey and instrument information on the Downhole Gamma Logging form.
2. Determine the borehole location on the referenced grid system established for the site.
3. Install the borehole manually with a jackhammer, or other shallow borehole-forming equipment.
4. Perform source check, battery check, and background check on the NAI detector. Record data on quality control forms.
5. Attach a string to the detector, clearly marked with black indelible ink at six-inch intervals.
6. Starting at the surface, directly over the borehole, collect 30 second count readings. Record the number of counts on a data sheet. Lower detector into the hole, stopping when the center of the NaI crystal is six inches below the ground surface. Collect 30 second count readings.
7. Continue to collect 30-second count measurements at six-inch intervals until reaching the bottom of the borehole. Most boreholes will be 5 feet in depth.

7.0 ATTACHMENTS

Downhole Gamma Logging Form

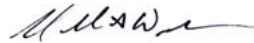
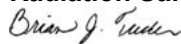
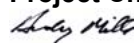
Quality Control Form

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Soil Gas Survey

APPROVED:

	9/30/2003
Mike Winters	
Radiation Safety Officer	Date
	9/30/2003
Brian Tucker	
Project Chemist	Date
	9/30/2003
Andy Mills	
Project Manager	Date

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP)-Soil Gas Survey is to provide the controls and the responsibilities necessary to perform soil gas surveys at the FUSRAP Maywood Superfund Site (FMSS) at locations where volatile organic compound (VOC) vapors are known or suspected to exist. at

Soil gas surveys for VOC compounds can be useful for such environmental characterization purposes as:

- Discovery of the extent of site VOC contamination
- Estimate of the source and extent of the area plume
- Selection of surface soil sampling locations
- Selection of boring locations
- Placement of groundwater monitoring wells
- Screening for disposal characterization purposes

They also may provide for more accurate placement of soil borings and monitoring wells in the next phase of investigation. In most instances, soil gas survey results are available instantaneously.

2.0 SCOPE

This SOP details the materials, equipment, and methods common to the surveying of soil gas samples for the presence of VOCs. This SOP presents the proper methods for conducting soil gas surveys. Always consult state-specific or other project-specific requirements to ensure compatibility of this SOP. Changes to this SOP should be documented within the task-specific Sampling and Analysis Plan (SAP), Site Safety and Health Plan (SSHP), or other applicable work plan. Field changes to this SOP shall be discussed with the Project Manager prior to implementation and shall be documented in project field log books. All changes will be made in accordance with the Maywood Contractor Quality Control Plan.

3.0 REFERENCES

1. SOP SW-MWD-402-1 – Operation of the TVA-1000 Photoionization/Flame Ionization Detector
2. SOP SW-MWD-505-1 – Cuttings and Fluids Management
3. SOP SW-506-1 – Decontamination
4. SOP SW-MWD-507-1 – Field Notebook Content and Control

4.0 DEFINITIONS

<u>EV</u>	Electron Volts
<u>FID</u>	Flame Ionization Detector
<u>FSP</u>	Field Sampling Plan
<u>GC</u>	Gas Chromatograph
<u>SSHP</u>	Site Safety and Health Plan
<u>PID</u>	Photoionization Detector
<u>PPE</u>	Personal Protective Equipment
<u>SAP</u>	Sampling and Analysis Plan
<u>SOP</u>	Standard Operating Procedure
<u>VOC</u>	Volatile organic compound

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform soil gas survey analytical screening.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the soil gas survey screening task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a site-specific SSHP. The Site Safety and Health Officer (who may also serve as a soil gas surveyor) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the project manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on conducting soil gas survey analytical screening in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each work day.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

5.5 SITE PERSONNEL

Site personnel assigned to perform the soil gas survey activities will be trained in the proper techniques for conducting the work. They are required to read and sign the site-specific SSHP and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All soil gas surveying activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

6.0 PROCEDURE

6.1 GENERAL EQUIPMENT AND MATERIAL REQUIREMENTS

The following is a list of equipment & material which is commonly used on all field VOC screening projects.

- Field Sampling Plan (FSP) and task-specific SAP
- SSHP. To be read and signed by all site personnel prior to site activities.
- Personal Protective Equipment (PPE)
- Field Logbook(s)
- VOC vapor meter (Photoionization Detector (PID) or Flame Ionization Detector (FID))
- Calibration gas for VOC vapor meter
- On/off valves
- Drill
- Drill bits, 1/2", 5/8", 11/16", and 3/4"
- 5/8" diam. pipe probes (driveable or passive)
- Generator - for power tools and/or non-battery operated vacuum pump
- 16" Needle valve

- Stainless steel union tee, 3/16"
- Stainless steel reducer, 3/16" to 1/8"
- Gray silicone rubber septa, 1/4" diam.
- Vacuum extraction pump (to 25" Hg) that does not contribute to blank contamination
- Retractable probes
- Sampling tips
- Air piezometer
- Detector tubes
- Zero Air compressed gas tank
- Hand auger
- Slide hammer, pneumatic hammer, and/or electric hammer (depending on the type(s) of sampling media anticipated)
- Teflon® tubing
- Compass
- "Rocktite", plumber's putty, or rubber stopper - to create surface seal for soil gas probe
- Field Data Forms
- Decontamination supplies - See Decontamination SOP and FSP
- Indelible markers
- Stakes with orange flags
- Fluorescent paint or wax pencils
- Trash containers
- Construction gloves
- Paper towels
- Aluminum foil
- Plastic garbage bags
- Storage containers (e.g. DOT approved 55 gallon drums) for storage and disposal of contaminants and contaminated soils

If a field Gas Chromatograph (GC) is being employed, include the following:

- Field GC
- Calibration standards
- 40 milliliter (ml) glass sample bottles with Teflon® lined lids

- Air-tight sampling syringes, 1 ml and 5 ml

6.2 GENERAL SOIL GAS SURVEY SCREENING ANALYTICAL PROCEDURES

Soil gas samples may be analyzed in the field using any of the following; a PID, a FID, and/or a portable GC. Depending on site conditions and/or the specific needs of the sampling program one of these methods will be chosen. Sections 6.3 and 6.4 contain the procedures which are common to all soil gas sample collection tasks. These steps should be followed in addition to the steps required for each method discussed in Sections 6.5, 6.6, and 6.7 below.

6.3 PRE-SOIL GAS SURVEY ACTIVITIES

An inspection of the area slated for the soil gas survey shall be conducted prior to field mobilization and as part of the planning task. Site access issues (e.g. physical and/or time restrictions), ground cover (e.g. paved and/or unpaved), the presence of power supplies, and the presence of subsurface utilities shall all be evaluated as part of the planning process.

Upon mobilization to the site, the following activities will be performed and recorded in the field log book immediately prior to conducting the site soil gas survey:

1. Create a sampling grid for site areas suspected of containing contamination; the sampling points should be located in rows and equally spaced (about 15 to 40 feet apart, depending upon the size of the sampling area). Spacing may be closer in areas where sources of contamination are known to exist. If possible, reference the grid to one or more site landmarks or unique features on the grid drawing. The orientation of the grid to compass "north" shall also be established and recorded.
2. A unique numbering system shall be used. One system that is recommended is to start sample point one at the northwest corner of the grid. Numbers would then increase from west to east across the first row and proceed from the northernmost row to the southernmost row (i.e., numbers would increase in a direction similar to the direction words are read on a page)
3. Use a steel measuring tape to layout the sampling grid. Clear each sampling point of loose debris and mark sampling grid using stakes with orange flags for dirt or grass areas and fluorescent paint or wax pencil for asphalt or concrete covered locations.
4. Draw grid layout with numbering system in Field Logbook.
5. Create Results Table in Field Logbook.
6. Assemble soil gas sampling train.
7. Adjust needle valve upstream of pump one and a half turns counter-clockwise from the closed position.
8. Swage an 1/8" stainless steel nut onto the PID (or FID) meter tubing by positioning the nut at a point along the tubing length that will allow the tubing to be inserted into the stainless steel tee during the testing.
9. Calibrate equipment; for details, see Section 6.10, Calibrations.

6.4 SOIL GAS SAMPLING ACTIVITIES

The following steps outline soil gas sample collection activities:

1. If the surface is concrete or asphalt, first make a hole in the concrete using a 3/4" drill with a masonry bit. The bit size should be 1/8" larger than the pipe probe diameter; e.g., if a 5/8" pipe probe is being used, drill the hole with a 3/4" bit.
2. Next, make a hole in the sampling surface at the desired location. The first option is to use a manual driver such as a bucket auger or slide hammer. While inexpensive, it can be time-consuming and labor-intensive. Manual driving may be impossible in hard-packed soil, gravel, or soil with sufficient amount of stones. The second option is to use an electrical hammer. This is an attractive option if driving the probe to deeper depths or penetrating pavement. A portable generator or electrical outlet (if available) is required for operation. The third option is to use a hydraulic unit. These are typically mounted in a field vehicle and can typically reach depths of 20 feet. Units equipped with percussion capability are even more effective and those with a rotary function can drill through concrete. The drawback to the hydraulic unit is the high capital cost.
3. Attach a shielded sampling tip to the end of the pipe probe. This tip will typically have Teflon[®] tubing attached that passes right through the pipe probe.
4. Drive the pipe probe with attached tip to a depth of about one foot.
5. If deeper sampling points are desired, manually push the probe further into the soil if the soil is soft. It is more likely that a slide hammer, pneumatic hammer, or electric hammer will be used depending on the nature of the soil and the desired depth. Use extension shafts for deeper depths.
6. A permanent position marking should be made every six inches along the lengths of the pipe probe and extension shafts so that the depth of sample collection can be recorded.
7. Pipe probe sampling depths as well as observations concerning the nature of the sampling surface must be recorded in the Field Logbook.
8. Make a seal at the surface using Rocktite or plumber's putty or a rubber stopper to keep surface air from short circuiting the system.

Test soil gas using field screening equipment (PID or FID) as follows:

1. Zero the PID or FID by operating the equipment in a background area, typically on or near the site perimeter at an upwind location.
2. The well volume should be evacuated prior to sampling. To sample soil gas, connect the PID or FID sample tubing to the tee arm of a stainless steel tee. The tee sidearm has a reducer fitting attached to it sized so that the PID or FID probe fits snugly into it. Insert the meter probe directly into the sidearm tubing. Allow the equipment to draw in the soil gas for several seconds prior to taking a reading. The maximum instrument response should be recorded. Record instrument response in Field Logbook Table and Soil Gas Screening Results Log (see Attachment B).

Instrumentation with digital (LED/LCD) displays may not be able to discern maximum headspace response unless equipped with a "maximum hold" feature or strip-chart recorder. The sampler must

clear the maximum response value prior to each sample screening event. Record the highest meter response as the soil gas concentration in the field log book and on the form included as Attachment B.

For additional details on screening detectors for the analysis of soil gas, refer to the following Sections:

- 6.5 for specific information regarding the use of PID instruments
- 6.6 for specific information regarding the use of FID instruments

For collection and analysis of soil gas vapors by field GC using a stainless steel tee with septum, proceed as follows:

1. Connect one end of the stainless steel tee to the pipe probe and the end directly opposite to a vacuum pump.
2. Screw a stainless steel nut containing a 1/4" gray silicone rubber septum onto the reducer end of the tee arm.
3. Turn on pump and flush the soil gas through the main manifold for one to two minutes (for blanks, use zero air as the gas source; for calibration standards, use commercially prepared standard mixtures, the concentrations of which bracket the range of interest).
4. Insert syringe needle through septum and into tee so that the tip of the needle is in the flow path of the soil gas.
5. Open syringe valve and draw plunger to about two-thirds of maximum capacity; depress plunger. Perform this step several times to flush syringe and reduce the likelihood of carryover. Finally, draw plunger to past the one ml mark, close the syringe valve, and withdraw needle. Change septum every 20 injections to avoid the possibility of leaks.

To Analyze Sample:

1. Analyze two calibration standards that bracket the concentration range of interest.
2. Analyze blank sample (blank sample is collected as per Section 6.9).
3. Depress syringe plunger slightly so that the plunger head is even with the 1 ml mark of the syringe.
4. With GC in the "ready to inject" status, insert the syringe needle with sample completely into the GC injection port. Simultaneously depress the syringe plunger and push the GC start or go button. For blanks, the same procedure should be followed using background air. Record instrument response in Field Logbook Table and Soil Gas Survey Results Log.

For more details on the use of field GCs for screening analysis of soil, refer to Section 6.7.

6.5 SOIL GAS SCREENING USING A PHOTOIONIZATION DETECTOR

A PID operates on the principle that VOCs, when subjected to a sufficient energy level of photoionizing energy will eject photons which can be detected by special instrumentation. Each

compound requires a specific level of energy which must be reached before this effect (and therefore the compound) can be detected. Refer to Attachment A - Photoionization Activation Energy Levels for Common Volatile Contaminants for the activation energy requirements of the common chemicals of concern. When using a PID meter at sites with unknown volatile chemicals of concern, PID instruments must be operated with a minimum 10.6 eV (+/-) lamp source (11.7 eV is recommended if available). For sites with known chemicals of concern Attachment A can be used to determine the minimum lamp energy required in your screening instrument.

Please note that certain compounds such as methane cannot be detected by the commercially available field instruments (11.7 eV is currently the maximum). PIDs are also more sensitive to low temperatures and the presence of moisture than FIDs. If wet field conditions or screening of water samples is anticipated, the use of a FID should be considered.

Operation, maintenance, and calibration of the PID shall be performed in accordance with the manufacturer's specifications.

6.6 SOIL GAS SCREENING USING A FLAME IONIZATION DETECTOR

Operation, maintenance, and calibration of the FID shall be performed in accordance with the manufacturer's specifications.

A FID will react to all VOCs. FIDs will also detect the presence of methane gas, which cannot be seen by field PIDs (methane has a photoionization activation energy level of 12.6 eV which is greater than the energy level field PIDs can generate). Methane gas is commonly present at landfills and in areas with active microbial activity such as wetlands. Although the presence of methane can be important from a health and safety standpoint because of its explosive properties, it is normally not a chemical of concern for environmental site investigations.

To distinguish between a FID response to "target" VOCs and methane, an activated charcoal filter must be placed over the sampling port so that the air sample is drawn through it. Activated charcoal will adsorb VOCs but will not adsorb methane. A FID response which is still present when a charcoal filter is employed is an indication that methane rather than VOCs is present.

6.7 SOIL GAS SCREENING USING A GAS CHROMATOGRAPH

Advances in field instrumentation are allowing the power of the compound specific identification of GCs to be used in the field. GCs are slower and more costly to operate than the readily available PID and FID meters, but under the right conditions may provide "real-time" analysis which can substitute for the slower and more costly laboratory analysis. The data quality objectives of the project must be considered to determine if the additional time and expense of field GC operation can be justified for your project.

It is important to note that most field GCs employ a PID energy source to detect VOCs. When employing a PID GC, the PID technology listed in Section 6.5 applies.

6.8 QUALITY ASSURANCE

Emphasis should be placed on thoroughly decontaminating sample collection equipment prior to use, and making sure that there is no cross-contamination or sampling equipment components that may introduce contamination. Sampling equipment will typically be decontaminated by the manufacturer or supplier.

Collect one duplicate sample for every ten soil gas samples collected. See Section 6.1 for sample bottle requirements if a field GC is to be employed. Soil gas survey screening data should be recorded and compared; generally, duplicate sample values should be consistent to plus or minus 20 percent.

Every ten samples, perform three successive measurements of a single sample as a check on single sample reproducibility.

Since the intent of soil gas surveying is for screening purposes, and since significant matrix effects are not anticipated, no matrix spikes will be performed.

6.9 BLANKS

If PID or FID field screening equipment is being used, collect an equipment blank as follows:

1. Connect zero air source (99.9999% pure) with needle valve attached to sampling manifold (without the pump) with sidearm tee
2. Make sure needle valve is closed; slowly open zero gas supply valve
3. Flush sampling manifold with zero air for about five minutes
4. To sample zero air, insert the PID or FID sample tubing into the sidearm tubing.
5. Allow the equipment to draw in the soil gas for several seconds prior to taking a reading. The maximum instrument response should be recorded. Record instrument response in the Field Logbook Table and Soil Gas Screening Results Log.

If portable GC analysis is being performed, collect an equipment blank by passing zero air through the pipe probe manifold and into a Tedlar bag or glass bomb, as follows:

1. Connect zero air source with needle valve attached to Tedlar bag or glass bomb
2. Make sure needle valve is closed; slowly open zero gas supply valve
3. Purge with zero air for at least five minutes
4. Collect the blank sample in the Tedlar bag or glass bomb. Isolate sample container by closing valve connection to sample collection device.
5. Analyze sample as per Section 6.0.

6.10 CALIBRATIONS

If field screening equipment is being used, calibrate the equipment in accordance with manufacturer's instructions. PID and FID field instruments shall be operated and calibrated to yield

"total organic vapors" in ppm (v/v) as benzene unless the user is screening for a specific compound of concern. In the latter case, the instrument can be calibrated for representative response to the target compound.

If a portable GC is being used, it must be calibrated with at least two standard concentrations that bracket the expected concentration range of the sample analytes. If the sample concentration exceeds the calibration range, the results should be considered estimated. Alternatively, the sample may be diluted to bring the concentration into the calibration range, or a higher concentration standard may be employed.

For soil gas analysis, instrument calibration shall be checked/adjusted no less than once every 10 analyses, or daily, whichever occurs sooner.

Calibration results should be saved by taping into the field notebook or placing in a separate binder.

6.11 DECONTAMINATION WASTES

For decontamination of equipment, refer to the SOP entitled Decontamination.

After removal and decontamination of the pipe probes, drill bits, and other sampling equipment that came into contact with the sampling medium, the sampling holes must be restored as much as possible to their original condition. If no contamination was detected by the survey equipment, any soil or asphalt removed to create the hole may be used to refill the hole. If a hole was made in uncontaminated concrete, a small slurry of concrete should be prepared and poured to restore the concrete. If contamination was detected, and if there's enough material, use a shovel to place the possibly contaminated soil, asphalt, or concrete into a 55 gallon drum. The drum should be labeled with the following information:

- a. Contents, in this case Investigation Derived Waste
- b. Site name
- c. Soil gas survey location
- d. Name and Initials of surveyor
- e. Date and time of filling

Decontaminate the shovel and any other equipment used to remove the contaminated soil.

7.0 ATTACHMENTS

Attachment A - Photoionization Activation Energy Levels for Common Volatile Contaminants

Attachment B - Soil Gas Survey Results Log

ATTACHMENT A

Photoionization Activation Energy Levels for Common Volatile Contaminants

Analyte	IP (eV)
Acetone	9.69
Acrolein	10.10
Allyl alcohol	9.67
Benzene	9.245
Bromochloromethane (I.S.)	10.77
Bromoform	10.51
Bromomethane	10.53
n-Butanol	10.04
2-Butanone (MEK)	9.53
Carbon disulfide	10.08
Carbon tetrachloride	11.47
Chlorobenzene	9.07
Chlorodibromomethane	10.59
Chloroethane	10.98
Chloroform	11.42
Chloromethane	11.28
1,2-Dibromoethane	10.19
Dibromomethane	10.49
1,2-Dichlorobenzene	9.07
1,3-Dichlorobenzene	9.12
1,4-Dichlorobenzene	8.94
Dichlorodifluoromethane	12.31
1,2-Dichloroethane	11.12
trans-1,2-Dechloroethene	9.66
1,2-Dichloropropane	10.87
Diethyl ether	9.53
Ethanol	10.48
Ethyl acetate	10.11
Ethyl benzene	8.76
Ethylene oxide	10.565
2-Hexanone	9.34
Iodomethane	9.54
Isopropylbenzene	8.69
Methane	12.98
Methanol	10.85
Methylene chloride (DCM)	11.35
4-Methyl-2-pentanone (MIBK)	9.30
Naphthalene	8.12
Nitrobenzene	9.92

**Photoionization Activation Energy Levels for
Common Volatile Contaminants**

Analyte	IP (eV)
□-Propiolactone	9.70
Pyridine	9.32
Styrene	8.47
Tetrachloroethene	9.32
Toluene	8.82
Trichloroethene	9.45
Trichlorofluoromethane	11.77
Vinyl acetate	9.19
Vinyl chloride	9.995
o-Xylene	8.56
m-Xylene	8.56
p-Xylene	8.445

Soil Gas Survey Results Log

Job No:

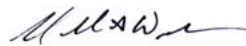
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STANDARD OPERATING PROCEDURE

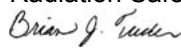
FUSRAP Maywood Superfund Site

Subject: Global Positioning System (GPS) Survey

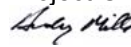
APPROVED:

 9/30/2003

Mike Winters
Radiation Safety Officer Date

 9/30/2003

Brian Tucker
Project Chemist Date

 9/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP)-Global Positioning System (GPS) Survey is to provide guidelines and requirements for the locating of sampling points with a Global Positioning System (GPS) at the FUSRAP Maywood Superfund Site (FMSS).

2.0 SCOPE

This procedure is applicable to all personnel involved in using the GPS to document sampling locations.

3.0 REFERENCES

Surveying and Mapping Product Training, Real-Time Surveying, Trimble Navigation Ltd., 1998.

Survey Controlled Reference Manual, TSC1, Trimble Navigation Ltd., December 1997.

4400 Reference Manual, Trimble Navigation Ltd., May 1996.

4.0 DEFINITIONS

GPS – A GPS is a satellite-based positioning system, operated / controlled by the U.S. Department of Defense. The GPS includes 24 satellites, and can be used by anyone who has a GPS receiver. The GPS receiver is used for position determination, navigation, and survey tasks on land, sea, and in the air.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to use the GPS for locating sampling points.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for using the GPS to locate sampling points.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a site-specific SSHP. The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designed by the Project Manager to supervise and investigate activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on using the GPS to locate sampling points in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each work day.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

6.0 PROCEDURE

The method of utilizing GPS varies with each application and the type of GPS equipment used. Operating methods range from low precision code phase systems to highly accurate carrier phase systems that facilitate on-the-fly measurements, also known as real-time kinematic surveying (RTK). Generally, the RTK system includes a GPS antenna, a GPS receiver, a radio modem and radio antenna, and a data collector for both the roving and the base stations. The first step in the RTK process is the base GPS antenna sends the observed satellite signals to the base receiver. The base receiver then sends the raw GPS data and base position to the radio modem. The base radio modem proceeds to send the observed data and base position to the roving radio modem. Finally, the roving receiver processes the observed data from both receivers and computes the roving position relative to the base.

Equipment and materials:

1. Trimble 4400 Site Surveyor base and roving stations with related cables, power supplies, and location equipment.
2. Trimble 4400 L1/L2 GPS base and roving antennas.

3. Trimble TSCI data collector.
4. Pacific Crest radios with antennas.
5. Trimble backpack with related cables.

Tasks:

1. Plan site visit. Check for adequate satellite coverage, determine approximate locations of necessary benchmarks, and find location for set-up of base station.
2. At site, set up base receiver, GPS antenna, radio antenna and modem, and necessary power supplies.
3. Start base receiver and rover receiver.
4. Start survey (typically RTK).
5. Perform GPS site calibration using surveyed benchmarks or know points.
6. Measure sampling points, and enter feature codes, if necessary.
7. When finished with survey, end survey, and power down receivers.
8. Download survey data and use as necessary.

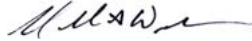
Quality control

GPS typically has quality control features that are built into the system. The system will not allow measurements to be taken if there are not enough satellites available to provide accurate readings, if the satellite geometry is not conducive to the survey, if any radio signals are lost, and for other reasons. Some systems also maintain quality control records during a survey that contain information about the quality of the GPS position, including the number of available satellites, satellite geometry, horizontal and vertical precision levels. These records can be accessed at any time during or after a survey in order to assure that the necessary quality standards are being met.

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Control of Sealed Radioactive Sources

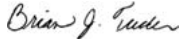
APPROVED:



9/30/2003

**Mike Winters
Radiation Safety Officer**

Date



9/30/2003

**Brian Tucker
Project Chemist**

Date



9/30/2003

**Andrew Mills
Project Manager**

Date

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides consistent methodology for handling, storage, and use of accountable sealed radioactive sources in support of FUSRAP Maywood Superfund Site (FMSS) operations.

2.0 SCOPE

This procedure applies to all personnel who receive, handle, or store sealed radioactive sources at the FMSS.

For the purpose of this procedure, guidance from the DOE (10 CFR 835) is being voluntarily incorporated as a conservative measure. The requirements of 10 CFR 835 with regards to sealed source control either satisfy or exceed NRC requirements outlined in 10 CFR 30.

3.0 REFERENCES

10 CFR 20, "Standards for Protection Against Radiation"

EM385-1-80, USACE Radiation Protection Manual

10 CFR 835, "Occupational Radiation Protection"

CFR 30, "Rules of General Applicability to Domestic Licensing of Byproduct material."

DOE Notice 441.2, "Radiological Protection for DOE Activities"

Safety and Ecology Corporation, Radiological Protection – Control of Sealed Radioactive Sources, JA-RP-19.

4.0 DEFINITIONS

Accountable Sealed Radioactive Source: A sealed source with a half-life greater than or equal to 30 days and an activity equal to or greater than that listed in Attachment 1.

Exempted Radioactive Materials: Radioactive materials exempted from accountability under DOE Notice 441.2. Exempt radioactive materials include: material in process, activated shields, and gaseous sources. Materials defined as consumer products (i.e., exit signs, smoke detectors, welding rods, etc.) are not subject to the requirements in this procedure.

Exempted Sealed Radioactive Source: A sealed source with a half-life of less than 30 days or an activity less than the value found in Attachment 1.

Physical Inventory: An inventory that confirms the physical location of each accountable sealed radioactive source. During the physical inventory, the adequacy of postings, labels, storage locations, containers, and/or devices where sources are stored are also evaluated.

Sealed Radioactive Source: Radioactive material that is contained in a sealed capsule, sealed between layers of non-radioactive material, or firmly fixed to a non-radioactive surface by electroplating or other means. A confinement barrier prevents dispersion of the radioactive material under normal and most accidental conditions relating to use of the sources.

Source Custodian: An individual who is responsible for physical control of the sealed source and for conducting a periodic physical inventory of all sealed sources assigned to his/her custody. This individual must be trained, at a minimum, as a radiological worker and instructed on site-specific source control procedures.

Source Integrity Test (leak test): A test to determine if a sealed radioactive source is leaking radioactive material. The test must be capable of detecting the presence of 0.005 μ Ci (200Bq).

5.0 RESPONSIBILITIES

1. The Radiation Safety Officer (RSO) is responsible for implementing this procedure.
2. Task Managers are responsible for ensuring that individuals assigned to routinely handle radioactive sources have successfully completed all commensurate training to include the following:
 - 40 Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and current 8 Hour Refresher.
 - Site Specific Employee Training (SET)
 - Radiation Worker Training (RWT)
3. Radiation Protection Technicians or any other work group using sealed radioactive sources are responsible for adhering to the requirements of this procedure.

4. Project Workers are responsible for utilizing sound ALARA concepts during handling, and notifying the RSO of the discovery of unattended sealed radioactive sources.

6.0 PROCEDURES

6.1 SOURCE CUSTODIANS

- 6.1.1 The site RSO or designee shall perform the function of Source Custodian.
- 6.1.2 The Source Custodian shall ensure that all accountable sealed sources are secured and locked in their respective storage containers when they are unattended or not in use.
- 6.1.3 Source Custodians shall ensure that physical inventories are taken every six months and that the accountability records are maintained for all accountable sealed radioactive sources.

The inventory list shall include:

1. Source Serial Number/ Model Number.
2. Isotope.
3. Activity.
4. Date of Assay.
5. Physical Location.
6. Date and results of semi-annual leak test

6.2 NEW, TRANSFERRED, LOST OR DAMAGED SOURCES

- 6.2.1 Source Custodians shall notify the RSO (unless the Source Custodian is the RSO) immediately of any change in use, storage, transfer, and disposal and of any loss of a radioactive source.
- 6.2.2 Any employee planning to procure additional radioactive sources shall notify the RSO in writing of the need for additional sources and all pertinent information pertaining to the source (e.g. type, form, isotope, activity, etc).

6.3 SOURCE INTEGRITY TESTING

- 6.3.1 Source Custodians shall ensure that for each accountable sealed radioactive source in inventory a sealed source integrity test (leak test) is performed at least:
 - Upon receipt of a new source
 - Every six months.
 - Upon transfer to a different storage location or site.
 - If damage to the source is suspected.

- 6.3.2 The test data shall be documented and maintained by the Source Custodians in the source inventory log. The test must be capable of detecting the presence of 0.005 μ Ci (200 Bq).

An integrity test consists of checking for the presence of removable activity which may have “leaked” from the sealed radioactive source. This is done by swiping the surface of the source. In the case where it is not appropriate to swipe the surface of the source (e.g., surface is electroplated, unreachable, surface swiping would be anti-ALARA, etc.) a surface adjacent to where the source is stored or used may be swiped.

Accountable sealed radioactive sources in long-term storage (more than six months) need only to have their integrity determined when they are removed from storage and before being placed in service (they still must be inventoried). Sources stored in this manner must be documented as such.

6.4 POSTING, LABELING AND STORAGE OF ACCOUNTABLE RADIOACTIVE SOURCES

- 6.4.1 Radioactive items or containers of radioactive materials shall be individually labeled if adequate warning is not provided by control measures and posting.
- 6.4.2 All sealed accountable radioactive sources, or their associated storage containers shall be clearly marked as radioactive material with the words “Caution - Radioactive Material”, or the standard radiation symbol.
- 6.4.3 Storage containers and devices containing sealed radioactive sources shall have a durable label identifying the:
- Radionuclide,
 - Source,
 - Activity,
 - Date of assay,
 - Model and serial number of the source, and the
 - Source custodian name and telephone number.
- 6.4.4 Storage rooms or cabinets containing sealed radioactive sources shall be locked and posted.
- 6.4.5 These storage rooms or cabinets should be chosen to meet the requirements of 5.4.4 of JA-RP-19, i.e.:
- Prevent damage from fire.
 - Be free of flammable substances.
 - Be isolated from occupied areas or located in radiological areas.

The cabinet is selected so that if there is personnel activity in the area, the radiation level at the closest approach is ALARA and does not exceed 0.5 mrem/hr on average.

6.5 SOURCE DOCUMENTATION

The RSO will generate and maintain a list of all sources. This list will include the following information on each source:

- Source type,
- Source serial number and other identifiers as appropriate,
- Original assayed value and date,
- Decay corrected values (when appropriate) at predetermined dates.

7.0 ATTACHMENTS

Attachment 1 "Values for Exemption of Sealed Sources from Inventory and Integrity Testing"

Attachment 2 "FMSS Source Inventory Log"

Attachment 3 "FMSS Source Check Out Log"

ATTACHMENT 1

**VALUES FOR EXEMPTION OF SEALED SOURCES
FROM INVENTORY AND INTEGRITY TESTING**

Less than 300 μCi (1×10^7 Bq)

H-3	Be-7	C-14	S-35	Ca-41	Ca-45	V-49	Mn-53
Fe-55	Ni-59	Ni-63	As-73	Se-79	Rb-87	Tc-99	Pd-107
Cd-113	In-115	Te-123	Cs-135	Ce-141	Gd-152	Tb-157	Tm-171
Ta-180	W-181	W-185	W-188	Re-187	Ti-204		

Less than 30 μCi (1×10^6 Bq)

Cl-36	K-40	Fe-59	Co-57	Se-75	Rb-84	Sr-85	Sr-89
Y-91	Zr-95	Nb-93m	Nb-95	Tc-97m	Ru-103	Ag-105	In-114m
Sn-113	Sn-119m	Sn-121m	Sn-123	Te-123m	Te-125m	Te-127m	Te-129m
I-125	La-137	Ce-139	Pm-143	Pm-145	Pm-147	Sm-145	Sm-151
Eu-149	Eu-155	Gd-151	Gd-153	Dy-159	Tm-170	Yb-169	Lu-173
Lu-174	Lu-174m	Hf-175	Hf-181	Ta-179	Re-184	Re-186m	Ir-192
Pt-193	Au-195	Hg-203	Pb-205	Np-235	Pu-237		

Less than 3 μCi (1×10^5 Bq)

Be-10	Na-22	Al-26	Si-32	Sc-46	Ti-44	Mn-54	Fe-60
Co-56	Co-58	Co-60	Zn-65	Ge-68	Rb-83	Y-88	Zr-88
Zr-93	Nb-94	Mo-93	Tc-95m	Tc-97	Tc-98	Ru-106	Rh-101
Rh-102	Rh-102m	Ag-108m	Ag-110m	Cd-109	Sn-126	Sb-124	Sb-125
Te-121m	I-129	Cs-134	Cs-137	Ba-133	Ce-144	Pm-144	Pm-146
Pm-148m	Eu-148	Eu-150	Eu-152	Eu-154	Gd-146	Tb-158	Tb-160
Ho-166m	Lu-176	Lu-177m	Hf-172	Ta-182	Re-184m	Os-185	Os-194
Ir-192m	Ir-194m	Hg-194	Pb-202	Bi-207	Bi-210m	Cm-241	

Less than 0.3 μCi (1×10^4 Bq)

Sr-90	Cd-113m	La-138	Hf-178m	Hf-182	Po-210	Ra-226	Ra-228
Pu-241	Bk-249	Es-254					

Less than 0.03 μCi (1×10^3 Bq)

Sm-146	Sm-147	Pb-210	Np-236	Cm-242	Cf-248	Fm-257	Md-258

Less than 0.003 μCi (1×10^2 Bq)

Gd-148	Th-228	Th-230	U-232	U-233	U-234	U-235	U-236
U-238	Np-237	Pu-236	Pu-238	Pu-239	Pu-240	Pu-242	Pu-244
Am-241	Am-242m		Am-243	Cm-243	Cm-244	Cm-245	Cm-246
Bk-247	Cf-249	Cf-250	Cf-251	Cf-252	Cf-254		Cm-247

Less than 0.0003 μCi (1×10^1 Bq)

Ac-227	Th-229	Th-232	Pa-231	Cm-248	Cm-250		

* These activities were selected to yield a committed effective dose equivalent of 10 mrem (100 μSv) or less for a credible incident to a member of the general public.

FMSS SOURCE INVENTORY LOG

Geographic Location _____
(State, city, project, other)

Local Source Custodian: _____

Project Source Custodian:

[illegible]

Item 1 -	Integrity test. A swipe taken from the source or surface adjacent to where the source is stored or used. Results are in dpm/swipe or source. Do not swipe the surface of an electroplated source. Counting instrument must match source radiation type (e.g., alpha counter for Th-230, Beta-Gamma counter for SrY-90)
Item 2 -	Indicate (yes or no) whether accountable sources are labeled as per Section 6.4 of this procedure (e.g., “Caution - Radioactive Material”, plus source type, Activity, SN, Date of Assay, Source Custodian name and phone number.). Storage locations are labeled and/or posted
Item 3 -	Indicate (yes or no) storage and/or containers of accountable sources meet the requirements of 5.4.4 of JA-RP-19 (e.g., chosen to minimize damage from fire, free of flammable, isolated from occupied areas or located in radiological areas, dose rate at closest approach is less than 0.5 mrem/hr on average).

ATTACHMENT 3

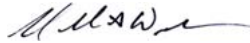
FMSS SOURCE CHECK OUT LOG

Source ID	Time out Time in	Date out	Signature in	Use/purpose	Comments
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STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Aquifer Testing

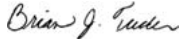
APPROVED:



9/30/2003

**Mike Winters
Radiation Safety Officer**

Date



9/30/2003

**Brian Tucker
Project Chemist**

Date



9/30/2003

**Andrew Mills
Project Manager**

Date

1.0 INTRODUCTION

This procedure presents a technique for calculating the Transmissivity and Storativity of an aquifer with an aquifer test. It is intended for use on the FUSRAP Maywood Superfund Site (FMSS).

2.0 LIMITATIONS

This Standard Operating Procedure (SOP) should be used in conjunction with task-specific work plans involving aquifer testing.

3.0 EQUIPMENT

A pump, capable of pumping and maintaining the expected discharge rates, will be installed in the well.

- The discharge will be directed into a tank capable of holding the volume of water produced during the aquifer test.
- A throttle valve will be installed in the discharge line to control the pumping rate.
- An in-line water meter, capable of accurately (+/-5%) measuring the pumping rate, will be installed in the discharge line. The water meter will be calibrated within one month of the aquifer test. The water meter will be installed ten feet from the throttle valve so that the turbulent flow from the valve does not affect the accuracy of the water meter.
- A sampling port will be installed in the discharge line, after the water meter, to collect groundwater samples.
- A stilling tube will be installed in the test well to the top of the pump.

- Pressure transducers will be installed at the bottom of the stilling tube in the test well and at the bottom of each monitoring well. The transducers will be connected to a hermit data logger.
- A rain gage will be installed at the site to measure the precipitation before, during, and after the aquifer test, unless this information is available from a local climatological station.
- A barometric probe attached to the hermit datalogger will be used at the site to measure the barometric pressure before, during, and after the aquifer test, unless this information is available from a local climatological station.
- An electronic water level indicator will be used to manually measure the water level in the test well and in each monitoring well.
- A stopwatch will be used to determine when water level measurements will be collected during the aquifer test.

4.0 METHODOLOGY

4.1 BACKGROUND MONITORING

The water level in the test well and selected monitoring wells will be measured hourly three days before the start of the aquifer test to determine regional trends in the water level and to check if there is any nearby pumping which may influence the water levels during the aquifer test. This will be done by installing a pressure transducer in the test well and selected monitoring wells. The pressure transducers will be connected to a data logger that will collect water level measurements.

The data will be downloaded to a computer and graphed to determine the long-term regional trends and to check if there is any nearby pumping that would affect the water levels during the aquifer test. If nearby pumping is affecting the water levels, then the owners will be contacted and asked to either turn off the pumps or hold the pumping rates constant during the aquifer test, if possible. If this is not feasible an antecedent trend analysis must be performed to take into consideration pumping from outside sources.

Barometric pressure will also be monitored on site three days before the aquifer test with a recording barometer. Barometric pressure measurements will be collected hourly.

If surface water is located within the anticipated radius of influence of the aquifer test, then a staff gage will be installed in the surface water and water levels will be measured from the staff gauge hourly during the three day pre-test monitoring.

Other relevant activities at the site and surrounding areas should also be noted if they may have an impact on the results of the test, for example excavations, water discharges, surface water ponding, and surface water diversions.

4.2 STEP DRAWDOWN TEST

A step drawdown test will be conducted in the test well to determine the pumping rate for the aquifer test. This will be done by pumping the test well at five evenly spaced pumping rates each for 100 minutes. Water level measurements will be collected on a

logarithmic time schedule from the start of each step and plotted on semi-logarithmic graph paper. The water levels measured during the second, third, fourth, and fifth steps will be corrected for the effects of the proceeding steps. The pumping rate that uses the most available drawdown but does not cause the water level to drop below the pump before the end of the aquifer test will be selected for the constant rate aquifer test.

4.3 AQUIFER TEST

Start the aquifer test and measure the pumping rate and water levels in the test well and monitoring wells manually on a logarithmic time schedule. Adjust the throttle valve in the discharge line as frequently as needed to maintain a constant-rate. Continuous water level measurements will be obtained and recorded using pressure transducers and data loggers. As a means of providing backup to the electronically obtained water levels, water level measurements will be obtained manually using a water level meter. The pumping rate should be measured and adjusted before starting each round of water level measurements so that the water levels reflect the proper pumping rate. After the water level has stopped oscillating from any change in the pumping rate, the water level in the pumping well should be measured and recorded. Water levels can then be measured in the monitoring wells. Water level measurements and pumping rates should be recorded on field data sheets with any appropriate comments. The water levels will be plotted in the field as the test progresses on semi-logarithmic graph paper. The pump will be turned off after the drawdown in the monitoring wells has remained constant for a long enough period of time to establish a trend. This could be after 24 hours for confined aquifer tests and after 72 hours for water table aquifer tests.

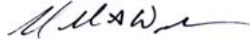
4.4 RECOVERY PERIOD

The water levels in the test well and monitoring wells will be collected at a logarithmic frequency after the pump has been turned off. The water level in each well will be recorded on field data sheets and on semi-logarithmic graph paper to monitor the recovery period. Water levels will be collected until 90 percent of the drawdown has recovered.

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Rock Coring

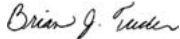
APPROVED:



9/30/2003

**Mike Winters
Radiation Safety Officer**

Date



9/30/2003

**Brian Tucker
Project Chemist**

Date



9/30/2003

**Andrew Mills
Project Manager**

Date

1.0 INTRODUCTION

This procedure presents the techniques for collecting and describing rock cores using standard bedrock coring methods. This procedure is intended for use on the FUSRAP Maywood Superfund Site (FMSS).

2.0 LIMITATIONS

This Standard Operating Procedure (SOP) should be used in conjunction with task-specific work plans involving rock coring.

3.0 REFERENCES

U.S. Environmental Protection Agency, Site Characterization for Subsurface Remediation, EPA/626/4-91/026, November 1991

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 Project Manager

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 Project Engineer

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the rock coring task.

5.3 Site Safety And Health Officer

All field activities must be carried out in accordance with the Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 Project Superintendent

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method of rock coring chosen in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin and that all necessary personnel are mobilized on time. This individual also maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected occurrences during rock coring and deviation from this SOP.

5.5 Site Personnel

Site personnel assigned to perform the rock coring activities will be trained in the proper techniques for conducting the work. All employees who are engaging in the rock coring activities are required to read and sign the (SSHP) and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All activities, including deviations to this SOP, will be recorded in field logbooks during onsite activities.

6.0 EQUIPMENT

- Knife
- Ruler
- Permanent marker
- 10x Hand lens
- Hydrochloric acid
- Camera with color film
- Munsell Color Chart
- Wire-line coring device

7.0 METHODOLOGY

Bedrock cores will be collected with either an NX or HQ size wire-line coring device. The core barrel will be lowered to the bottom of the boring and fitted inside of the coring casing. The top of the casing will be connected to the drilling rig and rotated. Water will be pumped down the borehole to cool the core barrel bit. Once the core is finished, the core barrel will be removed and brought to the surface. The core will be carefully removed from the core barrel and placed in the wooden core box labeled with the project name, project number, date, time, boring name, interval samples, and Rock Quality Designation (RQD). Additional information to include on the boring log will include start and stop of core run, depth to the top and bottom of the core run, and size and type of core barrel used. The core will be described as outlined below.

1. Place the core sample in natural light, remove any extraneous material and wash the sample, if necessary.
2. Describe the wetted rock core using the following criteria:
 - a. Rock Classification
 - b. Rock Type
 - c. Color
 - d. Bedding Thickness
 - e. Fracturing
 - f. Recovery
 - g. Weathering
3. Provide further detail of samples based on following steps:
 - a. Measure the length of the core.
 - b. Calculate the percent recovery.
 - c. Count and log the natural fractures and artificial (drilling-related) core breaks.
 - d. Calculate the RQD as described in Section 5.0.
4. Document the description in the Field Log Book and on the geologic log forms.
 - a. Rock Classification

Classify the rock using the Colorado School of Mines Classification System.
 - b. Rock Type

Identify the rock type and formation. Example, Lockatong Argillite, Passaic Sandstone, Stockbridge Limestone, Inwood Marble, Manhattan Granitic Gneiss.
 - c. Color

Rock colors should be described utilizing a Munsell Color Chart. A single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures should be used when describing color. A rock could, therefore, be referred to as

gray, or light gray, or blue-gray. Since color can be used in correlating units between sampling locations, it is important that color descriptions be kept consistent throughout the field operations. Rock core samples should be described while wet.

d. Bedding Thickness

Bedding thickness designations for rock classification are given in Table 1.

e. Fracturing

Determine the degree of fracturing of a rock by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracture structure is described by the following terms:

- Very broken (V.BR.) - Less than 2 inches (in).
- Broken (BR.) - 2 in. to 1 feet (ft).
- Blocky (BL.) - 1 to 3 ft.
- Massive (M.) - 3 to 10 ft.

The structural integrity of the rock can be approximated by calculating the RQD of cores recovered. RQD is described in Section 5.0.

f. Recovery

Calculate the recovery using the following formula:

$$\text{Recovery (\%)} = \left(\frac{\text{Length of Core Retrieval}}{\text{Length of Core Run}} \right) \times 100$$

g. Weathering

The degree of weathering is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering.

Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.

Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.

Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.

Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very soft.

TABLE 1
BEDDING THICKNESS CLASSIFICATION

THICKNESS (METRIC)	THICKNESS (Approximate English Equivalent)	CLASSIFICATION
>1.0 meter	>3.3 ft	Massive
30 cm - 1 meter	1.0 ft - 3.3 ft	Thick Bedded
10 cm - 30 cm	4 in - 1.0 ft	Medium Bedded
3 cm - 10 cm	1 in. - 4 in.	Thin Bedded
1 cm - 3 cm	2/5 in. - 1 in.	Very Thin Bedded
3 mm - 1 cm	1/8 in - 2/5 in.	Laminated
1 mm - 3 mm	1/32 in. - 1/8 in.	Thinly Laminated
<1 mm	<1/32 in.	Micro Laminated

8.0 ROCK QUALITY DESIGNATION

The RQD is used to indicate rock mass properties. RQD is based on a modified core recovery procedure which, in turn, is based indirectly on the number of fractures or solution cavities in the rock as observed in the rock cores. The RQD is an indicator of the general quality of the rock for both engineering and geological purposes and provides a numerical value, which is more sensitive and consistent than gross percentage core recovery. The length of only those pieces of hard and sound core, which are four-inches or greater in length, is divided by the total length of the core run.

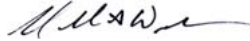
$$RQD = \left(\frac{\text{sum of length of pieces} > \text{four inches long}}{\text{length of coring run}} \right)$$

Note: The total core recovery may be greater than that portion which consists of pieces greater than or equal to four-inches in length. The RQD is expressed as a percentage.

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Slug Testing

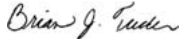
APPROVED:



9/30/2003

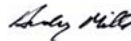
**Mike Winters
Radiation Safety Officer**

Date



9/30/2003

**Brian Tucker
Project Chemist
Date**



9/30/2003

**Andrew Mills
Project Manager**

Date

1.0 INTRODUCTION

This procedure presents a method for conducting a slug test that will measure the horizontal hydraulic conductivity of the soil immediately surrounding the screen of the well. This procedure is intended for use on the FUSRAP Maywood Superfund Site (FMSS).

2.0 LIMITATIONS

This Standard Operating Procedure (SOP) should be used in conjunction with task-specific work plans involving slug testing.

3.0 REFERENCES

U.S. Environmental Protection Agency, Ground Water Issue – Suggested Operating Procedures for Aquifer Pumping Tests, EPA/504/S-93/503, February 1993

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 Project Manager

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 Project Engineer

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the slug testing task.

5.3 Site Safety And Health Officer

All field activities must be carried out in accordance with the Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 Project Superintendent

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method of slug testing chosen in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin and that all necessary personnel are mobilized on time. This individual also maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected occurrences during slug testing and deviation from this SOP.

5.5 Site Personnel

Site personnel assigned to perform the slug testing activities will be trained in the proper techniques for conducting the work. All employees who are engaging in the slug testing activities are required to read and sign the (SSHP) and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All activities, including deviations to this SOP, will be recorded in field logbooks during onsite activities.

6.0 EQUIPMENT

- Water level meter
- Pressure transducer
- Hermit/Troll® data logger
- Slug and cable

7.0 METHODOLOGY

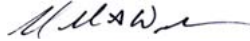
If the screen is fully saturated, both the falling and rising head tests can and should be conducted. If the screen is only partially below the water level, only the rising head test can be evaluated.

1. Measure the water level and the depth to the bottom of the well to determine the length of the water column in the well.
2. Install the transducer just above the bottom of the well.
3. Connect the transducer to the hermit data logger or insert a dedicated Troll (transducer/data logger) into the well and program the reference scale, offset, test number, sampling rate, number of inputs, and type of input into the hermit data logger. Allow a sufficient amount of time to pass for the water level to return to the static position.
4. Use a slug that displaces at least two feet of water in the monitoring well.
5. Set the slug two feet above the water level.
6. Start the data logger and quickly lower the whole slug below the static water level.
7. Continue the falling head test until the water level recovers to at least 90 percent of the pretest water level.
8. A rising head slug test can be conducted after the falling head test, and after the water level has fully recovered. This can be done by changing the test on the data logger, starting the test, and removing the entire slug from the water.
9. The rising head test should be continued until the water level recovers to 90 percent of the pretest water level.
10. Following downloading of the data from the transducer, the data can be analyzed using several test methods (e.g., Bower & Rice, Hvorslev).

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Packer Testing

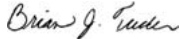
APPROVED:



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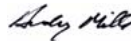
**Mike Winters
Radiation Safety Officer**

Date



9/30/2003

**Brian Tucker
Project Chemist
Date**



9/30/2003

**Andrew Mills
Project Manager**

Date

1.0 INTRODUCTION

This procedure presents a method for estimating the hydraulic conductivity of bedrock at the FUSRAP Maywood Superfund Site (FMSS).

2.0 LIMITATIONS

This Standard Operating Procedure (SOP) should be used in conjunction with task-specific work plans involving packer pressure tests.

3.0 REFERENCES

U.S. Environmental Protection Agency, Site Characterization for Subsurface Remediation, EPA/626/4-91/026, November 1991

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the rock coring task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with the Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method of rock coring chosen in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin and that all necessary personnel are mobilized on time. This individual also maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected occurrences during rock coring and deviation from this SOP.

5.5 SITE PERSONNEL

Site personnel assigned to perform the rock coring activities will be trained in the proper techniques for conducting the work. All employees who are engaging in the rock coring activities are required to read and sign the (SSHP) and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All activities, including deviations to this SOP, will be recorded in field logbooks during onsite activities.

6.0 EQUIPMENT

The packer pressure testing procedure includes two main components, the packer system and a data collection system.

6.1 PACKER SYSTEM

The two inflatable packers will be mounted on a perforated one-inch diameter galvanized steel pipe that allows water to be injected into the isolated zone between the packers. The length and number of packer intervals will be based on drilling data, core runs or borehole imaging photographs. The number and size of the perforations will be consistent with those described in Ground Water Manual, Department of the Interior, 1985. The bottom packer will be plugged to prevent water from coming out of the bottom of the packer. One-inch diameter galvanized steel pipe will extend from the top of the top packer to land surface.

6.2 DATA COLLECTION SYSTEM

6.2.1 Water Meter

An in-line water meter will be used to measure the flow rate injected into the isolated zone. The meter will be of an appropriate size to accurately measure (+/- 5%) the flow rate and be calibrated within one month of use.

6.2.2 Pressure Gage

A pressure gage capable of measuring the back pressure will be mounted to the one-inch diameter pipe between the flow meter and the well head.

6.2.3 Pressure Transducers

Pressure transducers capable of measuring water level fluctuations will be installed above, and within the test interval.

7.0 METHODOLOGY

Tests shall be performed on ten foot incremental sections of the borehole, except shorter sections may be tested if water losses are excessive or as necessary for the project. The borehole shall be flushed with water until the return water runs clear. Water pressures during the drilling or washing of boreholes for pressure testing shall not exceed 25 psi at the pressure gage.

The test shall be conducted as a "holding test" or a "pressure flow test" as described below.

7.1 HOLDING TEST

7.1.1 The holding test shall be conducted by lowering the packer or packers into the borehole to the predetermined depths and seating the packers to seal off the interval to be tested. Pressures above and below* the straddle-packer apparatus shall also be measured using pressure transducers to test for fluid leakage due to poor packer seal or to short circuiting fractures between the test interval and the remainder of the borehole.

7.1.2 Effective water pressure, in pounds per square inch (psi), equals the gage pressure, in psi, plus 0.43 times the height of the gage, in feet, above either the static water table or the center of the test section, whichever is smaller. Water shall be forced under pressure into the test section and the effective water pressure shall be adjusted so as not to exceed the values specified below.

- a. In the upper ten feet of rock, no gage pressure shall be applied unless the material is sound and unweathered. For sound, unweathered material, the

* If pressure is to be measured below bottom packer, care must be taken to ensure proper seal.

effective water pressure shall not exceed 1.0 psi per ft of depth from the ground surface to the center of the test section.

- b. Below ten feet of rock, the effective water pressure shall not exceed 1.2 psi per ft of depth from the ground surface to the center of the test section.

- 7.1.3 In no case shall the maximum gage pressure exceed 100 psi. These pressures are typical and may be altered.
- 7.1.4 When the test pressure is reached the valve shall be closed and the pump shut off. The pressure drop shall be recorded at intervals for a minimum of 3 minutes. In no case shall it be necessary to exceed an observation period of 10 minutes.
- 7.1.5 If the average pressure drop is less than 5 psi per minute, a pressure flow test may not be required. If the average pressure drop exceeds 5 psi per minute, a pressure flow test shall be conducted.

7.2 PRESSURE FLOW TEST

- 7.2.1 The pressure flow test shall be conducted immediately after completion of a holding test.
- 7.2.2 The pressure flow test shall be conducted at a minimum of three different effective pressures. These pressures shall be approximately 25, 50, and 100 percent of the maximum allowable effective pressure.
- 7.2.3 During each test, the pressure shall be held constant at the required test pressure by varying the pumping rate.
- 7.2.4 The total water take, in gallons, for a five minute interval at each pressure shall be measured by the flowmeter. If there is no measurable take for a period of two minutes, it is not necessary to continue the test for the full five minute interval.
- 7.2.5 The test shall be started at the lowest pressure and advanced using two or more increments to the maximum allowable pressure, after which the pressure shall be reduced by the same decrements to the initial starting pressure. If there is no measurable take for each increment of pressure as the pressure is increased, it is not necessary to repeat the tests with pressure decrements.
- 7.2.6 The pressures to be used will be computed. However, the maximum pressure at the gage shall not exceed 100 psi. In the event that the maximum pressure cannot be developed due to a water take exceeding the capacity of the pump, the maximum test pressure shall be taken as that which can be maintained constant for the five minute interval.
- 7.2.7 The following data will be recorded during each test.
- Radius of the borehole, r , in feet (ft).

- Length of the test section, A, in (ft).
- Depth from the pressure gage to the upper surface of the bottom packer, h_1 , in (ft).
- Applied pressure at the gage, h_2 , in (ft).
- Steady flow into the well for five minutes, Q, cubic feet per second (ft^3/s).
- Time that the test was started and the time of each measurement.

7.2.8 The hydraulic conductivity can be calculated from the data collected from each five minute step using the following equation:

$$K = \left(\frac{Q}{C_s r H} \right)$$

where:

K = Hydraulic Conductivity, feet per second under a unit gradient

Q = Water flow into the well, ft^3/s

C_s = Conductivity coefficient, published

r = radius of the well, (ft)

H = $h_1 + h_2 - L$, (ft)

L = head loss in the pipe due to friction, (ft)

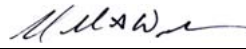
7.2.9 Conductivity coefficients, for different hydrogeological conditions, are in the Ground Water Manual, published by the U. S. Department of the Interior, Bureau of Reclamation. The calculated hydraulic conductivity values for each interval will be recorded on the geologic logs.

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Sediment Sampling

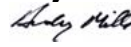
APPROVED:

 **9/30/2003**

Mike Winters
Radiation Safety Officer **Date**

 **9/30/2003**

Brian Tucker
Project Chemist **Date**

 **9/30/2003**

Andrew Mills
Project Manager **Date**

1.0 PURPOSE

This Standard Operating Procedure (SOP) - Sediment Sampling is to be employed when hand-collecting (without machines or power tools) sediment samples from swamps, ponds, lagoons, lakes, rivers and other water bodies with known or suspected environmental contamination at the FUSRAP Maywood Superfund Site (FMSS).

This SOP describes the procedures for collecting representative environmental and/or geotechnical samples from sediment. The following sections describe various methods and equipment used to collect sediment samples. These samples can be used for sediment classification and analytical testing purposes.

2.0 SCOPE

This procedure presents the proper methods of collecting both discrete and composite sediment samples. Selection of site-specific sampling locations and specific sampling technique(s) is dependent on the objectives of the environmental assessment. Consult the task-specific Sampling and Analysis Plan (SAP) or other applicable work plan(s) for sediment sampling locations and techniques. This method can be used for most sediment types. Sediment samples can be collected from swamps, ponds, lagoons, lakes, rivers and other water bodies. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sampling team member. Various methods can be used to collect the sediment sample. Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field log books. All changes shall be made in accordance with the Maywood Contractor Quality Control Plan.

3.0 REFERENCES

U.S. Environmental Protection Agency, Characterization of Hazardous Waste Sites - A Methods Manual, Volume II: Available Sampling Methods, EPA/600/X-83/018, March 1983.

SOP SW-MWD-506-1 – Decontamination

SOP SW-MWD-505-1 – Cuttings and Fluids Management

SOP SW-MWD-302-1 – Surface Water Sampling

SOP SW-MWD-504-1 – Labeling, Packaging, and Shipping Environmental Samples

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, and ensures that the Project Superintendent has been properly briefed and is prepared for sediment sampling task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with the Site Safety and Health Plan (SSHP). The Site Safety and Health Officer (who may also serve as a sediment sampler) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method of sediment sampling chosen in accordance with the project requirements, this SOP and related SOPs. This individual assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin

and that all necessary personnel are mobilized on time. He/she maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected occurrences during sediment sampling and deviation from this SOP.

5.5 SITE PERSONNEL

Site personnel assigned to perform the sediment sampling activities will be trained in the proper techniques for conducting the work. All employees who are engaging in sediment sampling activities are required to read and sign the Site Safety and Health Plan (SSHP) and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All sediment sampling activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

6.0 PROCEDURES

6.1 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR SEDIMENT SAMPLING

The following is a list of equipment & material that is commonly used on all sediment sampling projects. Refer also to related SOP equipment & material requirements to ensure completeness.

- Field Sampling Plan (FSP)
- SSHP. To be read and signed by all site personnel prior to site activities
- Personal Protective Equipment
- Field logbook(s)
- Volatile organic compound vapor meter (photoionization detector (PID) and flame ionization detector (FID))
- Decontamination supplies - See FSP and Decontamination SOP
- Indelible markers
- Weighted tape measure
- Stainless steel or plastic trowel or shovel
- Sampling Equipment - Dredge; Shovel; Fencepost digger; Scoop; Corer; or PVC Pipe Sampler
- Rope / Line for sampling equipment
- Global Positioning System (GPS) - optional
- Surveyors stakes
- Hammer for pounding stakes
- Flagging Tape
- Camera & Film
- Stainless steel mixing bowls
- Sample bottles and labels

- Chain-of-Custody forms- See Labeling, Packaging, and Shipping Environmental Samples SOP
- Chain-of-Custody tape
- Sample Coolers
- Bubble wrap or other sample packing material
- Ice or pre-cooled “cold” packs - for sample preservation
- Shipping forms (not needed if hand delivered to lab or courier pickup arranged)
- Shipping tape (transparent)
- Duct tape
- Paper towels

Avoid the use of devices plated with chrome or other materials if collecting soil samples for metals analysis. Plating is particularly common with garden implements such as potting trowels.

6.2 GENERAL SEDIMENT SAMPLING PROCEDURES

6.2.1 Pre-Sampling Activities

1. The task-specific SAP should be consulted to determine the sampling methods to be employed and the sampling and monitoring equipment necessary for field activities. Main considerations in determining the method of sampling the sediment should be: depth of water, means of access (boat, dock, from shore, wading into water, etc.), and type of water body (e.g., still water vs. rapidly flowing river).
2. In accordance with the SSHP, a general site survey should be performed prior to site entry. If a boat is to be used for sampling, it is important to note access points - docks, boat ramps, etc.
3. All sampling equipment should be decontaminated prior to each sampling episode. Decontamination procedures are detailed in the Decontamination SOP.
4. As appropriate, all sampling locations should be utility cleared and marked in some manner with stakes and/or flagging. Stakes/flagging are most useful for shallow samples (small stream, swamp/wetlands). Photographs should be taken of shore reference points if using stakes is not practical, e.g., sampling in middle of a river or lake. A detailed sketch of the sample location and location on a map/drawing should also be noted. If specified in the FSP or task-specific SAP, a GPS shall be used to locate unmarkable sampling points.
5. Measure the depth of the water from which the sample will be taken.
6. Any in-situ measurements, e.g. water pH, dissolved oxygen content, etc., should be taken prior to sampling activities.

7. If surface water samples will be taken at the same location, the surface water sampling should be performed prior to sediment sampling, because the sediment sampling activities will suspend fine sediments into the water column. Refer to the Surface Water Sampling SOP.

6.3 SEDIMENT SAMPLING

6.3.1 Appropriate field procedures are as follows:

1. If applicable, screen the area to be sampled using an organic vapor analyzer and record readings in the field logbook. The FID or PID screen is used as a field safety procedure, as well as for selecting potentially contaminated soil samples.
2. The readings should be compared to action levels presented in the SSHP. The operator of the FID or PID must be experienced in its use and aware of the effect of factors such as temperature, humidity, or methane affecting the instrument readings.
3. Retrieve a sediment sample using one of the methods described in Section 6.5.
4. If analyzing the sample for volatile organic compounds, using the EnCore sampler tool, collect the appropriate sample volume directly from the sampling device in the manner discussed in Attachment A.
5. For the remaining analyses, homogenize the sediment collected and obtain a discrete sample using a stainless steel lab spoon or its equivalent. Place the sample into the appropriate numbers of sterile wide-mouth glass soil sample jars with screw on caps. The appropriate order for filling the bottles is:
 - a. Semi-volatile organic compounds (SVOC)
 - b. Total Recoverable Petroleum Hydrocarbons (TRPH)
 - c. PCBs/pesticides
 - d. Metals
 - e. Radionuclides
6. Check that a Teflon liner is present in the cap of all analytical sample jars. Secure the caps tightly. Although chemical preservation of solids is generally not required, the samples should be refrigerated (normally in iced coolers to approach approximately 4°C) and analyzed within specified holding times. Refer to the Labeling, Packaging, and Shipping Environmental Samples SOP for specific requirements.
7. Label the sample bottle with the appropriate sample tag. Complete all chain-of-custody documents. Refer to the Labeling, Packaging and Shipping Environmental Samples SOP for specific requirements.

8. Record sampling event in the field log book (and on a sample log, if dictated by the task-specific SAP).
9. Decontaminate equipment after use and between sample locations. Also, decontaminate sample containers and/or isolate them (such as sealing in Ziploc bags). Refer to the Decontamination SOP for specific requirements.

6.4 PREPARATION OF COMPOSITE SAMPLES

- 6.4.1 Sediment samples may be either discrete or composite. A discrete sample represents a single location; it must be used for all volatile organic analyses. A composite sample represents a mixture of sediment from more than one discrete location. If a composite sample is to be obtained, it can be mixed in a shallow high density polyethylene pan, lined with aluminum foil, or in a stainless steel pan. Alternatively, compositing can be done on plastic sheets. However, compositing of samples suspected to be contaminated with organics should be done in a stainless steel bowl due to the potential for introduction of organic contaminants from the plastic sheeting. Stainless steel sieves may be used to remove larger rock fragments and organic matter. Compositing procedures are not appropriate for samples obtained for analysis of volatile organic compounds because the agitation of the sample results in a loss of volatiles from the sample.
- 6.4.2 The procedure outlined in Attachment B shall be followed for sediment compositing.

6.5 METHOD SPECIFIC SEDIMENT SAMPLING PROCEDURES

- 6.5.1 Sediment Sampling in Shallow Water Bodies (Wetlands, Brooks, Small Streams)
 - a. In these settings, the most appropriate method for obtaining sediment samples is likely wading in and obtaining a sample using a shovel, PVC pipe sampler, or fence pole digger. Proper safety equipment should be worn at all times, including a life jacket, a secured line to the shore, and a “buddy” who remains on the shore. Equipment should be tied off to shore if possible, to ease retrieval if anything is dropped.
 - b. Samples should be collected by driving the sampling equipment (shovel, fencepost digger, etc.) into the sediment. The equipment should be brought to the surface slowly, to minimize loss of sample into the water column. The sample should be placed into a receptacle from which analytical samples will be taken. This receptacle will most likely be on shore. Bottling of samples and decontamination of equipment should take place on shore.
 - c. Samples shall be collected downstream to upstream, so that any suspended particles will be transported away from the next sample point.
 - d. For surveying purposes, if possible, stakes or markers should be placed either at the sample location itself or on each bank or both on the same bank so that

the sample point is on the line between the two stakes. The precise location of the sample point can then be specified by measuring the distance from one of the stakes.

6.5.2 Sediment Sampling in Deeper Water Bodies (Lakes, Rivers)

- a. In these settings, the most appropriate method for obtaining sediment samples will be from a dock or bridge, if available, or more likely, a boat. If the water is shallow enough, (less than three feet deep), the same methods as specified in Section 6.5.1 may be used. For water depths greater than approximately three feet deep, a Ponar or Ekman dredge should be used to obtain the sediment sample. Proper safety equipment should be worn at all times, including a life jacket. Equipment should be tied off to the boat if possible, to ease retrieval if anything is dropped.
- b. The boat should be properly anchored before sampling activities commence. Bow and stern anchors may be required to properly position the boat.
- c. Samples should be collected by tying the sampler to a dedicated rope and dropping the sampling equipment over the side of the boat, through the water and into the sediment. Depending on the equipment being used (e.g. an Ekman dredge), a weight may need to be sent down the line to close the sampler. The rope should be marked at the water surface before withdrawing the sampler. The depth of the sample should then be determined by measuring the length of rope deployed. The equipment should be brought to the surface slowly, to minimize loss of sample into the water column. The sample should be placed into a receptacle from which analytical samples will be taken. In general, Ekman dredges are lighter than Ponar dredges. This makes the Ekman easier to handle, but also less stable in high flow areas. The Ponar dredge is heavier, closes automatically, and typically retrieves more sample.
- d. Samples shall be collected downstream to upstream, so that any suspended particles will be transported away from the next sample point.
- e. Consideration will be given to modifying this procedure if sediment samples must be collected for volatile organic compound analysis.
- f. If multiple sediment samples are being collected from a lake or pond (i.e. a relatively still body of water), sample collection should start with deeper points and move to shallower points.
- g. It is also important to size the boat appropriately. If the work is to be in a fairly small area, it may be best to locate as many operations as possible on shore. If all sampling and decontamination activities must be contained within the boat, care should be taken to minimize the amount of equipment required.

- h. If it is not possible to mark the sample location, photographic evidence of the location (shots of landmarks on shore) and precise locations on maps should be obtained.

6.6 GLOSSARY OF TERMS

Composite Sample - represents a mixture of sediment from more than one discrete location.

Corer - A stainless steel implement typically used for soil samples. Still appropriate for shallow samples or samples in swampy areas.

Discrete Sample - A discrete sample represents a single location. It must be used when collecting sediment samples for volatile organic analyses.

Dredge - Typically a “Ponar” or an “Ekman” dredge. An Ekman dredge is lighter and uses a weighted “slave” which is sent down the rope to trigger the trap to close. The Ponar dredge is heavier, and closes on contact.

FSP - Field Sampling Plan

Fencepost digger - Two handled shovel tool which is driven straight down, and then clamped shut by pushing the handles apart.

GPS - Global Positioning System

SAP - Sampling and Analysis Plan

Shovel – Long or short handle type. Used for obtaining sediment samples directly in shallow areas.

SOP - Standard Operating Procedure

SSHP - Site Safety and Health Plan

Trowel – Basic garden variety which resembles a small shovel. Constructed of steel or polypropylene (plastic). The blade of a trowel is generally flat and five to six inches in length. A scoop (blade has curved edges versus flat) may be substituted if necessary. Both can be purchased with volume calibrations.

Hollow-Stem Hand Auger – a short spiral bladed metal rod (auger) attached to a handle. Clockwise rotation of the T handle initiates the cutting process. Most of the loose sediment is discharged upwards as the auger moves downwards. However, if the sediment is cohesive, some of it will stick to the auger flight providing a collectable sample at a measurable dept.

Scoop - A jar or other container attached to the end of a pole. Hand made.

7.0 ATTACHMENTS

Attachment A – EnCore Extrusion and Sampling Procedures

Attachment B - Sediment Compositing Procedure

ATTACHMENT A, Sheet 1 of 2

Disposable EnCore® Sampler

EXTRUSION PROCEDURES

USING THE EnCore® 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. Use a pliers to break locking arms on cap of En Core Sampler. Do not remove cap at this time. (CAUTION: Broken edges will be sharp.)
2. 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.
3. 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.)
4. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. To release soil core, remove cap from Sampler and 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, DOWNTIME, 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.

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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.

ATTACHMENT A, Sheet 2 of 2

Disposable En Core® Sampler



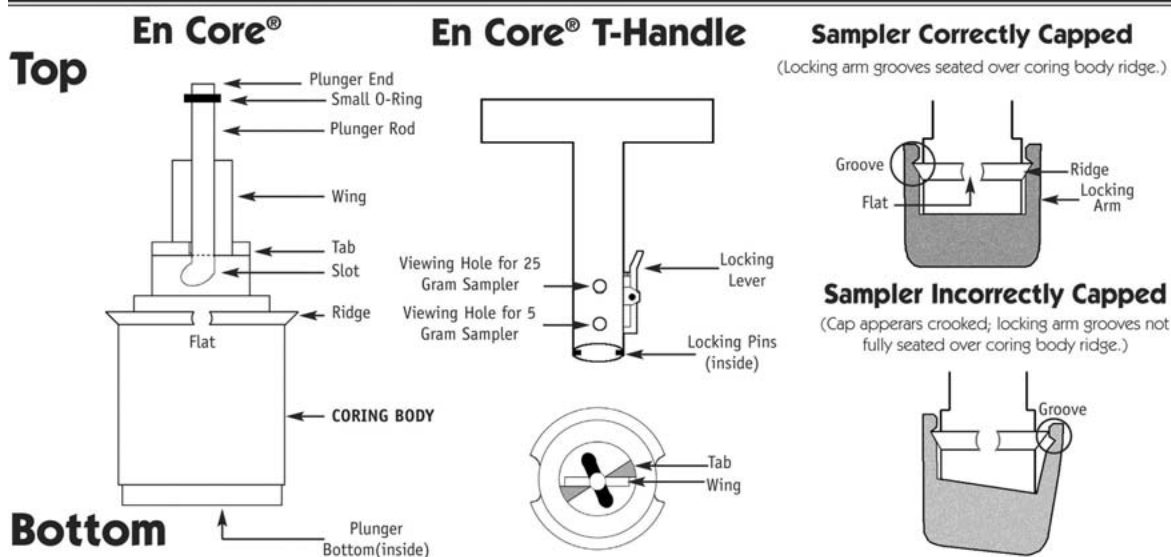
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Sampling Procedures

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.)



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.

ATTACHMENT B

SEDIMENT COMPOSITING PROCEDURE

The following procedure will be used for compositing grab samples from sediment collected.

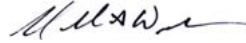
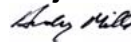
1. Empty the sediment container(s) into a stainless steel mixing bowl.
2. Inspect the material for large stones and other objects, which are not representative of the sample matrix, and remove them from the bowl.
3. Homogenize the remaining sample material by breaking up any large clumps and thoroughly mixing with stainless steel spatula.
4. Fill the sample container(s) using a spatula.

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Surface Water Sampling

APPROVED:

	9/30/2003
Mike Winters	Date
Radiation Safety Officer	
	9/30/2003
Brian Tucker	Date
Project Chemist	
	9/30/2003
Andrew Mills	Date
Project Manager	

1.0 PURPOSE

This Standard Operating Procedure (SOP) - Surface Water Sampling is to be employed when collecting surface water samples from locations with known or suspected environmental contamination at the FUSRAP Maywood Superfund Site (FMSS).

This SOP describes the procedures for collecting representative environmental samples from surface water. Surface water describes the water above the bottom of a body of water. The samples are typically taken three feet above the bottom. Where possible, surface water samples shall not be taken from the surface of a body of water. The following sections describe various methods and equipment used to collect surface water samples. These types of samples can be used for biological and analytical testing purposes.

2.0 SCOPE

This procedure presents the proper methods of collecting surface water samples. Selection of site-specific sampling locations and specific sampling technique(s) is dependent on the objectives of the environmental assessment. Consult the task-specific Sampling and Analysis Plan (SAP) or other applicable work plan(s) for sampling locations and techniques. Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field log books. All changes shall be made in accordance with the Maywood Contractor Quality Control Plan.

3.0 REFERENCES

U.S. Environmental Protection Agency, Characterization of Hazardous Waste Sites - A Methods Manual, Volume II: Available Sampling Methods, EPA / 600 / X-83 / 018, March 1983.

SOP SW-MWD-505-1 – Cuttings and Fluids Management

SOP SW-MWD-506-1 – Decontamination

SOP SW-MWD-504-1 – Labeling, Packaging and Shipping Environmental Samples

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for surface water sampling task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with the Site Safety and Health Plan (SSHP). The Site Safety and Health Officer (who may also serve as a surface water sampler) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method of surface water sampling chosen in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin and that all necessary personnel are mobilized on time. This individual also maintains a daily log of activities each work day.

The Project Superintendent coordinates and consults with the Project Manager on

decisions relative to unexpected occurrences during surface water sampling and deviation from this SOP.

5.5 SITE PERSONNEL

Site personnel assigned to perform the surface water sampling activities will be trained in the proper techniques for conducting the work. All employees who are engaging in surface water sampling activities are required to read and sign the (SSHP) and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All surface water sampling activities, including deviations to this SOP, will be recorded in field logbooks during onsite activities.

6.0 PROCEDURE

6.1 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR SURFACE WATER SAMPLING

The following is a list of equipment & material which is commonly used on all surface water sampling projects. Refer also to related SOP equipment & material requirements to ensure completeness.

- Field Sampling Plan (FSP) and task-specific SAPs
- SSHP. To be read and signed by all site personnel prior to site activities.
- Personal Protective Equipment
- Field logbook(s)
- Decontamination supplies - See FSP and Decontamination SOP
- Indelible markers
- Water level measure
- Sampling device such as a bailer, bucket, or surface water sampler
- Stakes / flagging (for marking on shore)
- Hammer - for pounding stakes
- 200 foot-length measuring tape
- If required, a hand held Global Positioning System (GPS) instrument
- Sample bottles (pre-preserved) and labels
- Chain-of-Custody forms - See Labeling, Packaging and Shipping Environmental Samples SOP
- Chain-of-Custody tape
- Sample Coolers
- Bubble wrap or other sample packing material
- Ice or pre-cooled "cold" packs - for sample preservation
- Shipping forms (not needed if hand delivered to lab or courier pickup arranged)
- Shipping tape (transparent)

- Duct tape
- Paper towels

6.2 SURFACE WATER PRE-SAMPLING ACTIVITIES

- 6.2.1 The task-specific SAP should be consulted to determine the sampling methods to be employed and the sampling and monitoring equipment necessary for field activities. The main considerations in determining the method of sampling the surface water should be: depth of water, means of access (boat, dock, from shore, wading into water, etc.), and type of water body (e.g., still water vs. rapidly flowing river).
- 6.2.2 In accordance with the SSHP, a general site survey should be performed prior to site entry. If a boat is to be used for sampling, it is important to note access points - docks, boat ramps, etc.
- 6.2.3 All sampling equipment should be decontaminated prior to each sampling episode. Decontamination procedures are detailed in the Decontamination SOP.
- 6.2.4 As appropriate, all sampling locations should be marked in some manner with stakes and / or flagging. Stakes / flagging are useful in some settings (small stream, swamp / wetlands). Photographs should be taken of shore reference points if using stakes is not practical, e.g., sampling in middle of a river or lake. A detailed sketch of the sample location and location on a map / drawing should also be noted. If available, a GPS should be used to locate unmarkable sampling points.
- 6.2.5 Measure the depth of the water from which the sample will be taken.
- 6.2.6 Any in-situ measurements, e.g. water pH, dissolved oxygen content, etc., should be taken prior to sampling activities.
- 6.2.7 If sediment samples will be taken at the same location, the surface water sampling should be performed prior to sediment sampling, because the sediment sampling activities will suspend fine sediments into the water column

6.3 SURFACE WATER SAMPLING

- 6.3.1 Appropriate field procedures are as follows:
1. Label the sample bottle with the appropriate sample tag. Complete all chain-of-custody documents. Refer to the Labeling, Packaging and Shipping Environmental Samples SOP for specific requirements.
 2. Collect sample by the appropriate method as described in Section 6.4 from an undisturbed area. Allow time for water to clear or sediment to settle if you have just waded into an area or dropped anchor.

3. Surface water samples shall be collected in the following order unless specifically superseded by the task-specific SAP. If a particular task does not require the collection of a particular analyte on the following list, proceed down to the next sample on the list that you are specified to collect.
 - a. Volatile organic compounds (VOC)
 - b. Semi-volatile organic compounds (SVOC)
 - c. Total Recoverable Petroleum Hydrocarbons (TRPH)
 - d. PCBs / pesticides
 - e. Metals
 - f. Radionuclides
4. Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g., EPA SW-846) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Label each sample as collected. Samples requiring cooling (volatile organics, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples will not be filtered.
5. See Attachment A for the container and preservative requirements for water samples anticipated to be collected. Additional special sample collection considerations are as follows:

VOCs

- Fill the sample vial slowly from sampler, minimizing air entrainment, until vial overflows (a meniscus should be present on the top of the sample bottle). Cap vial.
- Invert bottle and tap to check for air bubbles. If bubbles are present, open bottle, add additional water, and repeat this process until no air bubbles are present. If bubbles cannot be removed, the sampler should sample again using a different vial.

ELEVATED RADIONUCLIDES

- In surface water locations with elevated radionuclides, dedicated sampling equipment may be appropriate.
6. Record sampling event in the field log book and on a sample log, if dictated by the task-specific SAP.

7. Decontaminate equipment after use and between sample locations. Also, decontaminate sample containers and / or isolate them (such as sealing in Ziploc bags). Refer to the Decontamination SOP for specific requirements.

6.4 METHOD SPECIFIC SURFACE WATER SAMPLING PROCEDURES

6.4.1 Surface Water Sampling in Shallow Water Bodies (Wetlands, Brooks, Small Streams)

In these settings, the most appropriate method for obtaining surface water samples is likely wading in and obtaining a sample using a bailer, bucket, or certified clean sample bottle. Proper safety equipment should be worn at all times, including a life jacket, a secured line to the shore, and a “buddy” who remains on the shore. Equipment should be tied off to shore if possible, to ease retrieval if anything is dropped.

Samples should be collected by measuring the depth of the water, determining how deep a sample is appropriate, and collecting the sample. Sample bottles should be filled directly from the sampler. This will likely necessitate frequent trips to shore. Decontamination of equipment should take place on shore.

Samples shall be collected downstream to upstream, so that any suspended particles from activities in the water body will be transported away from the next sample point.

For surveying purposes, if possible, stakes or markers should be placed either at the sample location itself or on each bank or both on the same bank so that the sample point is on the line between the two stakes. The precise location of the sample point can then be specified by measuring the distance from one of the stakes.

6.4.2 Surface Water Sampling in Deeper Water Bodies (Lakes, Rivers)

In these settings, the most appropriate method for obtaining surface water samples will be from a dock or bridge, if available, or more likely, a boat. If the water is shallow enough, (less than three feet deep), the same methods as specified in Section 6.4.1 may be used. For water depths greater than approximately three feet deep, a surface water sampler should be used to obtain the surface water sample. Surface water samplers are open at both ends, with end caps held open by a strong elastic. A remote weight is sent down the line to depress the catch which is holding the elastic. This closes both ends of the sampler. The sample is collected from a spout located on the sampler.

Proper safety equipment should be worn at all times, including a life jacket. Equipment should be tied off to the boat if possible, to ease retrieval if anything is dropped.

The boat should be properly anchored before sampling activities commence.

Bow and stern anchors may be required to properly position the boat.

Samples should be collected by tying the sampler to a dedicated rope and dropping the sampling equipment over the side of the boat. Depending on the equipment being used, a weight may need to be sent down the line to close the sampler. The rope should be marked at the water surface before withdrawing the sampler. The depth of the sample should then be determined by measuring the length of rope deployed.

Samples shall be collected downstream to upstream, so that any suspended particles will be transported away from the next sample point. Sediment will be disturbed by the anchors and other activities.

If multiple surface water samples are being collected from a lake or pond (i.e. a relatively still body of water), sample collection should start with deeper points and move to shallower points.

It is also important to size the boat appropriately. If the work is to be in a fairly small area, it may be best to locate as many operations as possible on shore. If all sampling and decontamination activities must be contained within the boat, care should be taken to minimize the amount of equipment required.

If it is not possible to mark the sample location, photographic evidence of the location (shots of landmarks on shore), GPS coordinates, and precise locations on maps should be obtained.

6.5 GLOSSARY OF TERMS

<u>FSP</u>	Field Sampling Plan
<u>GPS</u>	Global Positioning System
<u>SAP</u>	Sampling and Analysis Plan
<u>SOP</u>	Standard Operating Procedure
<u>SSHP</u>	Site Safety and Health Plan

7.0 ATTACHMENTS

Attachment A – Container Requirements for Water Samples

ATTACHMENT A
CONTAINER REQUIREMENTS FOR WATER SAMPLES

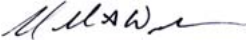
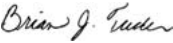
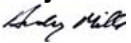
Analyte Group	Container	Preservative
Volatile Organic Compounds	3 - 40 ml glass vials with Teflon [®] -lined septum (no headspace)	HCl to pH <2 Cool, 4°C
Semi-volatile Organic Compounds	2 - 1L amber glass bottle with Teflon [®] -lined lid	Cool, 4°C
Pesticides / PCBs	2 - 1L amber glass bottle with Teflon [®] -lined lid	Cool, 4°C
Metals and Rare Earth Elements	1 – 1000 ml plastic or glass bottle	HNO ₃ to pH <2
TRPH	2 – 1000 ml glass bottle	HCl to pH<2 Cool, 4°C
Radionuclides	1 – 1000 ml plastic or glass bottle per radionuclide test, typ.	HNO ₃ to pH <2

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Monitoring Well Installation and Development

APPROVED:

	9/30/2003
Mike Winters	Date
Radiation Safety Officer	
	9/30/2003
Brian Tucker	Date
Project Chemist	
	9/30/2003
Andrew Mills	Date
Project Manager	

1.0 PURPOSE

This Standard Operating Procedure (SOP) - Monitoring Well Installation and Well Development is to be employed when one or more monitoring wells are to be installed and developed at properties within the FUSRAP Maywood Superfund Site (FMSS) with known or suspected groundwater contamination.

Monitoring well installation provides a permanent access for the collection of samples to determine groundwater quality and the hydrogeologic properties of the aquifer in which the contaminants exist. Such wells should not alter the medium, which is being monitored.

Monitoring well development serves to remove the finer grained material from the well screen and filter pack that may otherwise interfere with water quality analyses, restore the groundwater properties disturbed during the drilling process and to improve the hydraulic characteristics of the filter pack and hydraulic communication between the well and the hydrologic unit adjacent to the well screen.

2.0 SCOPE

This procedure details the materials, equipment, and methods common to Monitoring Well Installation and Development activities. Consult the Maywood task-specific Pre-Design Investigation Work Plans for monitoring well locations and special techniques. Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field log books.

3.0 REFERENCES

SOP SW-MWD-506-1 – Decontamination

SOP SW-MWD-410-1 – Groundwater Level Measurement

SOP SW-MWWD-5054-1 –Cuttings and Fluids Management

American Society for Testing and Materials, Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers, ASTM Designation D 5092 - 90, Annual Book of Standards, ASTM, Philadelphia, Pennsylvania, 1991.

Fetter, C. W., Jr., Applied Hydrogeology, Merrill Publishing Co., Columbus, Ohio, 1980, 488 p.

Gaber, M., and Fisher, B., Michigan Water Well Grouting Manual: Lansing, MI, Michigan Department of Public Health, 1988.

Gass, T., Monitoring Well Filter Pack and Screen Slot Size Selection: Water Well Journal, v. 42, no. 6, June 1988, p. 30-32.

Johnson Division, Groundwater Monitoring products: St. Paul, MN, Catalog published by Johnson Division, V.O.P., 1987, 12 p.

Keely, J. F., and Kwasi Boateng, Monitoring Well Installation, Purging, and Sampling techniques - Part 1: conceptualizations, Ground Water, v. 25, no.3, 1987, pp. 300-313.

Massachusetts Department of Environmental Protection, Standard Reference for Monitoring Wells, DEP Publication No. WSC-310-91, January 1991.

United States Army Corps of Engineers, Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites, Engineering Manual 1110-4000, August, 1994.

4.0 DEFINITIONS

Adsorption - the attraction and adhesion of a layer of ions from an aqueous solution to the solid mineral surfaces with which it is in contact.

Alkali - Hydroxide of sodium and potassium, classified as strong bases.

Aquifer - a geologic formation, group, or part of a formation that is saturated, and is capable of providing a significant quantity of water.

Borehole - a circular open or uncased subsurface hole created by drilling.

Bridge - an obstruction within the annulus, which may prevent circulation of proper emplacement of annular materials.

Casing - pipe, finished in sections with either threaded connections or beveled edges to be field

welded, which is installed temporarily or permanently to counteract caving, to advance the borehole, or to isolate the zone being monitored, or combination thereof.

Drawdown - a lowering of the water table of an unconfined aquifer or the potentiometric surface of a confined aquifer caused by pumping of groundwater from wells.

Groundwater - the water contained in interconnected pores located below the water table in an unconfined aquifer or located in a confined aquifer.

Hydration - the chemical combination of water with another substance.

Hydraulic Gradient - the change in total head with a change in distance in a given direction. The direction of water flow is that which yields a maximum rate of decrease in head.

Interface Probe - a hand-held, battery operated instrument used for measuring the thickness of separate phase non-aqueous phase liquids in a well.

Permeability - the capacity of a porous rock, sediment, or soil for transmitting a fluid.

pH - the negative logarithm value of hydrogen ion activity in an aqueous solution.

Slurry - a highly fluid mixture of water and finely divided material.

SSHP - Safety and Health Plan

Tremie Pipe - a pipe or tube that is used to transport filter pack materials and annular sealant materials from the ground surface into the borehole annulus or between casings and casings or riser pipe of a monitoring well.

Turbidity - the reduction in transparency of a sample due to the presence of particulate matter.

Water Table - the surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Site Manager has been properly briefed and is prepared for Monitoring Well Installation and Development activities.

5.3 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting Monitoring Well Installation and Development activities in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin. The Project Superintendent assures that all necessary personnel are mobilized on time and maintains a daily log of activities each work day. The Project Superintendent coordinates and consults with Project Manager on decisions relative to unexpected occurrences during monitoring well installation and development and deviation from this SOP.

5.4 SITE PERSONNEL

All employees who are engaging in monitoring well installation and development are required to read and sign the Site Safety and Health Plan (SSHP) and to follow the procedures in this SOP, unless superseded by project-specific requirements. All Monitoring Well Installation and Development activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

5.5 SITE SAFETY & HEALTH OFFICER

All field activities must be carried out in accordance with a site Safety and Health Plan (SSHP). The Site Safety & Health Officer (who may also serve as an observer of a monitoring well installation and development program) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

6.0 PROCEDURE

6.1 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR MONITORING WELL INSTALLATION & DEVELOPMENT

The following is a list of equipment & material, which is commonly, used on all monitoring well installation and development projects. Refer also to SOP equipment and material requirements to ensure completeness.

6.1.1 Items Supplied By Subcontractor

- Drilling Machine - capable of providing adequate rotation, feed, and retraction by hydraulic or mechanical means to the drill rods.
- Fluid Pump - capable of delivering sufficient volume and pressure for the diameter and depth of hole to be drilled. Combination of pump, drill rods and down-hole tools shall yield a clear-water up-hole velocity greater than 120 feet per minute.

- Clean water supply.
- Well construction materials (See Section 6 for details).
- Decontamination supplies for drilling equipment - See SOP Decontamination and FSP.
- Duct tape.
- Empty, clean 55 gallon drums with sealable covers, if required.
- Suitable grout mixers and grout pumps.

6.1.2 Items Supplied By Stone & Webster

- SSHP. To be read and signed by all site personnel prior to site activities.
- Personal Protective Equipment
- Field logbook(s)
- Clipboard
- Pencils
- Six-foot-ruler
- Pocket knife
- Camera (optional), check with Project Manager if required.
- Volatile organic compound vapor meter
- L.E.L. meter if required.
- Site boring logs and well construction logs
- Blank well installation logs
- Blank well installation development sheets
- Indelible markers
- Tape measure
- Water level measuring device - See S&W ENV SOP - Groundwater Level Measurement, Interface probe, if needed.
- Flow rate/volume measuring equipment (i.e. five gallon bucket and stopwatch).
- Decontamination supplies - See SOP Decontamination and FSP.
- Paper towels
- See Method-Specific Well Development Pumping Equipment List in Attachment F

6.2 SPECIFIC EQUIPMENT AND MATERIALS USED FOR MONITORING WELL CONSTRUCTION

- 6.2.1 The following sections are provided for selecting the most economical and chemically inert monitoring well construction materials commonly used in monitoring well installations. Monitoring well casing and well construction materials should be selected to meet the following criteria:

1. The materials should be resistant to deterioration resulting from long-term exposure to natural or synthetic chemical constituents in the groundwater at the site.
 2. The materials must have sufficient strength to ensure the structural integrity of the well.
 3. The materials should be selected to minimize their interference with the measurement of specific chemical parameters expected to be found at the site.
 4. The casing diameter should be large enough to accommodate commercially available down-hole instruments or sampling equipment, but also small enough to minimize the volume of water to be purged from the well.
 5. The well casing should be water tight.
 6. The well must be able to be secured against vandalism, leakage, and inadvertent damage.
 7. The screen and filter pack must be appropriately sized to provide representative data on hydraulic conductivity and groundwater quality.
- 6.2.2 The selection of well construction materials should be site specific and requires consideration of the project objectives, compliance with regulatory requirements, available data about the site geology, water chemistry, and the project budget. New well materials, filter packs and sealants are continually being developed. Individuals involved in well design and installation should be aware of recent developments in monitoring well technology. Refer to the typical components of a constructed monitoring well shown on Attachment A.

6.3 CASING MATERIALS

The casing, or riser pipe, is the part of the well that extends from the top of the well screen to the ground surface or above the ground surface. When selecting casings and well screens, both the composition and diameter must be taken into consideration. There are a number of commercially available well casing materials.

Some of the more commonly used materials are described below with their advantages and disadvantages. It is possible to combine different materials as long as they are compatible with one another. There is considerable debate over the significance of the adsorption and desorption potential of many well casing materials. However, adequate purging of the well prior to sampling of the well reduces or eliminates the potential for this to have a significant impact on the sample chemistry. The significance of the adsorption-desorption problem must be evaluated based on the monitoring well program, sampling and analytical requirements, and the concentrations one is trying to measure.

The size of the well casing, both the wall thickness and the inside diameter (ID) of the pipe, should be considered in well construction. The wall thickness determines the strength of the casing material, and the inside diameter must provide enough room for down-hole instrumentation. The thicker the casing, the stronger the pipe. Pipe or casing thickness is described in various “schedules.” For Polyvinyl chloride (PVC) monitoring well applications, Schedule 40 and Schedule 80 are commonly used. Schedule 80 is thicker and stronger than Schedule 40. Metal casing materials also come in various wall thickness, or schedules. Monitoring well casings are available in 3/4-, 1-, 1.5-, 2-, 4-, and 6-inch ID sizes. A minimum diameter of 2 inches is commonly used for all standard monitoring well installations. Two-inch ID wells will accommodate most commercially available sampling pumps and bailers. In some applications, larger diameter wells may be desirable so that standard pumps and skimmer systems can be used.

The selection of the size of the well casing will also influence the size of the borehole needed for proper well installation. Ideally, the diameter of the borehole should be at least 4 inches greater than the outside diameter of the well screen and the riser pipe. This larger diameter may not be economically possible, but the larger diameter helps to avoid “bridging-up” of sealant materials that are introduced around the well casing.

The following sections discuss some of the commonly used casing materials for monitoring well construction.

6.3.1 Polyvinyl Chloride

6.3.1.1 PVC is the most common well casing material used in monitoring well construction. PVC is thermoplastically molded casing composed of a rigid, unplasticized polymer. Flush-threaded or coupled PVC casing should be used for monitoring well construction. If flush-threaded casing is used, ASTM specified thread specifications should be used. Under NO circumstances should solvent cement be used to join casing sections together. Only PVC well casing listed with the National Sanitation Foundation (NSF) should be used because the products are essentially free of readily leachable plasticizers.

6.3.1.2 Advantages and Disadvantages of PVC

The advantages of PVC for use in well casing materials are:

- Excellent chemical resistance to weak alkalis, alcohols, aliphatic

hydrocarbons, and oil and grease.

- Good chemical resistance to strong mineral acids, strong oxidizing acids, and strong alkalis.
- Readily available.
- Lightweight.
- Inexpensive.
- Two wall thicknesses commonly available (Schedule 40 and 80) provide a choice of strengths.

The disadvantages of PVC for use in well casing materials are:

- May adsorb and desorb low levels of some organic constituents from the groundwater. This may not be a problem if the well is adequately purged prior to sampling.
- Poor chemical resistance to concentrated ketones, esters, and some aromatic hydrocarbons.
- Weaker, less rigid, and more temperature-sensitive than metallic casing materials.

6.3.2 Stainless Steel

Stainless steel provides an excellent casing material where corrosion resistance and strength are important. The strength provided by stainless steel may be essential when installing wells in deep boreholes (over 300 feet deep) due to the potential for other casing materials with lower strengths to collapse. Stainless steel is resistant to most chemicals and is suitable for monitoring many types of contaminants. Long periods of exposure to highly corrosive groundwater conditions may result in leaching of chromium or nickel from stainless steel well casing. Therefore, if the pH of the groundwater is low (four or less), stainless steel is not recommended for long-term monitoring of inorganic constituents. Stainless steel is available in a variety of types, each with a slightly different composition. As with PVC, stainless steel casing should have threaded, flush joints to assure watertight connections.

6.3.2.1 Advantages/Disadvantages of Stainless Steel

The advantages of stainless steel for use in well casing materials are:

- Excellent chemical resistance to corrosion and oxidation; will not adsorb or desorb organic contaminants.
- High strength, rigidity.
- Suitable for wide range of temperatures.
- Readily available.

The disadvantages of stainless steel for use in well casing materials are:

- Susceptible to galvanic and electrochemical corrosion.
- Heavy; may require additional equipment to lower down borehole.
- May leach chromium and/or nickel in acidic waters.
- Moderate to high cost.

6.3.3 Teflon®

Teflon® is a fluorocarbon polymer developed by Dupont. Teflon® displays a high resistance to chemical attack, reportedly low adsorption of chemicals, and low leaching of the casing compounds.

- Advantages/Disadvantages of Teflon®

The advantages of Teflon® for use in well casing materials are:

- High resistance to chemical attack.
- Very limited adsorption capacity.
- Low potential for leaching.
- Lightweight.

The disadvantages of Teflon® for use in well casing materials are:

- Low tensile strength and rigidity.
- Tendency towards excessive slippage during installation.
- Limited availability.
- In deep installations, slots in screen may close under the weight of the riser.
- Comparatively high cost.

6.4 WELL SCREEN SELECTION

A well screen is a filtering device that serves as the intake portion of monitoring wells constructed in unconsolidated or semi-consolidated aquifers. The screen provides a hydraulic connection to the saturated portion of the aquifer so that representative water level and chemical data can be obtained. It permits water to enter the well from the saturated aquifer, prevents sediments from entering the well, and serves to structurally support the unconsolidated aquifer material. The considerations for well screen construction are the same as for well casings; however, the strength of the screened section is less than that of the riser sections due to the openings. Other criteria to be considered in selecting the well screen are the slot size (i.e., percentage of open area) and style (i.e., non-clogging slots).

Well screens are characterized based on the width of the openings in thousandths of an inch. No. 10-slot, for example, represents an opening of 0.010 inch. Generally a 10-slot or 20-slot (0.010- or 0.020-inch, respectively) screen is appropriate for monitoring wells where low pumping rates are used. Obviously, it is important that the grain-size of the filter pack around the screen is larger than the width of the slots. Slot-size selection is

also important where field permeability tests are to be performed in the well casing in coarse-grained materials where the hydraulic conductivity of a small slot-size may have a lower permeability than the native soils. A larger slot-size is preferred in situations where highly viscous materials (i.e., heavy oils or creosote) are being monitored.

6.4.1 Styles of Well Screens

Two types of standard well screens commercially available for monitoring well construction are the slotted pipe and wire wound continuous slot. Hand-cut or hand-slotted well screens should never be used for monitoring wells.

6.4.1.1 Slotted Pipe

The slotted pipe consists of standard well casing that has been machine perforated with parallel rows of slots. The size, frequency and configuration of the slots will vary with the application and manufacturer. In general, slotted screens have approximately five to ten percent open area. Table 1 in Attachment B shows the total slot area for well screens of various gauges in square inches per foot.

- Advantages/Disadvantages of Slotted Well Pipe

The advantages of slotted well screens are:

- Machine-manufactured - good slot-size control.
- Readily available.
- Inexpensive.

The disadvantages of slotted well screens are:

- Limited open area; this may inhibit efficient well development.
- Prone to clogging by fines.

6.4.1.2 Wire-wound, Continuous Slot Pipe

Wire-wound, continuous slot screens provide a larger open area than slotted screens, typically twice as much. Wire-wound screens consist of triangular-shaped, continuously wound wire connected by vertical bars. The V-shaped openings are wider on the inside than the outside, reducing the likelihood of clogging by formation materials.

6.4.1.2.1 Advantages and Disadvantages of Slotted Well Screens

The advantages of wire-wound, continuous slot pipe are:

- Good slot control; wide range of sizes available.
- Larger percentage of open area than slotted screens.

- Large open area allows fluid to enter at a low velocity, reducing the turbidity of sample.
- Less susceptible than slotted pipe to plugging due to V-shaped slots.
- Readily available.
- Inexpensive.

The disadvantages of wire-wound, continuous slot pipe are:

- More expensive than screens made of slotted pipe.
- Not as strong as slotted pipe.

6.5 SEDIMENT SUMP PIPE

Sediment sumps, or silt traps, are used in formations consisting of sand, silt, or clay, where it may be difficult to completely prevent the migration of fines through the filter pack and well screen. Sediment sumps are attached to the bottom of the well screen to collect fines and are typically six to 24 inches in length. If a sediment sump is employed, one must be careful that the accumulated fines are not disturbed and suspended during purging or sample collection.

6.6 FILTER PACK

A filter pack around the well screen helps to reduce the movement of fine-grained materials into the screen that could potentially clog the screen and inhibit water movement. In addition, the filter pack provides support around the well screen to prevent the formation materials from collapsing around the screen. An effective screen provides a zone of high hydraulic conductivity around the screen and reduces the infiltration of fines. The filter pack must be chemically inert; otherwise, it may affect the chemistry of the groundwater as it passes through the filter pack and into the well.

When monitoring wells are installed in formations with a wide range of particle sizes, effective filtration can be difficult. To exclude the entrance of fine sands, silts and clays into a monitoring well, the grain-size distribution curve for the filter pack ideally is selected by multiplying the 50-percent retained size of the finest formation sample by two. This approach may not be practical in fine-grained materials (i.e., silts and clays). Table 1 in Attachment C lists the recommended (achievable) filter pack characteristics for common screen slot sizes. All filter pack material should be purchased from reputable suppliers who have properly cleaned and bagged the material. Typically, washed sand or silica sand is used. According to Gass (1988), monitoring wells should be filter-packed under the following circumstances:

- When there is more than ten to 15 percent clay-/or silt-sized particles in the formation.
- When the well is completed in a formation consisting of relatively fine uniform sand.
- When the physical characteristics of the formation in the screened zone are highly variable.

- When the formation is composed of friable or fractured rock, which allows sand, silt or clay to enter the well.
- When the formation is not an aquifer.

The amount of filter pack ordered should be sufficient to enable the filter pack to be as thick as practical, particularly in low permeability soils. Two types of filter packs are discussed below.

6.6.1 Washed Sand

Washed sand typically consists of concrete mortar sand that has had only the fine particles removed by washing and screening. Washed sand is usually available in different size ranges and is generally available in bulk quantities. The quality assurance and control of this type of material should be reviewed. Lack of Quality Assurance/Quality Control (QA/QC) is often the limiting factor for use as a monitoring well filter sand. A representative sample should be collected during drilling for analysis at a later date should concerns arise over the quality of the material.

6.6.1.1 Advantages and Disadvantages of Washed Sand

The advantages of washed sand used for filter sand are:

- Inexpensive.
- Wider range of grain sizes than silica sand.
- Readily available.

The disadvantages of washed sand used for filter sand are:

- Chemical composition and reaction with ground water usually not known.
- In deep boreholes particle-size segregation may occur during free-fall installation. Proper installation may require emplacement with a tremie pipe.

6.6.2 Uniformly-graded Silica Sand

Uniformly graded silica sand is manufactured by crushing quartzite into small particles. It is available in a variety of grain sizes, but it is usually more uniform in size than washed sand. Its angularity is greater than found in most washed sands. Ottawa sand is a brand name for silica sand that comes from Ottawa, Illinois. Ottawa sand is more rounded and spherical than other silica sand products. It is frequently specified for monitoring well installations, but it is much more expensive than locally manufactured silica sand with the same specifications. These products have acceptable QA/QC for use as a filter sand for monitoring wells.

6.6.2.1 Advantages and Disadvantages of Uniformly-graded Silica Sand

The advantages of uniformly graded silica sand used for filter sand are:

- Composition is essentially pure silica; as such, it is chemically inert.
- Generally has acceptable QA/QC.
- Readily available in bags.
- Easy to install

The disadvantages of uniformly graded silica sand used for filter sand are:

- More expensive than washed sand.
- Fine-grained silica sand sizes may be slow to settle; may increase installation time or require installation by tremie pipe.

6.7 SEALS

An effective monitoring well seal prevents the vertical movement of groundwater within the borehole and should not interfere with the water chemistry of the aquifer. The purpose of the seal is to isolate a specific section of an aquifer to obtain hydrogeologic and chemical information, prevent migration of fluids from the ground surface into the borehole, prevent contaminant movement from one section of an aquifer to another or between aquifers, and provide structural support for the well casing and prevent collapse of the borehole walls.

The three types of seals used in monitoring well installations are divider seals, surface seals, and annular seals.

- **Divider Seal** - A divider seal consists of a layer of bentonite slurry or pellets designed to prevent the liquid grout seal from plugging up the filter pack. It should be placed above the filter pack and below the annular seal. The minimum thickness is 6 inches; the recommended thickness is two feet.
- **Annular Seal** - Annular seals are placed in the annular space above the divider seal to plug up the open space between the well casing and the borehole wall. This type of seal is a low permeability material that will serve to inhibit the vertical movement of fluids within the borehole. It is generally composed of a grout seal.
- **Surface Seal** - A concrete seal around the top of the well shaped so that the surface water flows away from the casing. Bentonite is not an acceptable material for the surface seal. Based on the average depth of frost penetration at the monitoring well site, the surface seal and protective casing should, if possible, extend a minimum depth below frost penetration.

6.7.1 Sealing Materials

There are several types of sealants available for monitoring well installations. The selection of a well sealing material will depend on the depth of the application, the chemistry of the water, the well casing material, and the purpose of the well program. The two basic categories of well sealants are solid sealants and grout sealants. Since the New Jersey Department of Environmental Protection (DEP) and many other State DEPs do not allow use of solid sealants, only grout sealants will be described in the following sections.

6.7.1.1 Grout Seals

Grout is a mixture of powdered cement, bentonite, and water to create a pumpable fluid. In some applications, aggregates and chemical additives are added to the mix to enhance the properties of the grout or to alter the setup rate. In monitoring well applications, grouts are typically installed as an annular seal between the monitoring well casing and the borehole wall.

The two basic categories of grout seals are cement -based grout and bentonite-based grout. Often, bentonite-based grouts are used when it is desired that the grout remain flexible during the life of the installation. Cement-based grouts are used typically for filling in of cracks in the surrounding geologic material, or when a rigid seal is desired. The sealant qualities of grouts are related to the type of cement and/or bentonite that is used, the water-to-mix ratio, mixing methods, and installation methods. The rate at which the grout sets up is principally related to the chemical composition of the cement. Generally, Portland Type I or II cement is used for monitoring well seals. The characteristics and uses of five types of ASTM cements are shown on Table 1 in Attachment D. The properties and advantages and disadvantages with cement- and bentonite-based grouts are summarized on Table 2 in Attachment D.

Typical bentonite-based grouts consist of about one to 1.25 lb. of unaltered bentonite to each gallon of water, and with up to two lb. of Type 1 Portland cement (per gallon of water) added to stiffen the mix. Typical cement-base grouts consist of about 6 to 7 gallons of water per 94-lb bag Type 1 Portland cement, and from ten to ten percent (by dry weight of cement) of bentonite powder to retard shrinkage and provide plasticity.

6.7.1.2 Concrete Seals

Concrete is a mixture of Portland cement, sand, and water. It is generally used to cap grout or bentonite seals at the ground surface. The concrete increases the structural integrity of the road-box/protective well casing material and concrete/soil contact. It is not suitable as an annular sealant.

6.8 PROTECTIVE CASINGS

Protective well casings are required for all monitoring wells to protect the well from damage, leakage, tampering and vandalism. Protective casings are generally constructed of steel and have a locking cap. Two basic types of protective casings used in monitoring well installations are the above-ground casing and the flush-mount casing (i.e., road-box).

6.8.1 Above-ground Protective Casing

Above-ground protective well casings are typically constructed from steel or cast iron pipe sections, generally five to seven feet in length and four inches in diameter, assuming a two-inch-diameter well casing. The protective casing should be vented by drilling a 1/8- to 1/4-inch-diameter hole immediately above the ground surface. The protective casing should have a hasp on the top so it can be locked with a padlock. The padlock should be corrosion-resistant; for simplicity and convenience, padlocks at the site should be keyed alike.

In some heavily trafficked areas, three additional posts or casings should be installed around the protective casing to provide a buffer zone.

6.8.2 Flush-mount or Road-box Casing

A flush-mount protective casing is used where the well installation must be installed flush with the ground surface, such as in roadways, parking lots, and sidewalks. Some road-boxes have a five-sided bolt on the top that holds the cover on requiring a special wrench to open these protective casings. These road-boxes should be designed to be watertight that will allow surface water flow over the top of the road-box cover. In pervious materials, the road-box should rest on a layer of filter sand to allow drainage if water enters the road-box.

6.9 GENERAL MONITORING WELL INSTALLATION PROCEDURES

The proper installation of monitoring wells is an essential part of all environmental waste site investigations. Quality well installations require thoughtful consideration of several interrelated topics including the objective(s) of the well installation program, selection of the appropriate drilling method, network design, and well construction materials. The techniques described in the following subsections are some of the common and effective methods that can be used to install monitoring wells. Other methods may be utilized provided that the performance and integrity of the well components are maintained. This SOP focuses primarily on the installation of single standpipe wells, as this is the type of well most commonly installed.

In general, well installation involves positioning the well screen in a geologic unit of

interest and attaching a string of riser pipe to the well screen. The riser pipe extends to slightly below ground for a "Road Box" completion or slightly above the ground surface for a surface casing completion. The screened section is then backfilled with a filter pack material such as silica sand. A divider seal consisting of bentonite chips or pellets is placed above the filter pack to seal off the monitoring zone. The annular space above the divider seal is then filled with a grout slurry consisting of cement, water, and bentonite. A protective casing or road-box is installed in a concrete seal at the ground surface. See Attachment A for typical components of a monitoring well general construction schematic.

When the groundwater table is shallow, approximately six feet or less, it is generally physically impossible to follow the monitoring well installation procedures for deeper wells. The construction of the well, particularly the thicknesses of surface sealing materials will need to be modified.

Note: If no free standing water is observed in the bottom of the boring at the specified completion depth for well construction, contact the project manager before proceeding with well construction.

6.9.1 Borehole Preparation

After the borehole has been successfully drilled to the required monitoring well depth with augers or casings situated at the bottom of hole, measure and record the depth to the bottom of the borehole with a weighted measuring tape. If the borehole has been advanced beyond the desired well depth, it will be necessary to backfill the lower part of the hole with a backfill material up to the required depth of the well. This backfill material may consist of a sealant or sand depending upon the monitoring well design and sampling program. This will allow the well to produce water samples from a discrete zone of interest.

- If adequate vertical spacing is available (given well construction constraints), drop approximately 6 inches of filter pack into the flushed, cased hole. Measure and record the depth to the top of the filter pack.

6.9.2 Sediment Sump Pipe, Well Screen and Riser Placement Installation

1. In general, well screens being installed below the water table are shorter in length to prevent vertical dilution of aquifer samples. Five foot screen intervals are commonly used. Wells being screened across the water table generally have ten foot screen lengths bisecting the estimated water elevation. This arrangement allows for seasonal water elevation fluctuation.
2. Determine the length of the sediment sump pipe, well screen and riser pipe for well construction. The lengths of the new (uncontaminated) sump trap, well screen, and riser pipe shall be measured and recorded. The length of the slotted portion of the well screen section shall also be measured and recorded. Prior to cutting unused material, be certain that the units can be properly assembled and the pipe joints maintain a watertight fit without the

use of a solvent cement. Teflon[®] tape or o-rings can be used on the joints to help prevent leakage. When determining the length of the riser pipe, consider the length of the protective casing above ground. The top of the riser pipe should be approximately two to four inches below the top of the protective casing.

3. The well assembly should be vertical and centrally positioned in the borehole. This will help to ensure even placement of filter pack and seals and reduce the possibility of dead space or voids. Stainless steel centralizers should be used if installing through casing or larger inside diameter hollow stem augers.
4. Temporarily cover the top of the riser pipe to prevent unwanted material from entering the well casing. Measure and record the length of riser pipe above the ground surface (stick-up) prior to and during drill casing removal. If the well casing is installed properly, the stick-up will not change during the well installation procedure. If the riser stick-up length increases during the well installation process, then the well screen assembly is rising during drill casing (or auger) removal.
5. Cut top of riser at an angle to facilitate surveying and water level measurements.

6.10 FILTER PACK INSTALLATION

The filter pack should provide complete and even coverage around the well screen. A properly installed filter pack does not contain any voids. Cuttings or portions of the borehole wall should not be allowed to collect around the well screen. If adequate space is available, approximately six inches of filter pack is recommended below the sediment sump. A minimum of two feet of filter pack is recommended above the well screen. This will help prevent sealant materials to enter the screened interval and extend the monitored zone. For monitoring wells installed in groundwater at depths of approximately 6 feet or less, the thickness of the filter pack can be reduced so that there is enough room for a divider seal, concrete seal and the road box or protective casing. Typically the thickness of the divider seal is increased to the bottom of the surface concrete. Filter pack installations at depths greater than ten feet should be placed using tremie methods; i.e., tremie pipe where adequate annular space is present.

1. If casing is used to advance the hole, calculate the volume of filter pack required between the well screen and the borehole. Assume the volume to be filled maintains the outside diameter of the casing during the installation process. A simple method to achieve this is to place a section of well screen in a piece of casing or pipe that is equivalent to the borehole diameter, and determine the volume necessary to fill a one- to two- foot length of the annular space. The total length of filter pack can be multiplied by this number to determine the estimated quantity of filter pack necessary. If augers are used, a different measuring technique has to be used.

2. With the casings (or augers) installed to the bottom of the well assembly, begin installation of the filter pack.
3. From the ground surface, slowly pour the filter pack down into the annular space of the borehole. Slowly pouring the sand down the hole will prevent bridging of sand. If bridging does occur, flush clean water down the hole. Allow sufficient time for the sand to settle to the bottom of the hole prior to taking a “top of sand” measurement.
4. Approximately one to two feet of filter pack is allowed in the bottom of the casing prior to the casing’s retraction. To prevent collapse of the borehole walls as the casing is lifted off the bottom, the casing or augers should be slowly retracted approximately a half to one foot so that the filter pack can fill the space between the well screen and the borehole wall. The intent is always to have sand in the bottom of the casing to avoid collapse of the borehole walls as the casing is lifted. When augers are used, the sand pack drops at a much faster rate, and this issue becomes more of a concern.

Note: It is also important to prevent an excessive amount (greater than two to three feet) of filter sand from accumulating inside the casing at any given time. If there is an excessive amount of filter sand in the casing, the potential for the well casing to rise when the drill casing is retracted is great due to the increase in friction around the well screen.

5. Tamp, measure and record the depth to the top of the filter pack with a weighted tape to verify its location each time the casing is retracted.
6. Steps 3 through 5 shall be repeated until the desired length of filter pack has been installed.
7. The total amount of filter pack installed shall be recorded and compared to the total filter pack calculated. Note and record variations between the two quantities.

6.10.1 Divider and Annular Seal Installation

Well seals are a very important part of monitoring well installation. Well seals isolate the well screen at the desired depth within the formation, prevent the vertical migration of fluids and contaminants along the annular space of the borehole, and provide structural stability for the monitoring well.

The procedures for the installation of the divider and annular seals are described below.

6.10.2 Divider Seal Installation

1. The divider seal, consisting of a bentonite slurry, is placed on top of the filter pack. Prior to placement of the bentonite slurry below the water table, the casing or augers are retracted six inches to a foot above the filter pack. This prevents the bentonite from sticking to the inside of the casing and also

allows the bentonite to spread more easily at the bottom of the hole. If the hole is dry, the casing does not have to be retracted prior to bentonite installation. When the divider seal is installed below the water table, the amount of retraction depends upon the stability of the borehole walls.

2. Calculate the theoretical volume of bentonite slurry required to fill the annular space. The thickness of this seal shall range between two and five feet above the filter pack.
3. The bentonite slurry shall be dropped manually into the annular space at a very slow rate to avoid bridging of the bentonite in the casing. Prior to retraction of the casing, periodically measure and record the depth to the top of the bentonite in two- to four-inch incremental increases. Unless the hole is dry, ensure that the depth to the top of bentonite is below or at the bottom of the casing and that the bentonite is not bridging up inside the casing.
4. Repeat Step 3 until the desired seal thickness has been obtained. Measure and record the depth to the top of the seal and total volume of bentonite used to construct the seal. Compare and note the theoretical volume with the actual volume used.
5. If the divider seal is placed above the water table, approximately five to 10 gallons of water must be added to the seal to activate the swelling of the bentonite prior to the installation of the annular seal. If groundwater is shallow, less than approximately 6 feet, the divider seal will also be used as an annular seal.

6.10.3 Annular Seal Installation

The annular seal is installed above the divider seal, between the well casing and the borehole walls.

Note: If groundwater is shallow, the thickness of the divider seal will be increased and it will act as the annular seal. Grout mixtures are generally used for annular seals unless the groundwater is less than approximately 6 feet deep. If the grout is properly mixed using suitable cement/bentonite/water mix ratios and correctly installed, grout can be an effective well seal.

1. Calculate the theoretical volume of grout required to fill the annulus from the top of the divider seal to the ground surface. If groundwater is shallow (less than approximately 6 feet), estimate the volume of bentonite needed to fill the annulus to the bottom of the protective casing or road box. This step would have been done for the divider seal installation.
2. Prepare a suitable cement-based or bentonite-based grout mix based on the geologic formations encountered, hydrogeologic properties of the formations, and project requirements. Estimate at least 20 percent more than the theoretical volume of grout calculated in Step 1 above.

- For typical cement-based grouts, properly mix the grout as follows:
 - Add one 94 lb. bag of Type I or Type II Portland cement to every six to seven gallons of water. Thoroughly mix the cement and water in a container until the slurry is free of lumps.
 - Add two to ten percent unaltered bentonite powder to retard shrinkage and provide plasticity. The bentonite powder is added dry to the cement-water slurry without first mixing it with water. Thoroughly mix the grout until free of lumps.
 - For typical bentonite-based grouts, properly mix the grout as follows:
 - Bentonite powder must be the first additive placed in the water through a venturi device. Use approximately one to 1.25 lb. of unaltered bentonite to each gallon of water.
 - After the bentonite-water mix is allowed to hydrate, add up to two lb of Type I Portland cement (per gallon of water) to stiffen the mix.
3. Repeat Step 2 until the desired volume of grout has been obtained. It is recommended that extra grout be mixed to account for grout losses in the formation and at the ground surface.
 4. With the casing or augers at the top of the divider seal, lower a tremie or grout pipe equipped with a side discharge to the required depth, slightly above the divider seal.
 5. Inject grout through the tremie pipe to the top of the divider seal. The tremie pipe should be kept full of grout from start to finish with the discharge end of the grout pipe completely submerged as it is slowly and continuously lifted. Tremie the grout down the grout pipe in one continuous operation until grout of similar density discharges from the annular space at the ground surface. Approximately five to ten feet of grout pipe should remain submerged in the grout until the grouting is complete. If casing or auger removal does not commence until grout injection is completed, then additional grout shall be tremied in the annular space, as needed during casing removal, to maintain a continuous column of grout up to the ground surface.
 6. Once grouting is complete, pumps and hoses shall be flushed with clean water.
 7. Record total grout volume used for annular seal and compare with calculated grout volume. Record the volume of bentonite chips or pellets used if shallow groundwater was encountered.

6.11 PROTECTIVE CASING AND SURFACE SEAL

A protective casing, either a flush-mounted road-box or an above-ground protective casing protects the monitoring well. The current and/or future site of the monitoring well will dictate what type of protective casing shall be installed.

The protective casing is installed, at least partially, inside a concrete surface seal for additional structural support.

6.11.1 Protective Casing Installation

1. The steel protective casing shall be approximately five to seven feet in length. The inside diameter of the protective casing shall be sufficiently large to permit easy removal of the riser cap for water level measurement and sampling activities. The outside diameter of the protective casing shall be at least one to two inches smaller than the borehole diameter. If shallow groundwater is encountered, less than approximately 6 feet deep, it may not be feasible to install protective casing. Notify the Project Manager to discuss and choose alternative solutions (i.e., shorter protective casings, road box installation, or modification of protective casing installation procedure.
2. Install the protective casing over the riser and into the annular seal before the final set of the grout seal. If the grout has settled a few feet below the ground surface, fill the void with a concrete slurry to the surface. The protective casing should be erected and stabilized in a position concentric with the riser. The bottom of the protective casing should extend to a depth below the region's frost line, if well design permits, to avoid possible heave and well damage. In addition, the top of the well casing shall be approximately two to four inches below the top of the protective casing. The stick-up of the protective casing should be approximately two to three feet above the ground surface.
3. At the ground surface to a depth of approximately one foot, the hole surrounding the protective casing, if in soil-like materials, shall be enlarged to an approximate diameter 18 inches wider than the protective casing diameter.
4. Manually mix the required amount of concrete to fill the annular space surrounding the protective casing to a depth of approximately one foot. If the top of the annular grout is deeper than one foot, place the concrete seal from the top of the grout surface. The concrete pad surrounding the protective casing at the surface should form a conical-shaped collar around the casing, directing surface runoff away from the casing.
5. Measure and record depth to bottom of the monitoring well, concrete seal, protective casing, height of protective casing, height of well casing above ground, and the distance between the top of the well casing and the rim of the protective casing. With an indelible marker, mark a point at the top of the

riser pipe or make a “V” at the top of the riser pipe which will be used as a measuring reference point.

6. Install a vented well cap that will fit easily below the top of the protective well casing. Place a block of wood or other suitable spacer between the top of the well cap and the cover of the protective casing to prevent possible settlement prior to the set-up of the annular seal.
7. A ¼-inch-diameter hole shall be drilled through the protective casing a few inches above the ground surface.
8. Once the installation is completed, the protective casing shall be locked and labeled accordingly. The labeling shall be marked on the outside of the protective casing and on the outside of the well casing. Minimum information shall include a unique monitoring well number. Locate the monitoring well on a project site plan for future monitoring.

6.11.2 Road-Box Casing Installation

1. The road-box casing shall be approximately one foot in length. The inside diameter of the road-box casing shall be sufficiently large to permit easy removal of the riser cap for water level measurement and sampling activities. The outside diameter of the road-box casing shall be at least one to two inches smaller than the borehole diameter.
2. Once the annular seal begins to set, or after a divider seal is installed for shallow groundwater wells, place a two- to four- inch layer of drainage sand on top of the grout at approximately one foot below the ground surface. Install the road-box casing over the riser and place the bottom of the road-box into the drainage sand. The road-box should be erected and stabilized in a position concentric with the riser. The top of the well casing shall be approximately two to four inches below the top of the road-box cover.
3. At the ground surface to a depth of approximately one foot, the hole surrounding the road-box casing shall be enlarged to an approximate diameter 12 inches wider than the road-box casing diameter.
4. Manually mix the required amount of concrete slurry to fill the annular space surrounding the road-box casing to a depth of approximately one foot. If the top of the annular grout is deeper than one foot, place the concrete seal from the top of the grout surface to the ground surface. Construct the road-box casing so that the cover is flush with the ground surface.
5. Measure and record depth to bottom of the monitoring well, concrete seal, road-box casing, and the distance between the top of the well casing and the rim of the road-box casing. With an indelible marker, mark a point at the top of the riser pipe or make a “V” at the top of the riser pipe which will be used as a measuring reference point.

6. Install a locking, vented well cap that will fit easily below the top of the road-box cover. Place a block of wood or other suitable spacer between the top of the well cap and the road-box cover to prevent possible settlement prior to the set up of the annular seal.
7. Once the installation is completed, the five-sided bolt on the road-box cover shall be tightened to prevent water leakage. The monitoring well shall be identified with an indelible marker on the riser pipe, the well cap, and the underside of the road box cover. Locate the installed monitoring well on a site plan for future monitoring.
8. Record all measurements and any other details on well installation log. See Well Log Sheet in Attachment E.

6.12 General Well Development Procedures

Following installation of the well, the well shall be developed. The degree or extent to which the well is developed may vary with the intended use of the well. Well development serves to remove the finer grained material from the well screen and filter pack that may otherwise interfere with water quality analyses, restore the ground-water properties disturbed during the drilling process, and to improve the hydraulic characteristics of the filter pack and hydraulic communication between the well and the hydrologic unit adjacent to the well screen. Methods of well development vary with the physical characteristics of hydrologic units in which the monitoring well is screened and with the drilling method used. Well development activities should remove fluids that were introduced into the formation during drilling and well installation. This may not be a practical solution if a large quantity of drilling fluid was lost.

Section 6.12 describes pre-well development activities. Section 6.12 describes general water removal methods and requirements used for well development. In addition to fluid removal from the well, four important and commonly employed techniques used for enhancement of well development are discussed in Section 6.13.

6.12.1 Pre-Well Development Activities

The following activities will be performed and recorded in the field log book immediately prior to developing each well:

1. Monitoring wells will be allowed to stabilize for at least two days after placement of grout seals.
2. Check the well for proper identification and location.
3. Inspect the well head for any signs of forced entry. If the well shows signs of damage or forced entry, report finding to the Project Superintendent and/or Project Manager before proceeding further.

4. Immediately after unlocking the well and removing well cap, measure and record the ambient and well-mouth organic vapor levels using the organic vapor meter. If organic vapor levels exceed 200 ppm in the well mouth, check well for the presence of free-floating petroleum hydrocarbons using a clear, disposable bailer or interface probe (if on site). If unanticipated free-floating petroleum hydrocarbons are found to be present, report finding to the Project Superintendent and/or Project Manager before proceeding further.
5. Ensure that all equipment that will come in contact with well water has been pre-cleaned in accordance with the decontamination procedures specified in S&W ENV SOP Decontamination prior to introduction into site wells.
6. Locate the reference point at the top of the well casing from which depth measurements shall be made. If not present, a reference point for these measurements shall be made prior to taking groundwater level measurement. The reference point shall consist of either a "V"-cut or indelible mark, made on the highest point of the well casing.
7. Measure and record the distance between the top of the well casing and the top of the protective casing. Note any differences, if any, from well installation measurements.
8. Using the chosen water level measuring device (See S&W ENV SOP - Groundwater Level Measurement), measure and record both the depth to the static water level and the depth to the well bottom to the nearest 0.01 foot. Compare recorded depth of well to measured depth and note the difference as the amount of siltation. If petroleum hydrocarbons are found to be present on the water level measuring device or if a strong petroleum odor exudes from the device, check well for the presence of free-floating petroleum hydrocarbons using a clear, disposable bailer or interface probe, if on site. If unanticipated free-floating petroleum hydrocarbons are found to be present, report finding to the Project Superintendent and/or Project Manager before proceeding further.
9. Subtract the measured depth to water from the measured depth to the bottom of the well to determine the height of the water column in the well.
10. Calculate the fluid volume to be pumped using the following formula:

$$\text{Number of Gallons} = (5.8752) (C^2) (H)$$

Where: 5.8752 = Conversion factor (7.48 gallons per cubic feet times $\pi/4$)

C = Casing diameter, in feet

H = Height of water column (from bottom of well to top of water table, in feet)

11. Begin the well development activities listed in Section 6.12.

6.12.2 Water Removal (Pumping) Activities For Well Development

Refer to Attachment F for assistance in choosing the correct pumping equipment for the diameter of the well that is to be developed. The following steps outline water removal activities:

1. Prepare equipment and remove fluid from well using the appropriate method-specific steps outlined in steps 2 through 4 below. Follow any specific water removal methods used with particular well development method, (i.e., over-pumping, backwashing, mechanical surging, and air-lifting) described in Section 9.0 below.
2. The well developer shall collect a well development water sample from each pumped well volume. The pumped volume shall be either directly measured using a graduated container or estimated by determining flow rate and recording discharge time interval. Refer to FSP for instructions regarding disposal of well development fluids. If permitted by the FSP, pumped water shall be discharged to the ground surface at a distance more than ten feet from the well. If either the FSP or field measurements and/or observations indicate that pumped water must be dealt with as Investigation Derived Waste (IDW), then refer to S&W ENV SOP - Cuttings and Fluids Management for instructions.
3. The well developer shall measure and record the following on the Well Development Field Data Record for each well volume pumped (Refer to Attachment G for well development log sheet):
 - pH
 - Temperature
 - Specific Conductivity
 - Turbidity
4. Water removal is considered complete when:
 - a. A minimum of three casing volumes have been removed from the well, and pH, temperature, conductivity, and turbidity have stabilized (three successive measurements vary by less than 10%) and appropriate well development methods in Section 6.13 have been employed or attempted, or
 - b. The amount of fluids introduced into the well have been removed, the well water appears relatively clear and silt free, and appropriate well development methods in Section 6.13 have been employed or attempted, or
 - c. Five well volumes have been removed, the well water appears relatively clear and silt free; and appropriate well development methods in Section 6.13 have been employed or attempted, or

- d. The well is evacuated to dryness and recovers less than 20% of water column height within 15 minutes and appropriate well development methods in Section 6.13 have been employed or attempted.
5. To prevent cross contamination between wells, all equipment which will be reused at another well for well development must be cleaned in accordance with S&W SOP ENV - Decontamination.

6.13 METHOD - SPECIFIC PURGING PROCEDURES FOR WELL DEVELOPMENT

Water removal methods such as air-lift pumping, peristaltic pumping, or centrifugal pumping, are suitable pumping methods for well development depending predominantly on depth to water, bottom of well, and diameter-size of well casing.

6.13.1 Purging With Bailers For Well Development

Bailers are generally acceptable for well development if the volume to be extracted is minimal and depth to water is relatively shallow.

6.13.1.1 Bailer-Specific Equipment List For Well Development

- Bailers (Teflon[®], stainless steel, or disposable)
- Sampling cable or rope (ensure sufficient length for all sampling activities)

6.13.1.2 Bailing Procedures For Well Development

The following Purging procedures shall be used if a bailer is used to develop a well:

1. Attach precleaned bailer to cable or line for lowering into the well and tie end of line to a stationary object (i.e. outside of protective casing) to prevent losing bailer down-hole.
2. Lower bailer slowly until it contacts water surface.
3. Allow bailer to sink and fill with water.
4. Slowly raise bailer to surface. Do not allow bailer line to contact ground.
5. Continue as specified satisfying general Purging requirements and the requirements of Section 6.12 Items 2 and 3, until one of the criteria of Section 6.12 Item 4 is met.

6.13.1.3 Advantages/Disadvantages of Well Development Using Bailers

The advantages of choosing a bailer to purge a well for well development are that they:

- Are available in a wide variety of materials, permitting the choice of compatible materials for the chemicals of concern.
- Are economical and convenient.
- Require no external power source.

The disadvantages of bailers for use in well development are that they:

- Are impractical (level of effort) for purging large volumes of water from a well.
- Can cross-contaminate wells if equipment is not adequately cleaned after each use.

6.13.2 Well Development With Submersible Centrifugal Pumps

Submersible centrifugal pumps are acceptable for purging wells for well development. They can also be used to sample for all chemical classes except volatile organic compounds (VOCs), unless the low flow procedure is implemented.

6.13.2.1 Submersible Centrifugal Pump-Specific Equipment List For Well Development

- Submersible centrifugal pump
- Haul line (steel cable or nylon rope)
- Discharge hose line
- Power source (i.e. car battery)
- Rheostat (variable voltage control - to regulate speed)
- Clamp for securing discharge line

6.13.2.2 Submersible Centrifugal Pump Procedures For Well Development

The following Purging procedures for well development shall be used if a submersible centrifugal pump is used to purge the well. Refer to manufacturer's directions for any unique procedures regarding operation of sampling equipment:

1. Connect and secure purge hose line and haul line to pump and tie end of haul line to a stationary object (i.e. outside of protective casing) to prevent losing pump down-hole.
2. Connect pump power line to battery or power system. Briefly turn on pump to ensure it is operating.

3. Place pump in well and using the haul line, lower to the desired depth. While lowering the pump, simultaneously feed purging hose line. Do not feed the purging hose too quickly as it may cause the pump to become stuck. Do not attempt to raise or lower the pump by the discharge line.
4. Secure pump in well by tying off haul line to the surface casing, if present, with duct tape.
5. Arrange haul line, power line, and purge hose line so that they will not interfere with required operations.
6. Turn on pump at low setting and adjust the rheostat control on the pump to control rate.
7. Gauge initial pumping rate using a graduated bucket and stop watch while measuring drawdown in well.
8. If well draw-down stabilizes at less than the well drawdown limit, increase pumping rate incrementally until either desired rate is achieved or drawdown limit is encountered.
9. Continue as specified satisfying the general Purging requirements for well development and the requirements of Section 6.12 Item 2 and 3, until one of the criteria of Section 6.12 Item 4 is met.

6.13.2.3 Advantages/Disadvantages of Well Development With Submersible Centrifugal Pumps

The advantages of employing a submersible centrifugal pump for well development are:

- Can be used to develop several monitoring wells in a brief period of time
- Depending on size of pump and pumping depths, relatively large pumping rates are possible

The disadvantages of submersible centrifugal pumps are:

- Requires a power source to operate.
- Submersible centrifugal pump equipment is not typically available for wells with less than a two-inch inside diameter.
- If groundwater sampling is to be performed after well development, it cannot be used to sample groundwater if VOCs are constituents of concern unless Low Flow Sampling procedures are implemented.

- Must be decontaminated before use in each well.
- Requires a relatively large amount of support equipment.
- Not recommended for aquifers with a large amount of fine-grained materials (rotors bind).

6.13.3 Well Development With Peristaltic Pumps

Peristaltic pumps are acceptable for purging shallow water table wells (depth to water less than 20 feet below ground surface). If groundwater sampling is to be performed at a later date, it can be used to sample all chemical classes except VOCs.

6.13.3.1 Peristaltic Pump-Specific Equipment List For Well Development

- Peristaltic pump
- Pump tubing
- Power source (e.g. car battery)
- Rheostat (variable voltage control -to regulate speed)

6.13.3.2 Peristaltic Pump Procedures For Well Development

The following purging procedures used for well development shall be used if a peristaltic pump is used to purge the well. Refer to manufacturer's directions for any unique procedures regarding operation of pump.

1. Place clean tubing in pump (refer to manufacturer's directions for tubing installation instructions).
2. Connect pump power line to battery or power system. Briefly turn on pump to ensure it is operating.
3. Place pump intake line in well and lower to the desired depth.
4. Secure pump in well by tying off haul line to the surface casing, if present, with duct tape.
5. Arrange discharge line and power line so that they will not interfere with required operations.
6. Turn on pump at low setting and adjust the rheostat control on the pump to control rate.
7. Gauge initial pumping rate using a graduated bucket and stop watch while measuring drawdown in well.
8. If well draw-down stabilizes at less than the well drawdown limit, increase pumping rate incrementally until either desired

rate is achieved or drawdown limit is encountered.

9. Continue as specified satisfying the General well development requirements and the requirements of Section 6.12 Item 2 and 3, or until one of the criteria of Section 6.12 Item 4 is met.

6.13.3.3 Advantages/Disadvantages of Well Development Using Peristaltic Pumps

The advantages of employing peristaltic pumps for well development are that they:

- Minimize the possibility of cross contamination when sampling highly contaminated wells, since only disposable tubing comes in contact with well water.
- Are fairly portable (equipment not too bulky).
- Are not effected by well turbidity.

The disadvantages of peristaltic pumps for well development are that they:

- Require a power source.
- Have a limited depth of operation. Can't be used if the water table is more than 20 feet below ground surface.
- Provide relatively low water yield, as compared to other mechanical pump systems.

6.13.4 Well Development With Submersible Bladder Pumps

6.13.4.1 Submersible Bladder Pump-Specific Equipment List

- Submersible bladder pump.
- "Haul" line (steel cable or nylon rope used to raise and lower pump).
- Discharge hose line.
- Power source (e.g. car battery).
- Rheostat (variable voltage control).
- Clamp for securing discharge line.

6.13.4.2 Submersible Bladder Pump Procedures For Well Development

The following purging procedures used for well development are used if a submersible bladder pump is used to purge the well. Refer to manufacturer's directions for any unique procedures regarding its operation.

1. Connect and secure purge hose line and haul line to pump.

2. Connect pump power line to battery or power system. Briefly turn on pump to ensure it is operating.
3. Place pump in well and using the haul line, lower to the desired depth. While lowering the pump, simultaneously feed purging hose line. Do not feed the purging hose too quickly, as it may cause the pump to become stuck. Do not attempt to raise or lower the pump by the discharge line.
4. Secure pump in well by tying off haul line to the surface casing, if present, with duct tape.
5. Arrange haul line, power line, and purge hose line so that they will not interfere with required operations.
6. Turn on pump at low setting and adjust the rheostat control on the pump to control rate.
7. Gauge initial pumping rate using a graduated bucket and stop watch while measuring drawdown in well.
8. If well draw-down stabilizes at less than the well drawdown limit, increase pumping rate incrementally until either desired rate is achieved or drawdown limit is encountered.
9. Continue as specified satisfying the general well development requirements and the requirements of Section 6.12 Item 2 and 3 until one of the criteria of Section 6.12 Item 4 is met.

6.13.4.3 Advantages/Disadvantages of Well Development with Submersible Bladder Pumps

The advantages of purging a well for well development with a submersible bladder pump are that they:

- Can be used to develop and sample all wells for all constituents of concern.
- Can develop deep wells.

The disadvantages of well development with submersible bladder pumps are that they:

- Require compressed gas tanks as a power source to operate.
- Are difficult to decontaminate.
- Are very difficult to transport because of size and weight of required equipment.

6.14 METHOD-SPECIFIC WELL DEVELOPMENT ACTIVITIES

In addition to pumping a certain volume of water from the well and meeting groundwater parameter requirements, other methods aiding in the development of a monitoring well can be performed by a variety of methods and equipment. These methods may reduce the amount of time required and quantities of fluids removed from the well. Common well development methods include over-pumping, backwashing, mechanical surging, and air-lifting. Variations and combinations of these methods may be required at some sites. The specific method chosen for development of any given well is governed by the purpose of the well, well diameter and material, depth, accessibility, geologic conditions, static water level in the well, and the type of contaminants present.

6.14.1 Over-Pumping

Over-pumping a well involves pumping at a faster rate than the well would normally be purged for groundwater sample collection. This is one of the easiest and most common methods of well development. Theoretically, over-pumping increases the hydraulic gradient near the well by drawing the water level down as low as possible. The induced hydraulic gradient increases the velocity of the groundwater moving through the screen into the well. Care must be taken not to entrap air into the formation around the screen during development. This can be prevented by not lowering the water level outside the well below the bentonite/cement seal. For a water table well installation, it may not be possible to prevent the water level in the filter pack from dropping below the bentonite divider seal unless the formation material is highly permeable and the pumping rate is less than the recharge rate. If it is a water table well and the hydraulic conductivity surrounding the well is less than that of the filter pack, this procedure is not recommended. This method is best suited for aquifers comprised of sand and gravel or high yielding bedrock formations with shallow groundwater tables.

6.14.2 Over-Pumping-Specific Equipment List For Well Development

A variety of pumps can be used for this task. Refer to Section 6.12.2 for more specifics on pumping and equipment. Refer to Attachment F for the type of pump suitable for a particular depth and monitoring well size.

6.14.3 Procedures For Over-Pumping Method

1. Choose a suitable pump from the selection of pumps on Attachment F. An adjustable high-capacity pump is most suitable.
2. Refer to Section 6.12.2 for details on procedures of pumping.

3. The suction line, pump, or bailer is lowered down into the well and allowed to discharge at a rapid rate enough to nearly draw the well dry. If the permeability of the formation is sufficiently high, reposition the pump or intake line to cover along the entire length of the screen. Pump the well at a considerably higher rate than it would be during purging and sampling activities. Record the typical pumping rate(s) and the quantity of fluids removed.

Note: Care must be taken not to entrap air into the formation around the well screen during development. This can be prevented by not lowering the water level outside the well below the bentonite/cement seal. If this is a groundwater table well and if hydraulic conductivity in the vicinity of the well casing is relatively low, this well development method should not be used.

4. Stop pumping and allow the well to recover naturally to its static groundwater level. Repeat this procedure until one of the criteria of Section 6.12 Item No. 4 is met.
5. This method may also be combined with mechanical surging and backwashing techniques described below.

6.15 ADVANTAGES AND DISADVANTAGES OF WELL DEVELOPMENT BY OVER-PUMPING METHODS

The advantages of well development using over-pumping methods are:

- Useful in wells with shallow water-levels (less than 25 feet deep) where a suction line can be used.
- Relatively simple procedure.

The disadvantages of well development using over-pumping methods are:

- If the permeability is quite high or quite variable, only a section of the screened zone may actually be developed, especially in wells with long screens.
- Over-pumping may compact finer sediments around borehole and screen, restricting groundwater flow into the screen. If this happens, it may be very difficult to correct.
- May result in an unstable formation around the well screen (i.e., bridging of fines may allow formation of voids around coarser-grained material).
- May produce a large volume of water discharge that may need to be disposed of as hazardous waste.

6.15.1 Backwashing

Over-pumping may not adequately develop most monitoring wells. Pulling water toward the screen without some return of water into the formation may result in bridging of the soil or rock particles around the screen. This bridging may continue until the pumping is stopped. The fines may re-enter and settle into the well until the next time it is pumped. A modification to well development by over-pumping is the backwashing method.

6.15.1.1 Backwashing-Specific Equipment List For Well Development

A variety of pumps can be used for this task. Refer to Section 6.12.2 for more specifics on pumping and equipment. Refer to Attachment F for the type of pump suitable for a particular depth and monitoring well size. The equipment used for this method is the same as in over-pumping with similar operational techniques.

6.15.1.2 Procedures For Backwashing Method

1. Choose a suitable pump from the selection of pumps on Attachment F. An adjustable high-capacity pump is most suitable.
2. Refer to Section 6.12.2 for details on procedures of pumping.
3. The suction line, pump, or bailer is lowered down into the well and allowed to discharge at a rapid rate enough to nearly draw the well dry. If the permeability of the formation is sufficiently high, reposition the pump or intake line to cover along the entire length of the screen. Pump the well at a considerably higher rate than during purging and sampling activities. Record the typical pumping rate(s) and the quantity of fluids removed.
4. After drawdown is achieved, the pump is turned off and the water in the pump discharge line is allowed to re-enter the well and flow back into the formation. If bailers are used, carefully pour the same water back into the well.
5. Repeat Item nos. 3 and 4 of Section 6.15.1.2 until one of the criteria of Section 6.12 Item No. 4 is met.

6.15.2 Advantages/Disadvantages of Well Development By Backwashing Methods

The advantages of well development using backwashing methods are:

- Will help reduce bridging of fines around the well screen.
- Effective for short screens (five-foot or less) located in homogenous aquifers.

The disadvantages of well development using backwashing methods are:

- May overdevelop the more permeable zones, leaving a portion of the well underdeveloped.
- If the screened zone is highly contaminated, backwashing may cause mixing of the contaminants.

6.16 MECHANICAL SURGING

Mechanical surging employs a tool called a surge block, commonly found on a cable tool rig. This device first forces water within the well through the well screen and out into the formation, and then pulls water back through the well screen into the well along with fine soil or rock particles. An effective surge block mechanism will induce high local velocities in the screen and filter pack. It should remove unwanted fines from the filter pack and bridges the filter pack material over the well screen. Surge blocks are typically fabricated for specific well applications. Periodic bailing or pumping of the well screen should be performed to remove fines from the well. In addition to the common surge block described above, equipment to allow manual well surging is also available.

6.16.1 Mechanical Surging Equipment List For Well Development

- Surge block (with or without a valve) attached to a drill rod, drill stem, tube, or line that has sufficient weight to allow the surge block to rapidly drop through the water column.
- Waterra surge block
- Suitable well development pump used for over-pumping and backwashing. Refer to Section 6.12.2 for more specifics on pumping and equipment. Refer to Attachment F for the type of pump suitable for a particular depth and monitoring well size.

6.16.2 Procedure for Mechanical Surging Method

1. Attach surge block to pipe or other device.

Note: In formations with low yields, a valved surge block may be preferred; surge blocks with no valves tend to force water out of the well at a greater rate than it will flow back in. Surge blocks with valves tend to induce a greater inflow than outflow of water during surging.

2. Start the surging action at a slow pace near the water level within the well and progress to a faster pace near the well screen.
3. Periodically remove fines from the well using suitable pumping equipment and techniques.
4. Prior to surging activities in the screened interval, adequate measures must be taken to clean out accumulated fines in the well. Otherwise, the fines may be forced out through the well screen into the surrounding filter pack.
5. Measure and record the typical pump rates and water quantities removed

during surging activities. If necessary, repeat items 2 through 5 of Section 6.16.2.

6.16.3 Advantages/Disadvantages of Well Development By Mechanical Surging Methods

The advantages of well development using mechanical surging methods are:

- Gentle surging combined with gentle pumping through the center of the surge block has been very successful for development in formations containing a considerable amount of fine material.
- Inexpensive and relatively simple tool.
- Effective in wells installed in highly permeable homogenous formations
- Does not require the addition or withdrawal of substantial volumes of discharge water except for flushing.

The disadvantages of well development using mechanical surging methods are:

- Vigorous surging may damage non-metallic well screens.
- May cause the formation around the screen to become clogged by pushing fines back into the formation, reducing flow into well.
- If the surge block fits too tightly into the well casing, the surge block can damage the well screen.
- May remove sufficient formation material outside and above the well screen causing the seal to collapse, resulting in infiltration of overlying aquifer material.

6.17 AIR-LIFT PUMPING

As the name implies, air-lift pumping is a type of pump that uses air to remove water from a well. Compressed air (gas) is introduced into the well screen by a small tube in the base of an eductor pipe, which is lowered, to the base of the well. When air is introduced into the tubes, the air displaces the water in the eductor pipe, causing water to flow into the well through the eductor pipe and be discharged through a second tube at the surface. For successful development by this method, it is necessary to have a ratio of submergence of at least 60 percent. In other words, the water must rise high enough in the well so that it is possible to have 60 percent of the air line and eductor pipe in the well under water. The distance that the line is under water should be divided by the total length of line in the well, and then multiplied by 100.

6.17.1 Air-Lift Pumping Equipment List For Well Development

- Portable air compressor (if possible, an oil - less compressor or one with a hydrocarbon filter that attaches to the discharge line on the air compressor) with range capable of 40 to 100 psi at five to 15 cfm.
- Optional nitrogen gas rather than compressed air may be more desirable.
- Two clean tubes of sufficient length capable of reaching bottom of well.

- Clean eductor pipe.

6.17.2 Procedure For Air-Lift Pumping Method

1. Measure the depth to water, bottom of the well casing, and lengths of specific materials and tubing used; verify that the air line and eductor hose in the well will have a ratio of submergence of at least 60 percent.
2. Attach the smaller diameter tubing to the eductor intake pipe, this line will attach to a hydrocarbon filter which is attached to the discharge line of the compressor. Attach the larger diameter tubing to the discharge outlet of the eductor pipe; this tubing will discharge extracted water to the surface in accordance with S&W ENV SOP - Cuttings and Fluids Management. Refer to Attachment H for illustration of eductor pipe and associated tubing.
3. In addition to air-lift pumping procedures, the air-lift pump can and should also be used to over-pump and backwash the well. To perform over-pumping procedures, lower the output line from the air compressor down into the well and allow the well to discharge at a rapid rate enough to nearly draw the well dry. If the permeability of the formation is sufficiently high, reposition the pump or intake line to cover the entire length of screen. Pump the well at a considerably higher rate than during purging and sampling activities. Record the typical pumping rate(s) and the quantity of fluids removed. The pumping rate is controlled by opening or shutting control valves located on the air compressor or on the valves of the nitrogen tanks if nitrogen is used.

Note: Care must be taken not to entrap air into the formation around the well screen during development. The introduction of air or highly aerated water into the formation may alter the water quality, permeability, and geochemistry in the vicinity of the well. This can be prevented by not lowering the water level outside the well below the bentonite/cement seal.

4. Using air-lift pumping methods, combine over-pumping with back washing well development techniques described in Section 6.15.1.2, Items 3 and 4. First pump the well and then shut off the air supply to allow the rising water column to fall back down the discharge tube. If necessary, repeat this step several times.
5. Repeat Item nos. 3 and 4 of Section 6.12 until one of the criteria of Section 6.12 Item No. 4 is met. As for all well development methods, record extracted water volume from well, typical pumping rates, water characteristics (i.e., color and odor), and water levels during well development.

6. When well development is complete, remove tubing and eductor pipe and clean in accordance with S&W ENV SOP - Decontamination and FSP or dispose of materials in accordance with S&W ENV SOP - Cuttings and Fluid Management.

6.17.3 Advantages/Disadvantages of Well Development By Air-lift Pumping Methods

The advantages of well development using air-lift pumping methods are:

- Effective in wells with deep static water levels and in wells containing a high percentage of clays and silts.
- Effective in small diameter wells.
- Capability to pump and surge (backwash) without removing the equipment.
- A drill rig is not required with this equipment.
- Pumping rate can be controlled by air-flow.

The disadvantages of well development using air-lift pumping methods are:

- May force air into the formation, which may lead to air locking of the formation, affecting permeability, water quality and flow of water to the well.
- Generally, only low flow rates (i.e., one to two gpm) are possible.
- May not be effective in wells with less than 30- to 40-feet of standing water.

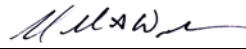
7.0 ATTACHMENTS

Attachment A	Typical Components of a Monitoring Well Showing Protective Casing
Attachment B	Table 1 Total Slot Area of Screen of Various Gauges in Square Inches Per Foot
Attachment C	Table 1 Recommended (Achievable) Filter Pack Characteristics for Common Screen Slot Sizes
Attachment D	Table 1 Summary of ASTM Cement Designations Table 2 Grout Properties for Cement- and Bentonite-Based Grouts
Attachment E	Monitoring Well Construction Log
Attachment F	Well Development Equipment Selection
Attachment G	Well Development Log
Attachment H	Air-Lift Well Development System

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Purging and Sampling Monitoring Wells

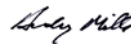
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1.0 PURPOSE

This Standard Operating Procedure (SOP) - Purging and Sampling Monitoring Wells is to be employed at the FUSRAP Maywood Superfund Site (FMSS) when collecting groundwater samples at locations with known or suspected groundwater contamination.

The purpose of purging groundwater from a monitoring well prior to sample collection is to prepare the physical environment within the well so that representative groundwater samples may be collected for analysis. The only exceptions to employing this standard procedure are when the objective of a monitoring well sampling event is to sample for the presence of either light non-aqueous phase liquids (LNAPL) or dense non-aqueous phase liquids (DNAPL).

The composition of groundwater within a well casing may differ from that of the formation it is screened in. For example, metals dissolved in groundwater such as iron and/or manganese may precipitate when exposed to an atmosphere richer in oxygen, as may be the case inside a well casing as compared to the surrounding formation. The dissolution of gases such as carbon dioxide due to chemical reactions between formation water and the atmosphere inside the well casing can alter pH and potentially reduce volatile organic compound concentrations in the water within the well. In the absence of purging, accumulated sediments within the well itself, if not removed, can also affect the concentrations of compounds within the aqueous samples collected. Purging a well prior to sampling is therefore necessary to ensure a more representative groundwater sample.

Precise and accurate analytical results of samples are critical to the correct characterization of the nature and extent of the constituents of concern in the subject study area. The method of sample collection chosen to sample groundwater monitoring wells can play a great role in the precision and accuracy of analytical results. The choice of the correct sampling method and the correct execution of the sampling procedures for that choice are therefore of paramount importance to the collection of representative sampling data.

2.0 SCOPE

This SOP details the materials, equipment, and methods to be used for monitoring well purging. Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field log books. All changes shall be made in accordance with the Maywood Contractor Quality Control Plan.

Section 5 - Responsibilities - outlines the areas of responsibility for each of the Stone & Webster project team members.

Section 6 – Procedures - outlines the methods and associated materials and equipment to be employed for monitoring well purging and sampling.

3.0 REFERENCES

SOP SW-MWD-409-1 – Onsite Water Quality Testing

SOP SW-MWD-504-1 – Labeling, Packaging and Shipping Environmental Samples

SOP SW-MWD-505-1 –Cuttings and Fluids Management

SOP SW-MWD-506-1 – Decontamination

Dunlap, N. J.; McNabb, J. F.; Scalf, M. R.; and Crosby, R. L., “Sampling for Organic Chemicals and Microorganisms in the Subsurface,” EPA-600/2-77-16, August 1977.

Characterization of Hazardous Waste Sites - A Methods Manual; Volume II, Available Sampling Methods, Second Edition EPA-600/14-84-076, December 1984.

EPA, “Region 2 Low Stress (Low Flow) Groundwater Sampling Procedures”, 3/16/98.

New Jersey Department of Environmental Protection and Energy, “Field Sampling Procedures Manual”, May 1992.

ASTM D5608-94, “Standard Practice for Decontamination of Field Equipment Used at Low Level Radioactive Waste Sites”.

U.S. Environmental Protection Agency (EPA), “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, Revision 1, Updates 1, 2, and 3”; 1986.

4.0 DEFINITIONS

DNAPL - dense non-aqueous phase liquids

FSP – Field Sampling Plan

SSHP – Site Safety and Health Plan

Interface Probe - a hand-held, battery operated instrument used for measuring the thickness of separate phase non-aqueous liquids in a well.

LNAPL - light non-aqueous phase liquids

pH - the negative logarithm value of hydrogen ion activity in an aqueous solution

SAP – Sampling and Analysis Plan

SOP - Standard Operating Procedure

SVOC – Semivolatile Organic Compounds

Turbidity - The reduction in transparency of a sample due to the presence of particulate matter

Water Table - The depth in a formation where the pressure at the surface of an unconfined water body equals atmospheric pressure.

VOC - Volatile organic compound

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with the Maywood Site Safety and Health Plan (SSHP). The Site Safety and Health Officer (who may also serve as a well purger/sampler) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the project manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method of well purging and sampling chosen in accordance with the project requirements, this SOP and related SOPs. This individual assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin and assures that all necessary personnel are mobilized on time. He / She maintains a daily log of activities each work day.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during well installation and deviation from this SOP.

5.5 SITE PERSONNEL

Site personnel assigned to perform the purging and sampling activities will be trained in the proper techniques for conducting the work. They are required to read and sign the Maywood SSHP and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All purging and sampling activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

6.0 PROCEDURES

6.1 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR PURGING AND SAMPLING OF MONITORING WELLS

The following is a list of equipment & material that is commonly used on all well purging and sampling projects. Refer also to Section 6.5 for the low stress method-specific equipment requirements to ensure completeness.

- Field Sampling Plan (FSP) and task-specific Sampling and Analysis Plan (SAP)
- SSHP. To be read and signed by all site personnel prior to site activities.
- Personal Protective Equipment
- Field logbook(s)
- Volatile organic compound vapor meter
- Site boring logs and well construction data
- Field Data Forms
- Decontamination supplies - See Decontamination SOP and FSP
- Well keys for site well locks
- Additional well locks
- Bolt cutters (for frozen or keyless locks)
- Indelible markers
- Purging equipment
- Plastic Tarp
- Disposable bailers - Always bring as backup for purging and sampling equipment

- Water level measuring device. Water level measuring devices(s), capable of measuring to 0.01 foot accuracy (electronic “tape”, pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level “tape” at the start and end of each record.
- Interface probe, if needed
- Sample bottles (pre-preserved) and labels
- Chain-of-Custody forms
- Chain-of-Custody tape
- Sample Coolers
- Ice or pre-cooled “cold” packs - for sample preservation
- Shipping forms (not needed if hand delivered to lab or courier pickup arranged)
- Bubble wrap or other packing material
- Shipping tape (transparent)
- Duct tape
- Flow rate / volume measuring equipment (i.e. graduated container and stopwatch)
- Power source (generator, nitrogen tank, etc). If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.
- Paper towels

6.2 GENERAL PURGING AND SAMPLING PROCEDURES

Wells may be purged and/or sampled with any of the following; a pump from the ground surface, a submersible pump, or with a bailer. Depending on site conditions and/or the specific needs of the sampling program one of these methods will be chosen. Sections 6.3 and 6.4 contain the procedures that are common to all purging methods. These steps should be followed in addition to the steps required for each method discussed in Section 6.5 and 6.6 below.

6.3 PRE-PURGING ACTIVITIES

The following activities will be performed and recorded in the field log book immediately prior to purging each well:

1. Record the date, time, and weather conditions.
2. Check the well for proper identification and location.
3. Inspect the well head for any signs of forced entry that could invalidate the sampling data. If the well shows signs of damage or forced entry, report finding to the Project Superintendent and/or Project Manager before proceeding further.
4. Measure and record the height of the protective casing.
5. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using the organic vapor meter. If organic vapor

levels exceed 200 ppm in the well mouth, check well for the presence of free-floating petroleum hydrocarbons using a clear, disposable bailer or interface probe (if on site). If unanticipated free-floating petroleum hydrocarbons are found to be present, report finding to the Project Superintendent and/or Project Manager before proceeding further.

6. Measure and record the distance between the top of the well casing and the top of the protective casing.
7. Ensure that all equipment that will come in contact with well water has been pre-cleaned in accordance with the decontamination procedures specified in the Decontamination SOP prior to introduction into site wells.
8. Locate the reference point of the top of the well from which depth measurements shall be made. If not present, a reference point for these measurements shall be made prior to groundwater level measurement. The reference point shall consist of either a "V"-cut or indelible mark, made on the highest point of the well casing.
9. A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft) and total well depth (to 0.1 ft) be measured the day before, in order to allow for resettlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance. Compare recorded depth of well to measured depth and note the difference as the amount of siltation. If petroleum hydrocarbons are found to be present on the water level measuring device or if a strong petroleum odor exudes from the device, check well for the presence of free-floating petroleum hydrocarbons using an interface probe, if on site. If unanticipated free-floating petroleum hydrocarbons are found to be present, report finding to the Project Superintendent and/or Project Manager before proceeding further.
10. Subtract the measured depth to the water table from the measured depth to the bottom of the well to determine the height of the water column in the well.
11. Calculate the volume to be purged using the following formula:

$$\text{Number of Gallons} = (5.8752) (C^2) (H)$$

Where:

5.8752 = Conversion factor (7.48 gallons per cubic feet times $\pi/4$)

C = Casing diameter, in feet

H = Height of water column (from bottom of well to top of water table, in feet)

12. Begin the purging activities.

6.4 GENERAL PURGING ACTIVITIES

The well purger shall collect a purge water sample from each well volume purged. The purge volume shall either be directly measured using a graduated container or estimated by determining flow rate and recording discharge time interval. Refer to FSP for instructions regarding purge water disposal. If permitted by the FSP, purge water shall be discharged to the ground surface at a distance more than ten feet from the well. Otherwise the purge water shall be dealt with as Investigation Derived Waste (IDW) (see Cuttings and Fluids Management SOP).

To prevent cross contamination between wells, all equipment that will be reused at another well for purging must be cleaned in accordance with the Decontamination SOP.

Wells shall be purged in accordance with one of the methods discussed in the following subsections.

6.5 LOW STRESS PURGING ACTIVITIES

6.5.1 Method Specific Equipment Needed

1. Extraction Device

Adjustable rate, submersible pumps are preferred (for example, centrifugal or bladder pump constructed of stainless steel or Teflon[®]).

Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/540/P-87/001, 1987).

The use of inertial pumps is discouraged. These devices frequently cause greater disturbance during purging and sampling and are less easily controlled than the pumps listed above. This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

2. Tubing

Teflon[®] or Teflon[®] lined polyethylene tubing is preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for inorganics analyses. These materials should not be used when sampling for organics.

Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs. However, it should not be used when sampling for metals.

The use of ¼ inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates.

Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.

3. Indicator field parameter monitoring instruments

Field instruments are needed to measure pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards are used to perform field calibration of instruments. Analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer's instructions.

6.5.2 Purging Procedure

Prepare equipment and purge well using the steps outlined below.

1. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The task-specific SAP should specify the sampling depth, or provide criteria for selection of intake depth for each well. If possible, keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there is two feet or less of standing water in the well.

2. Measure Water Level

Before starting pump, measure water level. If recording pressure transducer is used, initialize starting condition.

3. Purge Well

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.

Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1-0.4 L/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first

fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then “recover” as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even through the indicator field parameters have not stabilized.

4. Monitor Indicator Field Parameters

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every three to five minutes (or less frequently, if appropriate).

Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three to five minute intervals, are within the following limits:

- turbidity (10% for values greater than 1 NTU)
- DO (10%)
- specific conductance (3%)
- temperature (3%)
- pH (± 0.1 unit)
- ORP/Eh (± 10 millivolts)

All measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when

using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

When the above criteria have been satisfied, allow the water level to return to a sufficient level to collect a complete sample and proceed with the sample collection as described in Section 6.11.

6.6 TRADITIONAL PURGING ACTIVITIES

Refer to Attachment B for assistance in choosing the correct purging equipment for the diameter of the well you are to develop. The following steps outline well purging activities:

1. Prepare equipment and purge well using the appropriate method-specific steps outlined below.

- a. For Wells Screened across the Water Table

Lower the purging device (i.e. bailer, peristaltic pump, submersible centrifugal pump, submersible bladder pump) to the point below the top of the water column which is 20% of the height of the water column and begin purging. Low permeability formations may require the purging rate to be reduced to prevent de-watering the well. In this situation, the purging rate will be reduced to continue the purging process without depressing the water level in the well (de-watering) by more than 20% of the height of the water column within the well (measured from the bottom of the well to the top of water).

- b. For Wells with Screened Intervals below the Top of the Water Table

Place the purging device (i.e. bailer, peristaltic pump, submersible centrifugal pump, submersible bladder pump) at the static water level and begin purging. The purging device will not be lowered below the top of the well screen. As with water table wells, low permeability formations may require the purging rate to be reduced to prevent de-watering the well. In this situation, the purging rate will be reduced to continue the purging process without depressing the water level in the well below the top of the well screen.

2. Gauge initial pumping rate using a graduated bucket and stop watch while measuring drawdown in well. Ensure that the well is not being dewatered below allowable limits.
3. If well drawdown stabilizes at less than the well drawdown limit, increase pumping rate incrementally until either desired rate is achieved or drawdown limit is encountered. If well is being dewatered at the lowest setting the Project Superintendent and/or Project Manager shall be notified to discuss modifications to the standard purging procedures.
4. If the purging rate required to avoid de-watering the well drops below one-gallon per minute it may be necessary to purge the well dry before sampling. Should this low

recharge rate condition be encountered, the Project Superintendent and/or Project Manager shall be notified to discuss modifications to the standard purging procedures.

5. The well purger shall measure and record the following on the Groundwater Sample Field Data Record for each well volume purged (See Attachment A):
 - pH
 - temperature
 - specific conductivity
 - dissolved oxygen
 - Eh (oxidation/reduction) potential
 - color & turbidity
6. Purging is considered complete and the well ready for sampling when:
 - a. A minimum of three casing volumes have been removed from the well, and pH, temperature, and conductivity have stabilized (three successive measurements vary by less than 10%); or
 - b. Five well volumes have been removed; or
 - c. The well is evacuated to dryness and recovers less than 20% of water column height within 15 minutes.
7. When one of the above criteria have been satisfied, allow the water level to return to a sufficient level to collect a complete sample and proceed with the sample collection as described in Section 6.11.

6.7 PURGING WITH SUBMERSIBLE CENTRIFUGAL PUMPS

Submersible centrifugal pumps are acceptable for purging wells using either the low stress or traditional method and can be used to sample for all chemical classes.

6.7.1 Submersible Centrifugal Pump-Specific Equipment List

- Submersible centrifugal pump
- Haul line (steel cable or nylon rope)
- discharge hose line
- power source (i.e. car battery)
- rheostat (variable voltage control - to regulate speed)
- clamp for securing discharge line

6.7.2 Submersible Centrifugal Pump Procedures for Well Purging

The following purging procedures shall be used if a submersible centrifugal pump is used to purge the well. Refer to manufacturer's directions for any unique procedures regarding operation of sampling equipment:

1. Connect and secure purge hose line and haul line to pump and tie end of haul line to a stationary object (i.e. outside of protective casing) to prevent losing pump down-hole.
2. Connect pump power line to battery or power system. Briefly turn on pump to ensure it is operating.
3. Place pump in well and using the haul line, lower to the desired depth. While lowering the pump, simultaneously feed purging hose line. Do not feed the purging hose too quickly as it may cause the pump to become stuck. Do not attempt to raise or lower the pump by the discharge line.
4. Secure pump in well by tying off haul line to the surface casing, if present, with duct tape.
5. Arrange haul line, power line, and purge hose line so that they will not interfere with required operations.
6. Turn on pump at low setting, using the rheostat control on the pump to control rate.
7. Purge the well using one of the methods in Section 6.5 or 6.6.

6.7.3 Advantages/Disadvantages of Well Purging with Submersible Centrifugal Pumps

The advantages of employing a submersible centrifugal pump to purge a well are:

- Can be used to purge several monitoring wells in a brief period of time.
- Depending on size of pump and pumping depths, relatively large pumping rates are possible.
- Can be dedicated to a single well if desired.

The disadvantages of submersible centrifugal pumps are:

- Requires a power source to operate.
- Must be decontaminated before use in each well.
- Requires a relatively large amount of support equipment.
- Not recommended for aquifers with a large amount of fine-grained materials (rotors bind).

6.8 PURGING WITH PERISTALTIC PUMPS

Peristaltic pumps are acceptable for purging shallow water table wells (depth to water less than 20 feet below ground surface) in the traditional manner and can be used to sample for all chemical classes except they are not recommended for sampling VOCs.

6.8.1 Peristaltic Pump-Specific Equipment List

- Peristaltic pump
- Pump tubing
- Power source (e.g. car battery)
- Rheostat (variable voltage control - to regulate speed)

6.8.2 Peristaltic Pump Procedures for Well Purging

The following purging procedures shall be used if a peristaltic pump is used to purge the well. Refer to manufacturer's directions for any unique procedures regarding operation of sampling equipment:

1. Place clean tubing in pump (refer to manufacturer's directions for tubing installation instructions).
2. Connect pump power line to battery or power system. Briefly turn on pump to ensure it is operating.
3. Place pump intake tubing in well and lower to the desired depth.
4. Secure tubing in well by tying off to the surface casing, if present, with duct tape.
5. Arrange discharge line and power line so that they will not interfere with required operations.
6. control rate.
7. Purge the well using one of the methods in Section 6.5 or 6.6.

6.8.3 Advantages/Disadvantages of Well Purging with Peristaltic Pumps

The advantages of employing peristaltic pumps to purge wells is that they:

- Minimize the possibility of cross contamination when sampling highly contaminated wells, since only disposable tubing comes in contact with well water.
- Are fairly portable (equipment not too bulky).
- Are not effected by well turbidity.

The disadvantages of peristaltic pumps are that they:

- Require a power source.
- Have a limited depth of operation - can't be used if the water table is more than 20 feet below ground surface.

- Not recommended for sampling groundwater if VOCs are constituents of concern.
- Provide relatively low water yield, as compared to other mechanical pump systems.

6.9 PURGING WITH SUBMERSIBLE BLADDER PUMPS

Submersible bladder pumps are acceptable for purging wells using either the low stress or traditional method and can be used to sample for all chemical classes.

6.9.1 Submersible Bladder Pump-Specific Equipment List

- Submersible bladder pump
- “Haul” line (steel cable or nylon rope used to raise and lower pump)
- discharge hose line
- power source (e.g. car battery)
- rheostat (variable voltage control)
- clamp for securing discharge line

6.9.2 Submersible Bladder Pump Procedures for Well Purging

The following purging procedures are used if a submersible bladder pump is used to purge the well. Refer to manufacturer's directions for any unique procedures regarding operation of sampling equipment:

1. Connect and secure purge hose line and haul line to pump
2. Connect pump power line to battery or power system. Briefly turn on pump to ensure it is operating.
3. Place pump in well and using the haul line, lower to the desired depth. While lowering the pump, simultaneously feed purging hose line. Do not feed the purging hose too quickly as it may cause the pump to become stuck. Do not attempt to raise or lower the pump by the discharge line.
4. Secure pump in well by tying off haul line to the surface casing, if present, with duct tape.
5. Arrange haul line, power line, and purge hose line so that they will not interfere with required operations.
6. Turn on pump at low setting, using the rheostat control on the pump to control rate.
7. Purge the well using one of the methods in Section 6.5 or 6.6.

6.9.3 Advantages/Disadvantages of Well Purging with Submersible Bladder Pumps

The advantages of purging a well with a submersible bladder pump is that they:

- Can be used to purge and sample all wells for all constituents of concern
- Can be dedicated to a single well if desired
- Can sample deep wells

The disadvantages of purging with submersible bladder pumps is that they:

- Require compressed gas tanks as a power source to operate
- Are difficult to decontaminate
- Are very difficult to transport because of size and weight of required equipment

6.10 PURGING WITH BAILERS

Bailers are acceptable for purging wells using the traditional method only and can be used to sample for all chemical classes, including VOCs. Teflon[®] is generally the best construction material, but other materials (PVC, stainless steel, etc.) are acceptable if compatible with designated sample analysis.

6.10.1 Bailer-Specific Equipment List

- Bailers (Teflon[®], stainless steel, or disposable)
- Sampling Cable or Rope (ensure sufficient length for all sampling activities)

6.10.2 Bailing Procedures for Well Purging

The following purging procedures shall be used if a bailer is used to purge the well:

1. Attach precleaned bailer to dedicated cable or line for lowering into the well and tie end of line to a stationary object (i.e. outside of protective casing) to prevent losing bailer down-hole.
2. Lower bailer slowly until it contacts water surface.
3. Allow bailer to sink and fill with a minimum of surface disturbance.
4. Slowly raise bailer to surface. Do not allow bailer line to contact ground.
5. Continue as specified satisfying applicable purging requirements until one of the criteria of Section 6.6 Item 6 is met.

6.10.3 Advantages/Disadvantages of Well Purging with Bailers

The advantages of choosing a bailer to purge a well is that they:

- Are available in a wide variety of materials, permitting the choice of compatible

materials for the chemicals of concern.

- Are economical and convenient enough that a separated bailer can be dedicated to each well; some bailers are disposable.
- Require no external power source.
- Can be used to sample for VOCs.

The disadvantages of bailers are that they:

- Are impractical (level of effort) for purging large volumes of water from a well.
- Can cross-contaminate wells if equipment is not adequately cleaned after each use
- Cannot be used for low stress purging and sampling.

6.11 MONITORING WELL SAMPLING ACTIVITIES

The chosen method of water withdrawal should continue as specified, however, field water quality measurements can be suspended and the withdrawn water will now be placed in the appropriate sample containers. Samplers should employ certified clean and pre-preserved sample containers for sample collection activities.

1. Refer to the task-specific SAP for specific water quality samples to be collected. Cross-check sample bottles received from the laboratory against the task-specific SAP to ensure that the correct sample bottles, including appropriate preservatives are present (this should be done before mobilizing to the field).
2. Complete sample labels except for date and time-of-collection entries using a fine point indelible marker. Refer to Labeling, Packaging and Shipping Environmental Samples SOP for sample labeling requirements.
3. Place labels on sample bottles prior to sample collection. (Steps 2 & 3 can be performed prior to field work).
4. Prepare an area near the well for sample collection. Place plastic tarp on the ground and place sample cooler(s) on tarp.
5. Groundwater samples shall be collected in the following order unless specifically superseded by the task-specific SAP. If a particular task does not require the collection of a particular analyte on the following list, proceed down to the next sample on the list that you are specified to collect.
 - a. Methane
 - b. Volatile organic compounds (VOC)
 - c. Semivolatile organic compounds (SVOC)
 - d. Total Recoverable Petroleum Hydrocarbons (TRPH)
 - e. PCBs/pesticides
 - f. Metals

- g. Amenable Cyanide
- h. Sulfate and Chloride
- i. Nitrate and Ammonia
- j. Radionuclides
- k. Non-preserved inorganics

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g., EPA SW-846, water supply, etc) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling. Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, metals, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples will not be filtered.

See Attachment C for the container and preservative requirements for water samples anticipated to be collected. Additional special sample collection considerations are as follows:

VOCs

- a. Fill the sample vial slowly from discharge point, minimizing air entrainment, until vial overflows (a meniscus should be present on the top of the sample bottle). Cap vial.
- b. Invert bottle and tap to check for air bubbles. If bubbles are present, open bottle, add additional water, and repeat this process until no air bubbles are present. Verify pH has been appropriately adjusted.

ELEVATED RADIONUCLIDES

In groundwater wells with elevated radionuclides, dedicated sampling equipment may be appropriate.

6.11.1 Special Considerations for Low Stress Sampling

Water samples for laboratory analyses must be collected before water has passed through the flow-through-cell (use a bypass assembly or disconnect cell to obtain sample).

VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (outside diameter) tubing be used to help

ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, or connector (Teflon[®] or stainless steel) or valve to constrict sampling end of tubing; (2) insert small diameter Teflon[®] tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect VOC and other organic parameters samples and record new drawdown, flow rate and new indicator field parameter values.

6.12 POST SAMPLING ACTIVITIES

If recording pressure transducer is used, remeasure water level with tape.

After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 feet), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event. However, it is recommended if the well has a “silting” problem or if confirmation of well identity is needed.

Secure the well.

7.0 ATTACHMENTS

Attachment A - Groundwater Sample Field Data Record

Attachment B - Well Diameter and Purging Equipment Selection

Attachment C – Container Requirements for Water Samples

ATTACHMENT A
GROUNDWATER SAMPLE FIELD DATA RECORD

Page ____ of ____

- ☐ Monitoring Well Data
☐ Domestic Well Data
☐ Other

Case No. _____

By _____

Project Site Name _____ Project Site Number _____

S&W Source No. _____ Source Location _____

Total Well Depth		Purge Data					
Well Casing Size & Depth:	Eh	DO	Volume	pH	S.C.	Temp (°C)	Color & Turbidity
Static Water Level:							
One Casing Volume:							
Start Purge (hrs):							
End Purge (hrs.)							
Total Purge Time (min)							
Total Amount Purges (gal)							
Monitor Reading							
Purge Method:							
Sample Method:							
Depth Sampled:							
Sample Date & Time:	Sample Data						
	Eh	DO	pH	S.C.	Temp (°C)	Color & Turbidity	
Sampled by:							
Signature(s):			Observations/Notes:				
Type of Sample ☐ Low Concentration ☐ High Concentration ☐ Grab ☐ Composite ☐ Grab – Composite							
Analysis:			Preservative		Organic	Inorganic	
				Traffic Report No.			
				Tag No.			
				AB No.			
				Date Shipped			
				Time Shipped			
				Lab			
				Volume			

ATTACHMENT B
 WELL DIAMETER AND PURGING EQUIPMENT SELECTION

Diameter Casing	Bailer	Peristaltic Pump	Vacuum Pump	Airlift	Diaphragm “Fresh” Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
<u>1.25-inch</u>								
Water level								
<25 ft		X	X	X	X			
Water level				X				
>25 ft								
<u>2-inch</u>								
Water level								
<25 ft	X	X	X	X	X	X		
Water level				X				
>25 ft	X					X		
<u>4-inch</u>								
Water level								
<25 ft	X	X	X	X	X	X	X	X
Water level				X				
>25 ft	X					X	X	X
<u>6-inch</u>								
Water level								
<25 ft				X	X		X	X
Water level				X			X	X
>25 ft								
<u>8-inch</u>								
Water level								
<25 ft				X	X		X	X
Water level				X			X	X
>25 ft								

ATTACHMENT C **CONTAINER REQUIREMENTS FOR WATER SAMPLES**

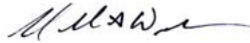
Analyte Group	Container	Preservative
Volatile Organic Compounds	3 - 40 ml glass vials with Teflon™ -lined septum (no headspace)	HCl to pH <2 Cool, 4°C
Semivolatile Organic Compounds	2 - 1L amber glass bottle with Teflon™ -lined lid	Cool, 4°C
Pesticides/PCBs	2 - 1L amber glass bottle with Teflon™ -lined lid	Cool, 4°C
Metals and Rare Earth Elements	1 – 1000 ml plastic or glass bottle	HNO ₃ to pH <2
TRPH	2 – 1000 ml glass bottle	HCl to pH<2 Cool, 4°C
Amenable Cyanide	1 – 500 ml plastic or glass bottle	NaOH to pH >12 Cool, 4°C
Methane	3 – 40 ml glass vials with Teflon-lined septum (no headspace)	HCl to pH <2 Cool, 4°C
Sulfate	1 – 250 ml plastic or glass bottle	Cool, 4°C
Ammonia	1 – 500 ml plastic or glass bottle	H ₂ SO ₄ to pH<2 Cool, 4°C
Nitrate-Nitrite	1 – 250 ml plastic or glass bottle	H ₂ SO ₄ to pH<2 Cool, 4°C
Fluoride	1 – 500 ml plastic or glass bottle	None required
Chloride	1 – 250 ml plastic or glass bottle	None required
Radionuclides	1 – 1000 ml plastic or glass bottle	HNO ₃ to pH <2

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Radon Sampling

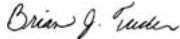
APPROVED:



9/30/2003

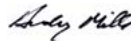
**Mike Winters
Radiation Safety Officer**

Date



9/30/2003

**Brian Tucker
Project Chemist
Date**



9/30/2003

**Andrew Mills
Project Manager**

Date

1.0 PURPOSE

This procedure provides guidance for the collection of radon samples at the FUSRAP Maywood Superfund Site.

2.0 SCOPE

This procedure applies to personnel performing radon sampling.

3.0 REFERENCES

None.

4.0 DEFINITIONS

Alpha Track Detector – An alpha track detector (ATD) consists of a piece of plastic or film enclosed in a container with a filter covered opening. ATDs are used to perform long-term (i.e., 3 months or greater) measurements of radon concentration in air.

Working Level Monitor – Instrument used to perform short-term measurements of radon decay products in air.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform radon sampling.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the downhole gamma radiation logging task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a site-specific SSHP. The Site Safety and Health Officer is responsible for ensuring that all site workers (Shaw Environmental, Inc. and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Shaw Environmental, Inc. and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on conducting downhole gamma radiation logging in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each work day.

6.0 PROCEDURE

6.1 ALPHA TRACK DETECTOR (ATD) PROCEDURE

- 6.1.1 Obtain the ATDs from New Jersey Department of Environmental Protection (NJDEP) certified vendor.
- 6.1.2 Suspend the ATD from the ceiling in an area that is not near any windows or near any air circulating devices (i.e., fan, air conditioner, etc.)
- 6.1.3 Record the date and time that the ATD was set up.
- 6.1.4 Allow the ATD to remain in place for the duration of the radon sampling (i.e., approximately 3 months).
- 6.1.5 Remove the ATD after the sampling period is over, and record the date and time that the ATD was removed.
- 6.1.6 Cover the exposed surface with the foil supplied by the manufacturer.
- 6.1.7 Ship the ATD to the manufacturer for the radon reading.

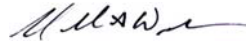
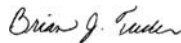
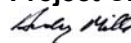
6.2 WORKING LEVEL MONITOR (WLM) PROCEDURE

- 6.2.1 Open monitor and perform source check as follows:
- Replace filter paper with the Th-230 check source (smooth side up).
 - Reinsert sample holder into inlet and clamp down.
 - Connect WLM to working level reader.
 - Select "WLM Test."
 - Select "Counter Test."
 - Input "60" for count time.
 - Following count, calculate 4π efficiency [$E = (\text{cpm/dpm}) \times 100$].
 - E should fall in range from 22 to 28%.
 - Press any key on keypad and answer "yes" to "ENDTEST?"
 - Remove source; replace with filter.
- 6.2.2 Program monitor for 24-hour sample, as follows:
- Open monitor, and depress "tst" button. Check that red lights go on in the order 3-2-1-3. If not, call manufacturer; otherwise, proceed.
 - Depress "rst" button.
 - Replace cover and plug WLM into the working level reader.
 - Verify date and time.
 - Respond "yes" to "Parameter file" inquiry.
 - If "O" is displayed, press "edit" and enter monitor number; press enter.
 - "Location code" will be displayed; press "edit" and enter property number; press enter.
 - Press "+"; "Sample int. (min.)" will be displayed; punch in "30"; press enter.
 - Press "+"; press "edit" and enter "48" for interval number; press enter.
 - Press "+"; "Tail intv. (min.) 060" will be displayed; press enter.
 - Press "+"; "Tail quantity - 004" will be displayed; press enter.
 - "Start time" will be displayed; press "edit" and enter month, day, and hour; press enter.
 - "Calib. Constant" will be displayed; press "edit."
 - "Know cal. factor" will be displayed; enter "+" and punch in "731"; press enter.
 - "units = wl" will be displayed; enter "+".
 - Printer will activate and tape should indicate "preset sample mode."
- 6.2.3 Place WLM in building at a height of at least one meter (on a table, chair, etc.).
- 6.2.4 Following 24-hour sample period, retrieve WLM.
- 6.2.5 To obtain result:
- Turn on reader.
 - Plug WLM into reader.
 - "Set clock" will be displayed; press "-".
 - "Parameter file" will be displayed; press "-".
 - "Data readout" will be displayed; press "+".
 - "History log" will be displayed; press "+".
 - Printer will activate.
 - "Printout of tail and sample" will be displayed; press "+".

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Surface and Shallow Subsurface Soil Sampling

APPROVED:

	09/30/2003
Mike Winters	Date
Radiation Safety Officer	
	09/30/2003
Brian Tucker	Date
Project Chemist	
	09/30/2003
Andy Mills	Date
Project Manager	

1.0 PURPOSE

This Standard Operating Procedure (SOP) - **Surface and Shallow Subsurface Soil Sampling** is to be employed when hand-collecting (without machines or power tools) soil samples at sites with known or suspected environmental contamination.

This SOP describes the procedures for collecting representative environmental and/or geotechnical samples from the surface or shallow subsurface soils. The following sections describe various methods and equipment used to collect disturbed soil samples. A disturbed soil sample is a representative sample of a selected geologic unit that has undergone structural alteration as a result of the sampling operation. These types of samples can be used for soil classification, soil index testing, and analytical testing purposes.

2.0 SCOPE

This procedure serves as general guidance on the proper methods of collecting both discrete and composite surface and shallow subsurface soil samples. This procedure can be used in most soil types but is limited to sampling depths attainable without the use of mechanized drills or augers. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sampling team member. The use of a flat, pointed mason trowel to cut a block of the desired soil can be helpful when undisturbed profiles are required. A stainless steel scoop, lab spoon, or hand auger will suffice in most other applications. Selection of site-specific sampling locations and specific sampling technique(s) is dependent on the objectives of the environmental assessment. Consult the task-specific Maywood Sampling and Analysis Plan for soil sampling locations and techniques. Always consult state-specific or program-specific requirements as well as manufacturer's instructions for equipment use to ensure compatibility of this SOP with project requirements. **Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field log books.**

3.0 **REFERENCES**

All references are part of the Chemical Data Quality Management Plan, Revision 1, September 2003, prepared for USACE by Shaw Environmental.

1. SOP SW-MWD-504-1 – Labeling, Packaging and Shipping Environmental Samples
2. SOP SW-MWD-505-1 – Cuttings and Fluids Management
3. SOP SW-MWD-506-1 - Decontamination
4. SOP SW-MWD-508-1 – Procedure for Shipping Radiologically Contaminated Environmental Samples
5. Maywood Quality Assurance Project Plan

U.S. Environmental Protection Agency, Compendium of ERT Soil Sampling and Surface Geophysics Procedures, EPA/540/P-91/006, January 1991.

U.S. Environmental Protection Agency, Characterization of Hazardous Waste Sites - A Methods Manual, Volume II: Available Sampling Methods, EPA/600/X-83/018, March 1983.

4.0 **DEFINITIONS**

None.

5.0 **RESPONSIBILITIES**

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for soil sampling task.

5.3 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the project manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method of soil sampling chosen in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary

equipment including safety equipment is available and functioning properly before project operations begin. The Project Superintendent assures that all necessary personnel are mobilized on time and maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager and Project Engineer on decisions relative to unexpected occurrences during soil sampling and deviation from this SOP.

5.4 SITE SAFETY & HEALTH OFFICER

All field activities must be carried out in accordance with a Site Safety and Health Plan (SSHP). The Site Safety and Health Officer (who may also serve as a soil sampler) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.5 PROJECT CHEMIST

The Project Chemist shall ensure that site personnel use this SOP and the quality requirements described in the Chemical Data Quality Management Plan and the Contractor Quality Control Plan while carrying out surface soil sampling activities. The Project Chemist, or designee, will inform the laboratory in advance of the number of samples to be shipped and for what parameters they must be analyzed. The Project Chemist also acts as the primary interface between Project personnel and off-site organizations providing analytical support.

5.6 SITE PERSONNEL

All employees who are engaging in soil sampling activities are required to read and sign the Site Safety and Health Plan (SSHP) and to follow the procedures in this SOP, unless superseded by project-specific requirements. All soil sampling activities, including deviations from this SOP, will be recorded in field logbooks during on-site activities.

6.0 **PROCEDURE**

6.1 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR SURFACE SOIL SAMPLING

The following is a list of equipment & materials commonly used during surface soil sampling projects. Refer also to related SOP equipment & material requirements to ensure completeness.

- Field Sampling Plan (FSP)
- Site Safety and Health Plan (SSHP). **To be read and signed by all site personnel prior to site activities.**
- Personal Protective Equipment
- Field logbook(s)

- Volatile organic compound (VOC) vapor meter
- Decontamination supplies - **See SOP – Decontamination, and FSP**
- Indelible markers
- Tape measure
- Stainless steel (SS) or plastic trowel or shovel
- “T”-handled hollow stem bucket auger or hand corer, if collecting soil samples below a depth of one foot below ground surface
- Surveyors stakes
- Hammer
- Flagging Tape
- Spray paint
- Stainless steel mixing bowls
- Sample bottles or containers and labels
- Chain-of-Custody forms - Labeling, Packaging, and Shipping Environmental Samples
- Chain-of-Custody tape
- Sample Coolers
- Sample packing material
- Ice or pre-cooled “cold” packs - for sample preservation
- Shipping forms (not needed if hand delivered to lab or courier pickup arranged)
- Shipping tape (transparent)
- Duct tape
- Paper towels

Avoid the use of devices plated with chrome or other materials if collecting soil samples for metals analysis. Plating is particularly common with garden implements such as potting trowels.

6.2 PRE-SAMPLING ACTIVITIES

1. The task-specific Sampling and Analysis Plan should be consulted to determine the sampling methods to be employed and the sampling and monitoring equipment necessary for field activities.
2. In accordance with a Site Safety and Health Plan, a general site survey should be performed prior to site entry.
3. All sampling equipment should be decontaminated prior to each sampling episode. Decontamination procedures are detailed in a separate SOP.
4. As appropriate, all utilities in the vicinity of sampling locations should be clearly marked in some manner with stakes and flagging or spray paint.

6.3 SURFACE SOIL SAMPLING

Appropriate field procedures are as follows:

1. Carefully remove the top layer of soil to the desired sample depth with a decontaminated tool.

2. If applicable, screen the area to be sampled using a VOC vapor analyzing meter and record readings in the field log. The VOC screen is used as a field safety procedure. The VOC readings should be compared to action levels presented in the project Health and Safety Plan. The VOC screen can also be used for selecting potentially contaminated soil samples.
3. Obtain a discrete soil sample with a SS or plastic (metals only) trowel. If analyzing samples for VOCs using the EnCore sampler tool, collect the appropriate sample volume in the manner discussed in Attachment A.
4. For the remainder of the chemical parameters, place the sample into a stainless steel mixing bowl. Homogenize the sample and place into appropriate sample containers using a stainless steel lab spoon or its equivalent. Alternatively, radiological parameters may be collected with a SS trowel, or equivalent, and placed into a one liter high-density polyethylene (HDPE) container until it is approximately 60% full. Homogenize the sample by mixing with the trowel or by capping and shaking the container vigorously until thoroughly blended (approximately 30 seconds).
5. If required by the Field Sampling Plan, check that a Teflon liner is present in the cap of all analytical sample jars used to collect samples for chemical parameters. Secure all caps tightly. Although chemical preservation of solids is generally not required, samples for chemical analysis shall be refrigerated because of the SW-846 requirement to refrigerate samples designated for mercury analysis (normally in iced coolers to approach approximately 4°C). Radiochemical soil samples do not require refrigeration. Refer to **SOP 504 - Labeling, Packaging, and Shipping Environmental Samples** or **SOP 508 - Procedure for Shipping Radiologically Contaminated Environmental Samples** for procedure-specific requirements.
6. Label the sample bottle with the appropriate sample tag. Complete all chain-of-custody documents. Refer to **SOP - Labeling, Packaging, and Shipping Environmental Samples** or **SOP 508 - Procedure for Shipping Radiologically Contaminated Environmental Samples** for procedure-specific requirements.
7. Record sampling event in the field log book and on a sample log, if dictated by the Sampling and Analysis Plan.
8. Decontaminate equipment after use and between sample locations. Also, decontaminate the outside of the sample containers and/or isolate them (such as sealing in Ziploc bags) as necessary. Refer to **SOP 506 - Decontamination** for procedure-specific requirements.

6.4 SHALLOW SUBSURFACE SOIL SAMPLING

A bucket auger or hand corer, can be advanced to obtain soil samples up to approximately 5 feet below the surface when soil conditions allow. The method is less effective with coarse, granular soils or soils containing cobbles or boulders. Appropriate field procedures are as follows:

1. To make a hand auger borehole, attach the auger bit to a drill rod extension, and attach a "T" handle to the drill rod.

2. Clear the area to be sampled of any surface debris (twigs, rocks, or litter). It may be necessary to remove the first three to six inches of surface soil for an area approximately six inches in radius around the auger location.
3. Begin augering by pressing down on the handle while manually rotating it. Periodically remove soil cuttings that accumulate on the ground around the auger stem with a decontaminated tool. This will prevent loose material from falling back down into the borehole when removing the auger or adding drill rods. If necessary, the cuttings from each foot of advancement should be screened for VOCs with a photoionization detector (PID) or for other parameters, as appropriate.
4. Compare PID readings to action levels presented in the project Site Safety and Health Plan. The operator of the PID must be experienced in its use and aware of such factors as temperature, humidity, and methane on the readings provided by the PID.
5. After reaching the desired depth, carefully remove the auger/corer from the hole.
6. If analyzing samples for VOCs, using the EnCore sampler tool, collect the appropriate sample volume in the manner discussed in Attachment A.
7. For the remainder of the chemical parameters place the soil sample into a stainless steel mixing bowl and homogenize it. Obtain a discrete soil sample using a stainless steel lab spoon or its equivalent and place in appropriate sample jars. For radiological parameters, collect and homogenize the sample in the same manner as described in Step 4 of Section 6.3. **See Section 6.5 for discussion of discrete vs. composite sample collection.**
8. If required by the Field Sampling Plan, check that a Teflon liner is present in the cap of all analytical sample jars used to collect samples for chemical parameters. Secure all caps tightly. Although chemical preservation of solids is generally not required, samples for chemical analysis shall be refrigerated because of the SW-846 requirement to refrigerate samples designated for mercury analysis (normally in iced coolers to approach approximately 4°C). Radiochemical soil samples do not require refrigeration. Refer to **SOP - Labeling, Packaging, and Shipping Environmental Samples** or **SOP 508 - Procedure for Shipping Radiologically Contaminated Environmental Samples** for procedure-specific requirements.
9. Label the sample bottle with the appropriate sample tag. Complete all chain-of-custody documents. Refer to **SOP - Labeling, Packaging, and Shipping Environmental Samples** or **SOP 508 - Procedure for Shipping Radiologically Contaminated Environmental Samples** for procedure-specific requirements.
10. Record sampling activities in field/sample log(s) as dictated by associated Sampling and Analysis Plans.
11. Decontaminate equipment after use and between sample locations. Also, decontaminate the outside of the sample containers and/or isolate them (such as sealing in Ziploc bags). Refer to **SOP 506 - Decontamination** for procedure-specific requirements.

6.5 PREPARATION OF COMPOSITE SAMPLES

Soil samples may be either discrete or composite fragments (refer to your Field Sampling Plan for designated sampling intervals). A discrete sample represents a single sample location within a vertical soil column and at a single horizontal area point. A composite sample represents a mixture of soil from more than one discrete location, either vertically, within the same soil column or horizontally, across an area. If a composite sample is to be obtained for chemical parameters testing, it can be mixed in a shallow high density polyethylene pan, lined with aluminum foil, or in a stainless steel pan. Stainless steel sieves may be used to remove larger rocks. Compositing procedures are not appropriate for samples obtained for analysis for VOCs because the agitation of the sample results in a loss of volatiles from the sample. For radiological samples, composite samples shall be mixed in the same manner as described in Step 4 of Section 6.3 and Step 7 of Section 6.4.

The sequence of sample collection (after collection of VOCs) shall be as follows:

- a. Semivolatile organic compounds (SVOC)
- b. Total Recoverable Petroleum Hydrocarbons (TRPH)
- c. PCBs/pesticides
- d. Metals
- e. Radionuclides

Procedure outlined in Attachment B shall be followed for soil compositing.

6.6 QUALITY CONTROL (QC) SAMPLES

QC samples shall be collected at the frequencies described in Section 4.4.2 of the Maywood Quality Assurance Project Plan. Frequency of sample collection shall be based upon the number of non-blank regular field samples; e.g., if the required frequency of a QC split sample was a minimum of 10%, and 10 regular non-blank field samples were being collected, one QC split sample must be collected. The required minimum frequencies of QC sample collection, in percent, are either the values shown below, or one per batch, whichever frequency is higher. Often, one per batch is the higher frequency.

	MS (metals and rad), MS/MSD(for organics)	Field Duplicates	USACE QC splits
Organics	10	5	10
Inorganics	5	5	10
Radiological	5	10	10

6.7 GLOSSARY OF TERMS

Composite Sample - represents a mixture of soil from more than one discrete location.

Discrete Sample - A discrete sample represents a single sample location within a vertical soil column and at a single horizontal area point. Discrete sampling must be used when collecting soil samples for VOC analyses.

Trowel - Resembles a small shovel. To be constructed of steel for sampling purposes. The blade of a trowel is generally flat and 5 to 6 inches in length. A scoop (blade has curved edges versus flat) may be substituted if necessary. Both can be purchased with volume calibrations.

Hand Corer - A hollow metal tube with a detachable, hardened metal cutting nose and a plastic “core catcher” fitting. This tube can be attached to a short spiral-bladed hollow metal rod (auger) attached to a “T” handle for hand-advancement. Clockwise rotation of the T handle with simultaneously applied downward pressure initiates the cutting process. Most of the soil is discharged upwards through the auger as it moves downwards. When the desired sampling interval is reached, rotation is stopped and the auger is withdrawn from the hole with the soil of interest inside it. If soil is extremely uncohesive (e.g. dry sand), a hand corer should be considered for use.

Hollow-Stem Bucket Auger - a short spiral-bladed hollow metal rod (auger) attached to a “T” handle for hand-advancement. Clockwise rotation of the T handle with simultaneously applied downward pressure initiates the cutting process. Most of the soil is discharged upwards through the auger as it moves downwards. When the desired sampling interval is reached, rotation is stopped and the auger is withdrawn from the hole with the soil of interest inside it. If soil is extremely uncohesive (e.g. dry sand), a hand corer should be considered for use.

7.0 ATTACHMENTS

Attachment A – Disposal EnCore Sampler, Extrusion Procedures

Attachment B – Soil Compositing Procedure

ATTACHMENT A, Sheet 1 of 2

Disposable EnCore® Sampler

EXTRUSION PROCEDURES

USING THE EnCore® 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. Use a pliers to break locking arms on cap of En Core Sampler. Do not remove cap at this time. (CAUTION: Broken edges will be sharp.)
2. 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.
3. 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.)
4. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. To release soil core, remove cap from Sampler and 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.

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Green Bay, WI 54302
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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.

ATTACHMENT A, Sheet 2 of 2

Disposable En Core® Sampler



En Novative Technologies, Inc.

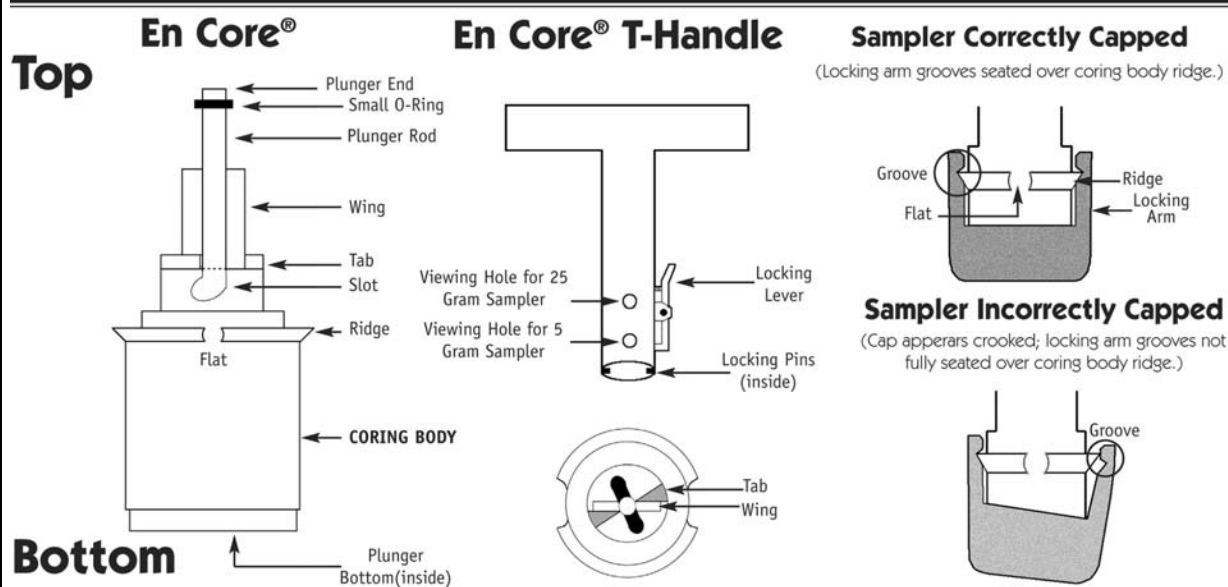
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Toll Free: 888-411-0757
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Sampling Procedures

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.)



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.

ATTACHMENT B

SOIL COMPOSITING PROCEDURE

The following procedure will be used for compositing grab samples from the soil piles for chemical analysis.

1. Empty the soil container(s) into stainless steel mixing bowls.
2. Inspect the material for large stones and other objects which are not representative of the sample matrix and remove them from the bowl.
3. Homogenize the remaining sample material by breaking up any large clumps and thoroughly mixing with stainless steel spatula.
4. Fill the sample container(s) using a spatula.

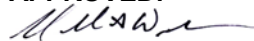
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September 2003
October 2002
1 of 7

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Soil Borings and Sampling

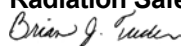
APPROVED:



09/30/2003

Mike Winters
Radiation Safety Officer

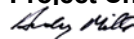
Date



09/30/2003

Brian Tucker
Project Chemist

Date



09/30/2003

Andy Mills
Project Manager

Date

1.0 PURPOSE

This Standard Operating Procedure (SOP) - Soil Borings and Sampling is to be employed at the FUSRAP Maywood Superfund Site (FMSS) when determining the extent of contamination, physical properties, arrangement, and thickness of the various soil and rock strata as they exist in the ground. It is necessary to locate and record the depth at which any change in stratification of the material occurs and the natural groundwater level. The Contractor shall measure and record the depth to the groundwater table in the borings in progress at the start of each work day, and the final groundwater level.

2.0 SCOPE

This procedure serves as general guidance on the proper methods of collecting both discrete and composite soil samples using hollow stem auger techniques. This procedure can be used in most soil types but sampling depths of auger investigations are limited by groundwater conditions, soil characteristics, and the equipment used. Representative samples can be collected with this procedure depending on the care demonstrated by the sampling team member. Selection of site-specific sampling locations and specific sampling technique(s) is dependent on the objectives of the environmental assessment. Consult the Maywood task-specific project Sampling and Analysis Plan (SAP) for soil sampling locations and techniques. Always consult state-specific or program-specific requirements as well as manufacturer's instructions for equipment use to ensure compatibility of this SOP with project requirements. Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field log books. Hollow stem auger techniques should be employed without the use of drilling water while drilling on hazardous waste sites. If water is deemed necessary by driller, its use must be approved by the drilling inspector. When water is used to advance boring, it must not be recirculated back into the boring. The drilling inspector should also record any detected odor from boring, and depth encountered.

3.0 REFERENCES

ASTM D1452-80 Soil Investigation and Sampling by Auger Borings
ASTM D 1586 Method For Penetration Test and Split Barrel Sampling Soils
SOP SW-MWD-503-1 – Overburden Drilling Methods
SOP SW-MWD-505-1 – Cuttings and Fluids Management
SOP SW-MWD-506-1 – Decontamination

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for soil boring and sampling activities.

5.3 CONTRACTOR QUALITY CONTROL SYSTEM MANAGER (CQCSM)

All drilling is inspected continuously by a CQCSM. The geologist or inspector is familiar with the particular drilling program, and is responsible for ensuring that established procedures are followed. The geologist or inspector has the authority to modify the program and/or procedures when warranted by unanticipated field conditions.

The inspector is responsible for maintaining field notes and for keeping a well log independent of the driller.

6.0 PROCEDURES

6.1 EQUIPMENT AND MATERIALS

The driller shall be capable of providing power-driven sectional hollow stem auger flights with a minimum inside diameter of 3-1/4 inches. In addition, the following equipment shall be present:

- a. Drill rods, minimum size equivalent to the "A" rod (1-5/8 inch OD and 1-1/8 inch I.D.)
- b. Hollow stem auger plug
- c. Drive hammer (1) 300 pound (lbs) and (1) 140 lbs
- d. two-inch OD split spoon sampler
- e. Roller bit and diamond corer bit

- f. Water tank and pump

6.2 DECONTAMINATION PROCEDURES

1. Auger Flites

Prior to drilling at a new test boring site and at the start of each day, all previously used auger flites and related downhole drilling equipment, including casing and hollow stem auger plugs and auger bits, shall be thoroughly steam-cleaned until free of visible soil, grease, or similar debris, to the satisfaction of Stone & Webster representative. The decontaminated equipment shall then be stored on aboveground racks until ready for use.

2. Drill Rig

The working end of the drill rig is steam-cleaned, and the rig is generally inspected by the geologist or inspector for evidence of leaks (i.e., gasoline or diesel fuel and hydraulic fluid).

3. Well Construction Materials

Well construction materials, including casing, screens, protective risers, and/or road boxes, are also steam-cleaned prior to use.

6.3 BORING PROCEDURE

Borings shall be by hollow stem auger. In the event that hollow stem augers produce unsatisfactory results, drive sample drilling techniques will be employed. (see Stone & Webster SOP, Overburden Drilling Methods). Borings shall be advanced by using an auger or cutting, chopping, or tricone bits, subject to the approval of Stone & Webster.

Each borehole shall be advanced by rotary drilling using hollow stem augers of minimum four-inch inside diameter. The soil samples shall be obtained at continuous two-foot intervals with a three-inch OD x 24-inch long split spoon sampler (or as directed by Stone & Webster, a two-inch OD sampler).

The method for sampling and advancing the hole will be as follows:

1. After rig setup on the test boring site, the first step will be to drive the split spoon sampler from the ground surface to a depth of 24 inches using Standard Penetration Test techniques.
2. Auger drilling will then be used to advance the hole to the base of the soil section sampled (24 inches) and rotation of the auger will continue until cuttings are no longer returned. The auger plug will then be removed and the sampler will be placed in the hole at this new depth and again driven 24 inches.
3. Sampling and augering shall continue in this fashion, continuously sampling and then advancing the boring in two foot increments until reaching depth. During this time, the auger bit should never be advanced ahead of the depth to which the sampler had been previously driven.

When an obstruction is met, the driller must attempt to penetrate the obstruction by the use of a roller bit or by coring. If attempts to penetrate obstruction are unsuccessful, boring will be abandoned.

The auger plug must be in place at the auger head while bore hole is being advanced to prevent soil from being transported through auger.

Prior to each sampling, the sampler shall be cleaned and decontaminated.

In addition, the contractor will be required to have the ability to drive casing of sufficient diameter so that the three inch split spoon sample can be utilized.

6.4 SPLIT SPOON SAMPLING

1. Equipment for obtaining the split-spoon samples shall conform to the requirements of ASTM D 1586.
2. At least four three inch OD X 24 inch long samplers shall be available on the rig. In addition, two-inch OD (1-3/8 inch ID) split spoons with a minimum length of 18 inches may be requested for use by Stone & Webster.
3. The drive shoe of the sampler shall be sharpened to form a cutting edge at its inside circumference. The cutting edge shall be maintained in good working condition and replaced as required by Stone & Webster. The sampler shall be fastened to its drill rod by a coupling head embodying a check valve which will permit ready escape of water trapped above the sample as the sampler is driven down into the soil, but which will close as the soil sample and sampler are withdrawn, thus preventing the development of hydrostatic pressure on top of the soil during recovery.
4. The drive hammer assembly shall consist of a hammer, manufactured specifically for standard penetration testing, with a nominal weight of 140 lb for the two-inch OD sampler and 300 lb for the 3-inch OD sampler, and a guide permitting a free fall of 30 inches. Precautions should be taken to ensure that the energy of the falling hammer is not reduced by friction between the hammer and the guide.
5. Stone & Webster will examine all drive hammers prior to the start of any split spoon sampling and will reject any damaged equipment. In addition, Stone & Webster may require that the drive hammer be weighed prior to the start of work. Prior to sampling, the sampler shall be cleaned and decontaminated (see Stone & Webster SOP Decontamination).
6. Soils collected from the sampler or brought to the surface by the drilling process are left onsite, unless there are specific instructions to the contrary (see Stone & Webster SOP Cuttings and Fluids Management).
7. Soils will be screened using a NaI scintillation detector for radiological contamination, and a photoionization detector (PID) or a flame ionization detector (FID) for chemical contamination.
8. Once the sampler has been retrieved from the borehole and broken loose from the drill rods, Stone & Webster will take custody of the sampler. Stone & Webster personnel will first split the sampler and place it on clean plastic to avoid contamination. VOA samples will be collected immediately using Encore samplers. Samples for other parameters will be collected in jars. Actual sample container requirements are provided in Table 4-1 of the Quality Assurance Project Plan (QAPP) (which is part of the Chemical Data Quality Management Plan (CDQMP) and shall also be included in each

task-specific SAP. The sequence of sample collection (after collection of VOCs) shall be as follows:

- a. Semivolatile organic compounds (SVOC)
 - b. Total Recoverable Petroleum Hydrocarbons (TRPH)
 - c. PCBs/pesticides
 - d. Metals
 - e. Radionuclides
9. Check that a Teflon[®] liner is present in the cap of all analytical sample jars, if required. Secure the caps tightly. Although chemical preservation of solids is generally not required, the samples should be refrigerated (normally in iced coolers to approach approximately 4°C) and analyzed within specified holding times. Refer to the Labeling, Packaging, and Shipping Environmental Samples SOP for specific requirements.
 10. Label the sample bottle with the appropriate sample tag. Complete all chain-of-custody documents. Refer to the Labeling, Packaging and Shipping Environmental Samples SOP for specific requirements.
 11. Record sampling event in the field logbook and on a sample log, if dictated by the task-specific SAP.
 12. Decontaminate equipment after use and between sample locations. Also, decontaminate sample containers and/or isolate them (such as sealing in Ziploc[®] bags). Refer to the Decontamination SOP for specific requirements.
 13. When the borehole is completed, the borehole creates the potential for migration of contaminants into previously uncontaminated deposits. Thus, the borehole will be filled with a Portland cement and bentonite slurry.

6.5 RECORDS

For each boring, a log will be prepared that contains the following information:

1. Site location, job designation, boring number, date boring was started and completed, the driller's name, method of advancing the hole, casing diameter and length, sample description (using Unified Soil Classification System, for example) and type and size of the soil samplers used.
2. Depth below ground surface of each stratum of soil encountered.
3. Depth at which each sample of soil was taken, together with the sample number, type of sample, and percent recovery.
4. Where split-spoon samples are taken, the number of blows for each 6 inches of penetration or fraction thereof for each sample. The use of a nonstandard drive hammer or sampler shall be noted whenever applicable.
5. Comments by the inspector on any special conditions, which may have been encountered, such as obstacles, cavities, and artisan water conditions.

See Attachment A for an example of a boring log.

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ATTACHMENT A, Sheet 1 of 2

Stone & Webster Engineering Corporation				BORING-LOG				Boring J.O. Sheet 1 of	
Site: Client: Coordinates: Groundwater Depth/Date: Contractor:						Logged by: Date Start - Finish: / / - / / Ground Elevation: ft Total Depth Drilled: ft Rig Type:			
Methods: Drilling Soil: Sampling Soil: Drilling Rock:						Casing Used:			
Comments:									
Elev (ft)	Depth (ft)	Sample Type No.		Blows or Recovery RQD	SPT N Value	USC Symbol Drill Rate (min/ft)	Sample Description		
Legend/Notes • Datum is • ▽ indicates groundwater level. • ■ indicates location of samples. • Blows = number of blows required to drive 2" O.D. sample spoon 6" or distance shown using 140 pound hammer falling 30". • () = inches of sample recovery. • Recovery = % rock core recovery. • RQD = Rock Quality Designation. • SPT N = Standard Penetration Test resistance to driving, blows/ft. • USC = Unified Soil Classification system. • * indicates use of 300 pound hammer.									
• Sample Type:								Approved Date	

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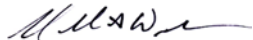
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STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Concrete Core Sampling

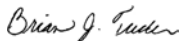
APPROVED:



09/30/2003

Mike Winters
Radiation Safety Officer

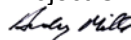
Date



09/30/2003

Brian Tucker
Project Chemist

Date



09/30/2003

Andrew Mills
Project Manager

Date

1.0 PURPOSE

This Standard Operating Procedure (SOP) is to be employed at the FUSRAP Maywood Superfund Site (FMSS) for obtaining concrete core samples at an area of known or suspected contamination. The purpose of this procedure is to ensure that concrete core sampling is conducted using well-developed techniques and methods.

2.0 SCOPE

This Procedure provides information on the proper setup, equipment and techniques involved in concrete core sampling. Review of the information herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described should be followed whenever applicable, noting that site-specific conditions may require adjustments in methodology.

3.0 REFERENCES

Stone & Webster SHE (Safety, Health, and the Environment) Program Procedure 8-4.

Stone & Webster SHE (Safety, Health, and the Environment) Program Procedure 8-6.

Stone & Webster, Chemical Data Quality Management Plan – FUSRAP Maywood Superfund Site, February 2000.

4.0 DEFINITIONS

Cross Contamination – The introduction of contaminants into the sample through the sampling and/or sample-handling procedures, which can cause an otherwise representative sample to become non-representative.

Telescoping - A series of corings, in one location or sample point, which become smaller in diameter as the boring gains depth.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for concrete core sampling task.

5.3 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designed by the Project Manager to supervise and investigate activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the methods of concrete core sampling chosen in accordance with the project requirements, this SOP, and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin. The Project Superintendent assures that all necessary personnel are mobilized on time and maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during concrete core sampling and deviation from this SOP.

5.4 PROJECT CHEMIST

The Project Chemist shall ensure that site personnel use this SOP and the quality requirements described in the Chemical Data Quality Management Plan and the Contractor Quality Control Plan while carrying out concrete core sampling activities. He will inform the laboratory in advance of the number of samples to be shipped and for what parameters they must be analyzed. He will act as the interface between the site Personnel and the laboratory.

5.5 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a Site Safety and Health Plan (SSHP). The Site Safety and Health Officer (who may also serve as a concrete core sampler) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.6 PROJECT ENVIRONMENTAL SAMPLER

All employees who are engaging in concrete core sampling activities are required to read and sign the SSHP. They are responsible for carrying out all sampling in accordance with approved procedures and methodologies as defined in the Chemical Data Quality Management Plan (CDQMP) and this SOP, unless superseded by project specific requirements. All concrete core sampling activities, including deviations from this SOP, will be recorded in field logbooks during on-site activities.. Additionally, they are responsible for generating trip blanks, equipment blanks, and acquiring replicate samples as defined in the CDQMP. Project Environmental Samplers will record all field data in Logbooks, and fill out chain-of-custody forms.

6.0 PROCEDURE

Care should always be used in obtaining any type of sample from a given medium to ensure that cross contamination is prevented. A sampling grid should be developed, prior to sample collection, to determine the locations of all sampling points. Concrete cores can be taken on walls, floors, or other equivalent medium. A coring device, such as a Hilti hammer-drill, is used to obtain the concrete cores. The following are steps taken when collecting concrete core samples.

- Site Preparation
- Organic Vapor Survey
- Radiation Survey
- Preparation for Sampling
- Sample Collection

6.1 SITE PREPARATION

Proper site preparation includes:

- Setting up the decontamination area
- Setting up the equipment storage area
- Setting up the sample storage area (if necessary)
- Preparation of sampling equipment (i.e., assembling of equipment, decontamination of equipment)

6.2 MONITORING

Preliminary monitoring for organic vapors, explosivity, and radiation, as well as monitoring for dust during sampling activities, shall be completed for all Stone & Webster tasks relating to this SOP at the Maywood site. Refer to Stone & Webster SHE (Safety, Health, and the Environment) Program Procedures 8-6, "Air Monitoring", and 8-4, "Radiation Protection" for detailed guidance in performing this monitoring.

6.3 PREPARATION FOR SAMPLING

After the hazards of the site have been visually identified and identified through air or radiation monitoring, preparation for sampling can begin.

Preparation for sampling includes:

- Development and layout of a sampling grid, prior to sample collection, to determine the locations of all sampling points. When collecting corings, the sample location can be marked by writing the corresponding sample number directly adjacent to the sample location with a mean streak marking pen, or another type of permanent marking device. Marking the sampling locations will aid in efficiently relocating the sample points upon receipt of sample results.
- Measurement of sampling point locations relative to fixed objects such as telephone poles, buildings, and bench marks (for outside sampling). These measurements are recorded on a sketch map and in the sampler's notebook. Measurements from a minimum of three locations are obtained for ease in relocating each sampling unit.
- Double checking all equipment and mechanical tools to ensure that they are in good condition and in proper working order.

6.4 SAMPLE COLLECTION

There are two common procedures used to sample concrete cores. These are:

- Standard concrete coring method.
- Telescoping the concrete core (an alternate drilling process).

Care must always be used in obtaining any type of sample medium to ensure that cross contamination does not occur. Cross contamination can be minimized by vacuuming of the boring after the sample has been obtained, to remove all residual dust particles. Rinsing the coring with water while vacuuming helps to remove small dust particles and dust particles in hard to reach areas.

6.4.1 Standard Drilling and Sample Collection Procedures

A concrete core will be drilled for each sample point. The following steps are to be carried out during standard drilling and collecting procedures:

1. Using a Hilti hammer-drill (or specified drilling device), drill a concrete core using the desired coring bit (usually a 3-inch diameter bit). Once the desired depth is reached, the coring is ceased.
2. Don a clean pair of sample gloves.
3. Retrieve the concrete core and place in appropriate sample container (8-oz. sampling jar).
4. Immediately label the sample container with a sample label and document the sample accordingly.
5. The boring is then vacuumed with a shop vacuum and rinsed with water simultaneously to retrieve any residual dust before coring is continued.

6. Decontaminate the sampling equipment (i.e., the coring bit) accordingly (see Stone & Webster Decontamination SOP).
7. Repeat these sampling procedures for all sampling points.

6.4.2 Telescoping (an alternate drilling procedure)

The following Steps are to be carried out when the telescoping method of drilling is performed.

1. Using a hammer-drill (or specified drilling device) drill a concrete core to ½" depth with the largest coring bit usable for a given sampling point. Once the ½" interval has been reached, the coring is ceased.
2. Don a clean pair of sampling gloves.
3. Retrieve the concrete core and place in appropriate sample container (8 oz. sampling jar)
4. Immediately label the sample container with a sample label and document the sample accordingly.
5. If a second (or third) depth based sample is required from the same sampling point, then the boring is then vacuumed with a shop vacuum and rinsed with water simultaneously to remove any residual dust before coring is continued.
6. Decontaminate the sampling equipment (i.e., the coring bit) accordingly.
7. Using the Hilti hammer-drill (or specified drilling device) with a coring bit of smaller diameter than the bit used for the 0" - ½" depth coring, drill the next concrete core from ½" - 1" deep in the same sampling point.
8. Repeat these sampling procedures for each of the following 1" increment samples.

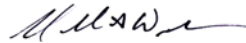
7.0 EQUIPMENT

- Hilti hammer-drill (or specified drilling device) with coring bit set
- 8 oz. sampling jars (or specified sampling containers)
- Shop vacuum with a High Efficiency Particulate (HEPA) filter
- Decontamination solutions and supplies
- Sampling gloves
- Air Monitoring Equipment
- Sampling Labels
- Chain-of-Custody Forms
- Field Sampling Logbooks
- Black ink pen and permanent marking device
- Radiation monitoring equipment
- Personal Protective Equipment (including hearing protection) as specified in the Maywood Site Safety and Health Plan

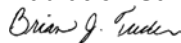
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Building Materials Sampling

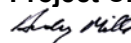
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This Standard Operating Procedure (SOP) is to be employed at the FUSRAP Maywood Superfund Site (FMSS) for obtaining building materials samples. The purpose of this procedure is to ensure that building materials sampling is conducted using well-developed techniques and methods.

2.0 SCOPE

This Procedure provides information on the proper setup, equipment and techniques involved in collecting building material samples for the purpose characterization of building floors, walls, and/or other surfaces, either in interior or exterior. Review of the information herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described should be followed whenever applicable, noting that site-specific conditions may require adjustments in methodology.

3.0 REFERENCES

None

4.0 DEFINITIONS

Building materials samples are any structural component of a residential or commercial building which are collected for analyses of the concentrations of the contaminants of concern.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel

assigned to project tasks are properly qualified to perform building materials sampling.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the building materials sampling task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the project manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on conducting building materials sampling in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each work day.

5.5 PROJECT CHEMIST

The Project Chemist shall ensure that site personnel use this SOP and the quality requirements described in the Chemical Data Quality Management Plan and the Contractor Quality Control Plan while carrying out building material sampling activities. He will inform the laboratory in advance of the number of samples to be shipped and for what parameters they must be analyzed. He will act as the interface between the site Personnel and the laboratory.

5.6 SITE PERSONNEL

Building material samples will be collected by field personnel under the direction of the Project Superintendent and, if radiological contamination is present or suspected, the project health physicist.

6.0 EQUIPMENT

- Survey Forms and Maps
- Sample Jars
- Tape Measure
- Appropriate Portable Survey Instruments
- Latex Gloves

7.0 PROCEDURE

7.1 GENERAL GUIDELINES AND REQUIREMENTS

Personnel performing building materials sampling shall take necessary precautions to minimize the possibility of spreading contamination (i.e., changing gloves after handling highly contaminated surfaces, wrapping instruments in poly or other suitable material.)

1. Prior to entering the area for the purpose of collecting building materials samples, personnel should be aware of the anticipated contamination levels. If radiological contamination is suspected, a review of previous surface activity surveys, if available, should be made to determine the expected radiation and surface contamination levels.
2. When high levels of surface contamination are expected, collect the samples in such a manner as to proceed from the areas with the lowest levels of contamination toward the areas with the highest levels of contamination.
3. The detector windows of an instrument must not be covered by any material.

7.2 BUILDING MATERIALS SAMPLING PROCEDURES

1. If radiological contamination is suspected, scan the surface of the material to be sampled with a NaI detector and/or a ZnS alpha scintillation detector, and record the readings in the field notebook.
2. Record the location of each sample in the field notebook. In the case of radiological contamination, utilize the same grid system established for gamma exposure rate and surface alpha surveys.
3. Using a hammer and chisel, chip away at the material to be sampled until sufficient volume has been collected. The necessary volume will be determined by the analytical laboratory. Be sure to place a sheet of plastic sheeting beneath the area, if applicable, to collect the material as it breaks free of its original location. Collect the materials in a suitable plastic or glass sample jar, as directed by the laboratory.

8.0 ATTACHMENTS

Attachment 1 Building Materials Collection Form

BUILDING MATERIALS SAMPLE COLLECTION FORM

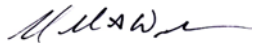
SAMPLE IDENTIFICATION	GRID LOCATION (X,Y)(1)	COLL. DATE	DEPTH (FT)	REQUIRED ANALYSES (2)	COMMENTS
	(1) GRID LOCATIONS	(2) REQUIRED ANALYSES			
	+ X = EAST				
	+ Y = NORTH				COLLECTED BY _____
					DATE _____
					TOTAL NO. SAMPLE

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Wipe Sampling Procedures

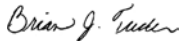
APPROVED:



09/30/2003

Mike Winters
Radiation Safety Officer

Date



09/30/2003

Brian Tucker
Project Chemist
Date



09/30/2003

Andrew Mills
Project Manager

Date

1.0 PURPOSE

This Standard Operating Procedure (SOP) is to be employed at the FUSRAP Maywood Superfund Site (FMSS) for obtaining wipe samples. The purpose of this procedure is to ensure that wipe sampling is conducted using well-developed techniques and methods.

2.0 SCOPE

This Procedure provides information on the proper setup, equipment and techniques involved in collecting wipe samples to indicate contamination on hard surfaces such as stone, metal, concrete, brick, tile, and wood surfaces that are characteristic of manmade structures. Review of the information herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described should be followed whenever applicable, noting that site-specific conditions may require adjustments in methodology.

3.0 REFERENCES

Midwest Research Institute's Field Manual For Grid Sampling of PCB Spill Sites to Verify Cleanup.

40 CFR part 761 Polychlorinated Biphenyls Spill Cleanup Policy, Subpart G, Sec.761.123 Definitions.

SOP SW-MWD-506-1 – Decontamination

4.0 DEFINITIONS

Wipe Sample – A sample taken over a known area (usually 10 centimeter (cm) x 10 cm) on a hard surface with a wiping of known size partially saturated with known solvent.

Template – An outline of the area to be sampled usually made of paper or other non-contaminating materials.

5.0 RESPONSIBILITIES

5.1 Project Manager

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform wipe sampling.

5.2 Project Engineer

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the wipe sampling task.

5.3 Site Safety and Health Officer

All field activities must be carried out in accordance with a Site Safety and Health Plan (SSHP). The Site Safety and Health Officer (who may also serve as a wipe sampler) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 Project Superintendent

The Project Superintendent is the individual designated by the project manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on conducting wipe sampling in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each work day.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

5.5 Project Chemist

The Project Chemist shall ensure that site personnel use this SOP and the quality requirements described in the Chemical Data Quality Management Plan and the Contractor

Quality Control Plan while carrying out wipe sampling activities. He will inform the laboratory in advance of the number of samples to be shipped and for what parameters they must be analyzed. He will act as the interface between the site Personnel and the laboratory.

5.5 Site Personnel

Site personnel assigned to perform the wipe sampling activities will be trained in the proper techniques for conducting the work. All site personnel have the responsibility for correctly creating or generating documentation, maps, sample point locations, chains-of-custody and related items. Wipe Samples are documented the same as other samples except the matrix of a sample is "wipe" instead of liquid or solid. The description should include the size such as "100 cm² Wipe".

They are required to read and sign the SSHP. They are responsible for carrying out all sampling in accordance with approved procedures and methodologies as defined in the Chemical Data Quality Management Plan (CDQMP) and this SOP, unless superseded by project specific requirements. All wipe sampling activities, including deviations to this SOP will be recorded in field books during on-site activities.

6.0 GENERAL INFORMATION

Surface sampling techniques are not as reproducible as most other sampling techniques. Contaminant recovery varies widely, depending on the technique of the sampler and the texture of the surface. The results are reported as a two-dimensional matrix and not as a three dimensional matrix. The results are reported as $\mu\text{g}/\text{m}^2$ instead of $\mu\text{g}/\text{m}^3$

An advantage of wipe samples is that they can be obtained quickly and easily without compromising the integrity of the area of surface under investigation.

7.0 PROCEDURE

7.1 Preliminary Site Assessment

A preliminary assessment of existing data should be consulted in planning a wipe sampling operation. Of special importance are items that can be used to characterize the types of hazardous materials present at the site (e.g. previous field logs for the site, generator records, manifests, inventories, personal interviews, and monitoring data). The Project Superintendent should be consulted to answer any questions and to confirm information that relates to the sampling activity:

- Is the site location accessible (can you get there)?
- Is wipe sampling going to accomplish the goals of the project?
- Are all phone numbers complete and correct?
- Are the wipe solvents correct for the analyte under investigation?
- Is all equipment on the equipment list needed?
- Is the site accessible to personnel at the scheduled time period?

- Do other special conditions exist?
- Are site maps or drawings available?

Equipment should be checked and inventory logs completed at this time. There should be enough sample jars, gloves, solvent etc. to get the job done, allowing for breakage or failures. If a vehicle will be used, have it reserved, checked out mechanically, and FULLY fueled.

In general, the preliminary site assessment should be completed prior to leaving for the site to make sure everything goes smoothly on the project. A field characterization should help to establish ambient conditions and identify potential hot spots. This information must be plotted on a site sketch. Observations from maps and aerial photographs can also be used in compiling the site sketch.

7.2 General Equipment and Material Requirements

The following equipment is needed for proper wipe sampling:

- Non-powdered latex or nitrile sample gloves
- Teflon-coated forceps
- Templates (usually 10cm x 10cm)
- 11.0 cm diameter Whatman GF/A filter paper (glass microfibre)
- 8 ounce glass sample container with Teflon-lined bakelite cap
- Hexane (pesticide reagent grade) or other applicable and appropriate solvent
- Teflon squeeze bottles
- Sample labels
- Absorbent pads (spill diapers)
- Field log book
- Indelible ink markers
- Tape measures
- Garbage bags
- Blue ice for the cooler

7.3 Preparation for Sampling

Preparation for sampling includes obtaining measurements from fixed reference points (such as telephone poles, buildings, or benchmarks) to accurately establish the sampling point locations. Three reference points per sample point should be used. Setting up a decontamination area for people and or equipment may be necessary depending on the level of protection required. Decontaminating equipment before sampling begins must also be done (see Stone & Webster Decontamination SOP).

A grid system is usually the best way to make and record measurements. These measurements are recorded on a site map and in the sampler's notebook. Measurements are made and/or samples are collected within the grid squares, and in such a fashion that relocating the exact sampling locations at a later time can readily be accomplished.

If sampling is done in Level D the only decontamination will be for the forceps which can be done over a sample jar. If the sampling is taking place in Level C or higher a decontamination area will have to be set up. Decontamination of the Teflon squeeze bottle and forceps can be accomplished by rinsing with hexane (or the solvent in use) prior to first use. Gloves, filter pads, and sample bottles should already be clean.

7.4 Wipe Sampling Precautions

Excessive dust can interfere with wipe sampling by absorbing the solvent and preventing proper wetting of the surface. To reduce this problem, the filter may be held over the sample jar and carefully rinsed during the sampling process. Care should be taken when using the sampling area outline templates, especially in dusty areas, to avoid contaminating the sample field with falling dust.

Rough surfaces are very difficult to sample representatively. The texture of the sampled surface should always be noted in the field log. If cotton or gauze are used, care must be taken so that the material does not tear or shred and remains on the sampling surface.

Make sure that the template being used will not react with the sample material or solvent used and that the proper solvent is being used for the desired analyte (See Attachment A for solvent data).

7.5 Sample Collection

The steps to be followed in wipe sampling are as follows:

1. Don a clean pair of disposable latex sample gloves.
2. Remove the lid of the sample jar and place it upside down on an absorbent pad.
3. Don a second clean pair of disposable latex sample gloves.
4. Remove one GF/A filter from the filter box and fold the GF/A filter paper in half three times.
5. Place hexane (or solvent being used) rinsed forceps onto the GF/A filter in such a manner that the forceps hold the filter paper approximately one cm away from and parallel to the triple-folded edge of the filter.
6. Saturate the filter paper as much as possible with the appropriate solvent from a Teflon[®] squeeze bottle.
7. Carefully place the template on the area to be sampled.
8. Wipe the sample surface ten times horizontally and ten times vertically in two swaths each direction. Each swath is approximately 5.5 cm wide, overlap 0.5 cm, and

approximately 9.5 cm long (This method of wiping a surface area provides for a consistent sample area of 100 cm²).

9. Dab any fragments from the GF/A filter that may have been torn from the sample surface with the filter to prevent loss of recovery from the sample area.
 - a. Place the filter into an 8 ounce sample container. Hold the forceps over the container and rinse with the appropriate solvent (removing any residual surface contamination that the forceps may have picked up).
 - b. Replace the Teflon[®]-lined lid on the sample container, and label and seal the sample properly.
 - c. Dispose of template.
 - d. Repeat steps 1 through 9 as necessary until all the samples have been collected. Pack samples in cooler for shipping as appropriate
10. Discard all disposables in appropriate container.

7.6 Wipe Sampling QA/QC

A field blank should always be collected with the sampling batch to ensure the quality of the data. This consists of a filter pad wet with the chosen solvent and placed into a prepared sample container. This will help identify potential introduction of contaminants through the sampling method and contributions from the pad, solvent, or sample container.

Spiked samples may also be collected to better assess the data being generated. Spikes may be prepared by spiking a piece of foil of known area with a known amount of the standard of the analyte under investigation. The solvent containing the standard is allowed to evaporate and the foil is wiped in a manner identical to Sec. 7.4 steps 1 through 9.

8.0 ATTACHMENTS

Attachment A Solvent Selection

ATTACHMENT A

SOLVENT SELECTION

ANALYTE	SOLVENT
Semi- and nonvolatile organics (PCBs, Dioxin, Dibenzofurans, Pesticides)	Hexane
Metals (Except Hexavalent Chromium - CR ⁺⁶)	1:1 Nitric Acid (10% HNO ₃)
Hexavalent Chromium (CR ⁺⁶)	D.I. Water
Cyanide	1% Sodium Hydroxide (NaOH)

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STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Drum Handling and Sampling	
APPROVED: Mike Winters Radiation Safety Officer Date Brian Tucker Project Chemist Date Andrew Mills Project Manager Date	

1.0 PURPOSE

This Standard Operating Procedure (SOP) presents the method for handling drums and taking drum samples at the FUSRAP Maywood Superfund Site. This procedure provides the methods for identifying and quantifying hazardous substances so that the appropriate level of protection may be determined. The purpose of this procedure is to ensure that drum handling and sampling is conducted using well-developed and consistent techniques and methods.

2.0 SCOPE

This procedure is applicable to the handling and sampling of closed containers (120 gallon or less) on the Maywood project sites. The contents of these containers may or may not be known. This SOP can be used for either situation. Bulk tanks such as railroad tank cars, large above- and below ground tanks (with a capacity of more than 120 gallons), and tank trailers are not addressed in this procedure.

3.0 REFERENCES

Standard Operating Procedure for Drum Sampling by Ecology and Environment, Inc.
January, 1990.

Corporate Safety, Health, and Environment Manual by Stone & Webster
Labeling, Packaging, and Shipping Environmental Samples SOP
Decontamination SOP

U.S. Department of Energy, Handbook for Occupational Safety and Health during Hazardous Waste Activities. DOE/EH-0535, June 1996.

4.0 DEFINITIONS

Air Reactive Wastes - Some chemicals, such as white phosphorus and some of the metallic hydrides, react with the oxygen in the air and combust or produce considerable amounts of heat and may possibly release toxic or flammable vapors.

Compatibility Testing - A series of tests performed on individual drum samples where the object of the testing is to find those drums that have similar and potentially compatible contents. After further testing the contents of these drums would be mixed together to form a larger single waste stream for disposal purposes.

Container - Defined as any drum, bottle, can, bag, etc., with a capacity of 120 gallons (450 liters) or less.

Dosimeter - A portable, transistorized survey meter that can be used for radiation monitoring purposes and/or contamination measurements.

Exotic Metal Drums - (i.e. aluminum, nickel, stainless steel, or other unusual metals). Very expensive drums that usually contain an extremely dangerous material.

Glass Thief - A glass tube 4 feet long and 3/4 inches in diameter, used for taking samples from drums. The tube is usually broken up and disposed of in the drum following sampling.

LEL - (Lower Explosive Limit) An air monitoring device can test the surrounding air for sufficient oxygen content for life support and/or the presence of combustible gases or vapors which may pose a potential flammability hazard. The Lower Explosive Limit is defined as the minimum concentration of a particular combustible gas in the air that can be ignited. The Upper Explosive Limit (UEL) is defined as the maximum concentration that can be ignited.

Laboratory Packs - Such drums are commonly used for disposal of expired chemicals and process samples from laboratories, hospitals and similar institutions. Bottles in the laboratory pack may contain incompatible materials and may not be packed in absorbent material. They may contain radioisotopes, shock sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs have been the primary ignition sources for fires at some hazardous wastes sites.

Monitox - A portable warning device used for detecting specific toxic gases found in the surrounding air (i.e. H_2S , HCl , Cl_2 , HCN and $COCl_2$).

PID - (photoionization detector) A portable air-monitoring instrument used to detect organic vapors. The PID does not distinguish between different types of vapors or tell if more than one vapor is present.

Polyethylene or PVC-lined drums - Often contain strong acids or bases. If the lining is punctured, the substance usually corrodes the steel, resulting in a significant leak or spill.

Shock Sensitives - A chemical which may undergo a very rapid chemical transformation, with the simultaneous production of large quantities of heat and gases, if introduced to shock (i.e. friction).

Single-Walled Drums Used as a Pressure Vessel - These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. Such drums may contain reactive, flammable, or explosive substances.

Vapor Control - The use of an LEL, PID, Monitox, or any other air monitoring device to assure the quality of air meets all safety requirements.

Waste Blending Test - A waste blending test is done on sample materials from drums that were found to be similar and potentially compatible with each other. The sample materials are proportionally and sequentially blended with each other and observations and measurements are made during and after the blending process to determine if any potentially hazardous reactions are occurring (i.e. temperature rise, outgassing, or other reactions).

Water Reactive Wastes - Some chemicals will react violently with water on contact or through exposure to moisture in the air while others may give off toxic or flammable gasses. Sodium or potassium metal reacts violently with water while calcium carbide reacts to produce a flammable gas (acetylene).

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform wipe sampling.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the wipe sampling task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a site-specific SSHP. The Site Safety and Health Officer (who may also serve as a wipe sampler) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the project manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on conducting wipe sampling in accordance with the project requirements, this SOP, and related SOPs. He or she assure that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each work day.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

5.5 SITE PERSONNEL

Site personnel assigned to perform the drum handling and sampling activities will be trained in the proper techniques for conducting the work. They are required to read and sign the site-specific SSHP and to follow the procedures in this SOP, unless superseded by other project-specific requirements. All drum handling and sampling activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

6.0 PROCEDURE

6.1 INTRODUCTION

The guidance presented is based on field experience in working with containers on uncontrolled hazardous substance sites and on information contained in United State Environmental Protection Agency (USEPA) and other government agency publications. In many cases strict rules cannot be followed, and professional judgment is required because uncontrollable variables are involved. For example, there is always some uncertainty in the identity of a container's contents. Labels cannot be absolutely trusted. Only educated guesses can be made after a thorough review of all available background data, such as potential sources of the wastes.

During many drum projects, several phases will be in progress simultaneously. Air monitoring, dust control, and organic vapor control operations should be in progress throughout the course of the project. The Maywood Site Safety and Health Plan addresses air monitoring procedures to be utilized. Strict adherence to safety precautions will occur during drum handling, opening and sampling. Site Safety and Health Plan procedures and requirements will be adhered to during field activities on-site.

6.2 DRUM HANDLING

In addition to the following procedures, drum handling and sampling activities will be performed in accordance with the Drum and Container Handling Procedure (SHE 9-2) in Stone & Webster's Corporate Safety, Health, and Environment Manual.

The handling, movement, and transport of drums and other containers should be by use of mechanical equipment only; no drums should be handled manually. Remote drum handling equipment may consist of a grappler equipped backhoe or front-end loader. Drum transportation should be by front-end loaders or fork lifts with modified carrying platforms. Portions of equipment that contact drums or canisters should be constructed of non-ferrous metals or contact portions should be coated or lined to preclude spark generation. Handling and transport equipment must be equipped with full frontal and side splash and explosion shields. Class ABC fire extinguishers will be fitted to the body of each piece of equipment.

6.2.1 General Precautions

Personnel involved in handling and transporting containerized waste will work in teams containing no fewer than two people. Visual contact will be maintained between members of the working team at all times. All members will be able to communicate between themselves and with the Site Safety and Health Officer by intrinsically safe two-way radios at all times on the work site.

Whenever possible, drums or other containers to be sampled should be opened and sampled in place to minimize handling. However, when drums are stacked or are close together, they may have to be moved to prevent sympathetic detonation of, or chemical reaction with, other drums around the one being opened. The main criterion is distance to other drums--a reasonable distance should be maintained to keep the drum to be opened segregated from the others.

6.2.2 Leaking or Deteriorated Drums

The contents of drums that exhibit leakage or apparent deterioration such that movement will cause rupture (determined by the Site Safety and Health Officer (SSHO)) must immediately be transferred to a repack drum. Equipment, including transfer pumps used in the repack operation must be of explosion-proof construction.

Leaking drums containing sludge or semi-solids, drums that are structurally sound but which are open and contain liquid or solid waste, and drums which are deteriorated but can be moved without rupture must be placed in overpack containers. Make certain that representative samples are obtained from overpack drums. Sample the actual drum, not material that has leaked from the drum into the overpack.

6.2.3 Bulging Drums

Drums which potentially may be under internal pressure, as evidenced by bulging, must be sampled in place. Extreme care shall be exercised when working with and adjacent to potentially pressurized drums.

Should movement of a pressurized drum be unavoidable, handle only by a grappler unit constructed for explosive containment. The bulging drum should be moved only as far as necessary to allow seating on firm ground or it should be carefully overpacked.

6.3 PRIMARY STAGING OF DRUMS

A staging configuration must allow the samplers reasonable access to each drum for inspection, sampling, and overpacking, if necessary, while economizing on space. Drums are staged in rows, two wide, with isle space between rows. According to the Handbook for Occupational Safety and Health during Hazardous Waste Activities, "In all staging areas, stage the drums two wide in two rows, per area, and space these rows 7 to 8 feet apart to enable movement of the drum handling equipment."

6.4 DRUM OPENING

Drum opening operations are completed by remote means prior to the collection of samples. This provides the sampler a means for collecting a sample in an otherwise sealed container.

6.4.1 Opening Area

When possible, the drum opening area should be physically separated from the drum removal and drum staging operations. When drums must be opened after they are already in a staging area, personnel should be a minimum of 50 feet from the drum opening area. When drum opening can be performed at an area other than the staging area, there should be adequate distance between the drum opening and the removal and staging operations to prevent a chain reaction or fire during the drum opening procedure.

6.4.2 Caterpillar 215 Grappler

Drum opening is normally accomplished with a Caterpillar 215 grappler using a brass-tipped punch. A remote drum punching unit may also be used on smaller drum projects. At all times the staging area should be clear of personnel on the ground during punching operations. Extreme caution should always be taken when drum punching/opening is being performed. **AT NO TIMES SHOULD DRUMS BE PUNCHED MANUALLY BY HAND USING HAND HELD TOOLS!!** Drums that have been placed inside overpack drums upside down will need to be punched to obtain sample(s) of both liquids in them and any settled solids.

6.4.3 Opening Specifications

Stone & Webster procedures prohibit the opening of drums containing unknown materials by hand. Employees found to be opening drums by hand will face disciplinary action. The drums will be opened by using a remote operated air punch or by the method described above.

Containers that are inside warehouses, basements, or other buildings should be moved outside before they are opened. Opening and sampling of containers inside a building should only be done when there are no areas outside of the building that could be safely or physically used for these purposes.

If it is determined that opening and sampling of containers must be done inside of a building, then the following minimum requirements must be met:

1. Adequate ventilation must be provided.
2. Containment must be in place around drum opening and sampling area.
3. A,B,C type fire extinguishers must be in place.
4. Sand and mechanized equipment for spreading the sand in case of a fire or reaction must be present.

6.5 SECOND INSPECTION

After the drums have been staged and opened, a second inspection of the drums is required. During the initial inspection, the drums would have been sealed and only inspection of the outside of the drums was possible. Since the drums are now open, visual observations of the drum contents will aid in locating drums that will require special handling.

Special handling techniques are required for containers which may expose personnel to particularly hazardous conditions. These techniques and techniques for recognition of special handling drums are described in general below, although site-specific conditions may require the development of specialized methods for handling of special handling drums.

6.5.1 Drums Containing Biohazards

A biohazard is defined by the Biohazards Committee of the American Industrial Hygiene Association (AIHA), as “an agent that is biological in nature, capable of self-reproduction, and has the capacity to produce deleterious effects upon other biological organisms, particularly humans.” Biological agents are substances which could be biohazardous substances, but are not limited to the following:

- Infectious or parasitic agents
- Non-infectious microorganisms (such as some fungi, yeasts and algae)
- Plants and plant procedures
- Animals and animal products which can cause occupational disease

Recognition is the key to avoiding disease contaminated biological waste. Be aware that this may take the form of cultured animal cells, infected clinical

specimens (tissues, fluids, etc.), or tissues from experimental animals (including animal dander). Open drums should be examined for evidence of biological material such as:

- Gauze
- Hypodermic Syringes
- Petri dishes
- Cultures
- Blood
- Animal tissues
- Waste from orthopedic casts (may be gray, crumbly solids resembling a type of insulation)

Biological waste that has been prepared for incineration or for autoclaving may be packaged in red plastic bags or may be contained in plastic bags that are marked with the universal biohazard symbol. Biohazards such as research bacterial cultures may be sent through the mail if they are packaged in a mailing tube. It is conceivable that either type of packaging could be found on a hazardous waste project.

If a biohazard or possible biohazard is identified, seal the drum and immediately notify the Site Safety Officer and the Project Superintendent.

6.5.2 Drums Containing Explosive or Shock Sensitive Waste

If drums containing wastes that have been identified by sampling, or are suspected by visual examination to be explosive in nature are found, the Project Manager and the SSHO must be notified immediately, before the drums are handled in any way.

If the Project Manager and the SSHO approve handling of these drums, they shall be handled with extreme caution. Initial handling shall be by a grappler unit constructed for explosive containment. Drums shall be palletized prior to transport to a high hazard interim storage and disposal area.

If at any time during remedial activities, an explosive, pursuant to provisions of Title 18, U.S. Code, Chapter 40 (Importation, Manufacturer, Distribution, and Storage of Explosive Materials, 1975 Explosives List) is identified, it should be secured and the appropriate state and federal agencies notified.

Identification of an explosive substance during the course of a remedial action is usually based on the experience of the on-site personnel. Potentially explosive materials usually may be identified by their physical characteristics such as texture, color density, etc. as well as by the way they are packaged. Most explosives are solids. In some cases they are packaged in water-tight containers to exclude water while in other cases they are packaged wet to preclude explosion.

Prior to handling or transporting drums containing explosive wastes, personnel working in the area shall be removed to a safe distance (as determined by the SSHO). Continuous contact with the communication bases shall be maintained until handling or transporting operations are complete. An audible siren signal system shall be used to signify the commencement and completion of explosive waste handling or transporting activities.

6.5.3 Drums Containing Radioactive Wastes

After the containers are opened, another radiological survey will be conducted. Drums containing radioactive wastes shall not be handled until radiation levels have been determined by a field survey which is recorded in a field notebook. The survey shall include background levels, direct gamma readings and laboratory analysis of drum surface wipe samples.

Depending on the level of radiation encountered, handling and transport may require special shielding devices to protect personnel. Following handling and transport, equipment used shall be surveyed by the SSHO and decontaminated to background levels prior to recommencing work. Surveys shall also be made of the ground surface in the vicinity of original drum storage to identify potential soil contamination by spilled or leaked radioactive waste. Prior to recommencing work in the area, radioactive soil areas shall be isolated to prevent tracking of radioactive contaminants about the site, and workers who entered the area should have their gloves and boots surveyed for radiation.

6.5.4 Packaged Laboratory Wastes (Laboratory Packs)

If drums known or suspected of containing discarded laboratory chemicals, reagents or other potentially dangerous materials in small volume, or individual containers are found, the Project Manager is to be notified immediately, before the drums or containers are moved or opened.

Lab pack drums are easily identified by the presence of vermiculite or other absorbent type packaging material. If a drum contains such material, there is a good possibility that the drum is a lab pack drum. Further investigation may reveal that the drum also contains smaller containers inside such as sample jars, metal shipping containers, specially sealed packages, or sealed 5 gallon buckets.

If the Project Manager and the SSHO approve the handling of these containers, they shall be handled with extreme caution. Until otherwise categorized, they shall be considered to be explosive or shock-sensitive wastes. Initial handling shall be by a grappler unit constructed for explosive containment. Drums shall be palletized and overpacked, if required, prior to transport to a staging area where sorting, identification, repackaging and/or stabilization can be done.

Prior to handling or transporting Laboratory Packs from the existing drum area, personnel working in the immediate area shall be removed to a safe distance.

Continuous contact with the communications base shall be maintained until handling or transporting operations are complete. An audible siren signal system, similar to that employed in conventional blasting operations will be used to signify the commencement and cessation of Laboratory Pack handling or transporting activities.

6.5.5 Air Reactive Wastes

If the presence of an air reactive substance is verified or even suspected, the material should be immediately segregated and transported to a separate high hazard interim storage and disposal area.

Air reactive wastes may be discovered during opening or sampling operations. Air reactive substances are routinely packaged in special containers or packages that keep the material from making contact with the air. They may be stored under kerosene or some other liquid to minimize air contact. They may also be found in sealed ampoules, corrugated drums, stainless steel canisters, sealed aluminum containers, or specially lined drums.

6.6 Numbering and Mapping

Accurate numbering is critical. Mistakes in numbering, such as missing numbers or double numbering, are minimized by numbering after primary staging. To avoid problems, empty containers should be numbered and recorded on drum inventory logs as empty. DRUM NUMBERING SHOULD BE STRICTLY NUMERICAL.

Mistakes in numbering occur in most drum sampling projects. In large part, mistakes made have very little consequence until samples have been submitted to the laboratory. It is for this reason that drum numbering and drum mapping must occur before samples are collected.

After the drums in the staging area have been numbered, a drum map is made. The drum map is reviewed for double numbers and missing numbers. Any double numbered drums or missing numbers are corrected in the staging area and on the drum map before any sampling is to be performed in the staging area.

6.7 Sampling

Collection of samples should occur only after the procedures of the previous subsections have been followed. The following subsections describe collection of samples from drums which have been inspected, handled, staged, remotely opened, inspected a second time prior to sampling, and numbered.

All drums not in direct contact with ground surface and mechanical equipment should be grounded prior to the commencement of sampling. The reason for grounding of drums which are not in direct contact with ground surface is that a simple static electricity charge transferred to a drum which is not grounded, can cause an explosion or start a fire.

A grounding rod driven into the ground surface, which is attached to copper wire, which is attached to a metal or copper clip, which is clipped to the drum being sampled is an acceptable method of grounding a drum.

6.7.1 General Sampling Procedures

Once the drum has been grounded, and personal protective equipment (PPE) if appropriate, has been donned, sampling of the drum can begin. The steps to be followed in sampling are as follows:

1. Remove the lid of the overpack container or remove the polyethylene sheeting from the top of the drum.
2. Record any markings, special drum conditions, and type of opening on the Drum Inventory Log.
3. Record the identifying number from the drum onto the Drum Inventory Log. Have a copy (reduced size if necessary) of the drum staging area map and double-check the drum number and location.
4. Use a PID (if weather permits) and an LEL meter to collect air monitoring readings from the drum. Record the results on the Drum Inventory Log.
5. Insert glass tubing almost to the bottom of the drum or until a solid layer is encountered. About one foot of tubing should extend above the drum.
6. Allow the waste in the drum to reach its natural level in the tube. Cap the top of the sampling tube using a thumb or forefinger.
7. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container. Release thumb or forefinger from tube and allow the glass thief to drain completely into the sample container.
8. Repeat steps 6 & 7 until the required sample volume has been collected.
9. Place the used sampling tube, along with paper towels or waste rags (used to clean up any spills), into an empty metal barrel marked "sampling waste" for subsequent disposal.
10. Close the sampling container cover tightly, wipe off with a paper towel and place a label on the sample container.
11. Replace the overpack lid or place a plastic cover over the drum/container.
12. Measure the sample for radioactivity and record results on the Drum Inventory Log.

13. Fill out Chain-of-Custody Record and carefully package samples in accordance with Stone & Webster's Labeling Packaging and Shipping Environmental Samples SOP.

14. Complete the appropriate shipping forms. Drum samples are always considered to be high-hazard samples.

6.7.2 Sampling Solids and Semisolids

Solids in drums are sampled by scooping the material up with the use of tongue depressors. All reasonable efforts shall be made to obtain sample to a depth of 12 inches or refusal. It is sometimes necessary to sample the material with the use of a trier. This sampling device is often not used however, due to the substantial increase in time necessary to obtain the trier. Tongue depressors will be disposed after each use. Non-expendable sampling tools must be decontaminated between drums. Sometimes, the material must first be broken up with a non-sparking hammer or hammer and chisel (NOTE: This is the only time in which a sampler is allowed to have a hammer or chisel in their hands), or, for rubber-like solids, a piece may need to be cut off with a knife.

6.7.3 Sampling Solids Underneath Liquids

Sludge or solids underneath a liquid may be sampled by lowering a pipette into the drum. If the sludge does not run out into the jar, whacking the pipette or tapping it against the side of the bottle may loosen the sample. If this fails, one may break the pipette and put the pieces which have the solid in them in the bottle.

When pipettes are used for sampling, samplers must wear Whizard glove liners (stainless steel mesh glove liners designed to prevent cuts which could be caused by sharp objects such as broken glass tubing).

6.7.4 Materials Between Drum and Overpack

In many drum sampling projects where drums have been overpacked, it is typical to find liquids or solids between the drum and the overpack in which it is contained. Sometimes these materials have the same appearance and matrix as the material inside of the drum itself, although they may be quite different than the material inside the drum.

6.7.4.1 Solids

Solids may appear in an overpack, between the drum and the overpack, that are different than the solids or liquids in the drum itself. If these solids appear to be in soil, then a notation must be made on the Drum Inventory Log that the material exists between the drum and the overpack. This material does not need to be sampled. If these solids appear to be something other than soil, then this material must be

sampled in accordance with Sampling Solids and Semisolids. In addition, a notation that the material exists between the drum and the overpack must be made on the Drum Inventory Log.

6.7.4.2 Liquids

Liquids may appear in an overpack, between the drum and the overpack, that are different from the solids or liquids in the drum itself. This material must be sampled in accordance with Sampling Procedures. In addition, a notation that the material exists between the drum and the overpack must be made on the Drum Inventory Log.

6.7.4.3 Sampling Frozen Drums

Stone and Webster may be faced with the need to collect samples in conditions where the temperature is below 32° F (0° C) and the material inside the drum is partially or completely frozen. In situations where the material in the drum is frozen, a Milwaukee wood bit with an air driven drill or hand drill is used (with the Milwaukee wood bit) to drill, or auger through the frozen material. Every few inches of augering, the bit is removed and the shavings are placed into the appropriate sample container(s). This procedure is repeated until a sufficient volume of the material has been obtained. Care must be taken to insure that a hole is not drilled through the bottom of the drum.

6.7.5 Post-Sampling Procedures

After the sample has been taken, the outside of the bottle will be wiped off and labeled with the drum number. The drum number will also be written on the lid of the bottle. All sampling data and observations will be recorded on the drum inspection log.

After a group of drums have been sampled, the samples will be collected. The sampling trash, sample gloves, paper towels, etc., will be collected and placed into a drum marked "sampling waste" for disposal. The sampling pipettes will also be collected and packaged in the sampling waste drum for disposal.

All openings shall be plugged except during sampling operation. The reason for this is to prevent rainwater from entering the drum before or after sampling has been performed. For drums which are in overpack containers, this is simply having the lid on the overpack container. For drums which are not in overpack containers, this can be accomplished by placing polyethylene sheeting over the top of the drum in a manner that will keep rainwater from entering the drum.

6.8 DRUM INVENTORY LOG

The field data gathered during the drum sampling activities will be recorded on a Maywood Project Drum Inventory Log sheet. The following is a list of the information necessary to complete the form.

1. Drum Number - Number only; at least 3 digits in length (001).
2. Site Number - Assigned by Stone & Webster to each site on the project.
3. Page - of - If Material Safety Data Sheets (MSDS) or other information is included, then the total number of pages accompanying the drum log is required. Most of the time it will be page 1 of 1.
4. Site Location - Name assigned by Stone & Webster to each site on the project
5. Project Superintendent or designee - see Section 5.4.
6. Phone - Site phone or number of the supporting Stone & Webster office.
7. Logger - Name of individual responsible for filing in the sampling portion of the Drum Inventory Log.
8. Sampler - Name of individual(s) responsible for obtaining the sample
9. Weather - Weather conditions during sampling (e.g., temperature and/or precipitation).
10. Date - Date when sample was collected.
11. Time - Time when sample was collected.
12. Drum Type – Indicate the drum type and materials of construction.
13. Lid Type – Indicate the type of closure on the container.
14. Drum Condition – Describe the integrity of the drum. State “Meets DOT specifications” if the drum can be shipped according to Department of Transportation (DOT) regulations.
15. Drum Size - Provide the volume of drum when full. If the drum is overpacked, the inner drum volume should be indicated, not the size of the overpack.
16. Drum Contents - Provide the volume of waste contained in the drum.
17. Overpacked - Indicate if the container was overpacked, and state the type of overpack utilized.
18. Layers - Designates the layer as top, middle or bottom for a multi-layered sample. If only one layer exists, complete only the line associated with the top layer, “T”.
19. Physical State – Indicate the actual physical state of each layer.

20. Color – A standard color description for each layer of the sample should be written in.
21. Clarity - Indicate the clarity of each layer of the sample.
22. Layer Thickness - Record the thickness of each layer in inches; an estimate of how deep the layer is.
23. pH - Record pH measurement in standard units (SU); 0 to 14 or the designation “N/A” if there was no measurement obtained.
24. PID - Record the results for vapor analysis by photoionization detector (PID) or the designation “N/A” if there was no measurement obtained. The PID scale reads in ppm (0 to 2,000).
25. Dosimeter - The results of the field radiation survey is recorded in this space or the designation “N/A” if there was no measurement obtained. The dosimeter’s scale units are in millirems per hour (mr/hr or mrem/hr).

26. Other - This space is for additional analysis which may take place or the designation "N/A" if there were no other measurements. The information should include the equipment used, the parameter being measured, and its concentration. Example: Drager tube - HCN - 5 ppm.
27. DOT Haz - Hazard category from placards or stencils on drum. Example: Corrosive Liquid.
28. UN/NA - Space for any UN or NA numbers which are stenciled or written on the drum. These numbers are always fixed by either UN or NA.
29. MFG Name - Name, address, and telephone number of the company producing or distributing the chemical/product. If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.
30. Chemical Name - Any chemical or compound, key ingredient, trade name, and/or chemical name of the contents on the label or stenciled on the drum. Indicate whether the information was printed on a label or stenciled or handwritten on the drum. If the space provided is inadequate, indicate that the information continues on the back of the log, and do so.
31. Additional Information - This space is for additional information or comments for which no specific space is designated. It can include unusual comments or problems such as the contents are too hard to sample, drum color, or that colored crystals have formed on the drum. If the space provided is inadequate, indicate that the information continues on the back of the log.

6.9 SAMPLE PRESERVATION AND PACKING PROCEDURES FOR DRUMMED WASTE SAMPLES

- No preservatives shall be used.
- Place sample in a zip-lock plastic bag. (If sample is liquid, place bottle in plastic bag)
- Place each bagged container in a covered metal can containing absorbent packing material
- Mark the sample identification number on the outside of the can.
- Arrange for the appropriate transportation mode consistent with the type of hazardous waste involved. Depending on mode of transportation and type of material being transported, additional packaging requirements may apply.
- In general follow the procedures given in Stone & Webster's Labeling, Packaging and Shipping Environmental Samples SOP.

6.10 DECONTAMINATION PROCEDURES

All sampling equipment used in obtaining samples from containers will be either dedicated (disposable) or pre-cleaned and decontaminated. For detailed guidance in decontamination procedures, refer to Stone & Webster's Decontamination SOP.

1. Thoroughly scrub with a brush using a detergent (Alconox) and hot water solution to remove large particles.
2. Thoroughly rinse the detergent solution off the equipment with tap water.
3. Rinse the equipment with deionized water.
4. Solvent rinse the equipment with pesticide grade isopropanol.
5. Solvent rinse the equipment with pesticide grade hexane.
6. Air dry the equipment before use.

6.11 RESEALING AND SECONDARY STAGING

All containers opened for sampling need to be resealed to prevent the escape of vapors and possible reactions with rainwater and air. The resealing methods will depend on the opening methods used and include the following:

- Replacing the lid and retaining ring.
- Replacing the screw-type drum plug.
- Placing the drum in an overpack (larger drum) when it cannot be resealed by any other method.
- Placing polyethylene sheeting over the drum in a manner that prevents rainwater from entering the drum. The sheeting should be secured to prevent it being blown off by the wind.

It is important to note that these resealing methods are for the purpose of preventing leakage from the container while it is in storage on the site. If the container is to be moved off the site, DOT regulations regarding transportation and sealing of drums will apply.

Once the drum is sampled and resealed, it should be left where it cannot react with other containers on the site. For a small number of drums, the storage areas may be the staging and opening area. In any event, the sampled drums should be placed in an area away from other groups of containers on the site. The reason is that slowly progressing chemical reactions can start when a container is opened and the contents exposed to air or

the disturbance caused by handling the drum. Such a reaction could take hours or even days to occur. Another reason for the segregation and identification of drums for recovery is for use as evidence and as an indication of which drums have been sampled.

6.12 SAMPLE CONTROL

The Project Chemist or his/her representative on-site is responsible for the identification, preservation, packaging, handling, shipping, and storage of samples obtained from the site. For detailed guidance in these procedures, refer to Stone & Webster's Labeling, Packaging, and Shipping Environmental Samples SOP.

7.0 CHARACTERIZATION AND TEST BLENDING

A waste blending test is used to determine if the drums included in a waste stream are truly compatible. Whether the wastes are to be blended on site or to be sent in drums to a disposal facility, a waste blending test must be performed for waste profile purposes. Waste blending is usually performed by the on-site Chemist.

Samples of the blended waste to be sent off-site for laboratory analysis for disposal parameters will be shipped by the following procedures and by the procedures listed in Stone & Webster's Labeling, Packaging, and Shipping Environmental Samples SOP.

1. The lids of the sample jars will be tight and sealed with tape.
2. The sample container will be placed inside two 4-mil plastic, protective bags.
3. The sealed sample will be placed in a metal paint can.
4. The samples will be placed into a cooler and packed with blue ice to maintain their temperature at 4 degrees Celsius.
5. Bubble pack or other insulating packing material will be placed into empty spaces in the cooler.
6. The cooler will be sealed, addressed, identified, and placarded according to the nature of the hazards associated with the materials being shipped.

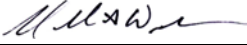
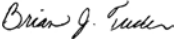
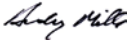
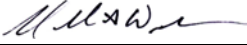
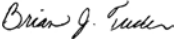
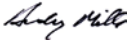
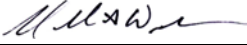
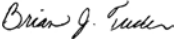
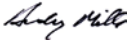
8.0 EQUIPMENT

The equipment listed below will normally be required to accomplish drum sampling on a project site.

- Spill Control Kit
- Remote controlled drum opening equipment - pneumatic, hydraulic or other

-
- LEL/O₂ meter (MSA Model 260/360)
 - HNU portable organic vapor analyzer (Model HW - 101)
 - Fire extinguisher, Class A, B and C, size as per Health & Safety Plan requirements
 - Radiation survey meter, internal GM detectors (Ludlum Model 5, P/N 48 - 1607)
 - Personal protective equipment. This may include: robar or Tingley boots, Tyvek and/or saran protective suit with hood, acid jacket and pants, vinyl booties, vinyl sample gloves, nitrile outer gloves, hard hat with splash shield and respirators.
 - Rolls of plastic sheeting (Visqueen)
 - Sampling Equipment
 - Equipment and supplies needed for drum sampling (per 100 drums)
 - ◆ 120 drum log sheets
 - ◆ 120 8oz jars with Teflon lined lids
 - ◆ 200 tongue depressors
 - ◆ 120 11mm dip tubes
 - ◆ 400 pair sample gloves
 - ◆ 5 mean streaks
 - ◆ 4 rolls of paper towels
 - ◆ 2 30 gal. Polyethylene trash bags
 - ◆ 12 chain-of-custody forms
 - ◆ 4 Liters of isopropanol
 - ◆ 4 Liters of hexane (Pesticide grade)
 - Equipment and supplies generally needed per drum job
 - ◆ 1 12-column book
 - ◆ 2 Stone & Webster record books
 - ◆ 1 knife, beryllium copper (BeCu)
 - ◆ 1 bung wrench, Ampco metal
 - ◆ 1 screwdriver, beryllium copper
 - ◆ 1 scraper, beryllium copper
 - ◆ 1 hammer, claw, BeCu alloy
 - ◆ 1 chisel, Ampco metal, 1" wide
 - ◆ 2 pairs cut-proof glove liners
 - ◆ (2) 15/16" sockets, BeCu alloy
 - ◆ (2) 1/2" drive ratchets, BeCu alloy
 - ◆ 1 1/4" x 18"L wood boring bit
 - ◆ 1/2" air powered drill, low RPM

- ◆ 1 tool box, polyethylene with lock
 - ◆ 2 wash bottles, isopropanol
 - ◆ 2 wash bottles, hexane
 - ◆ 2 wash bottles, acetone
 - ◆ 1 H₂S monitox with gas generator
 - ◆ 1 HCN monitox with gas generator
- Source of pressurized air (100 psi and 8 CFM) and air hoses for air drill and remote pneumatic drum punch.

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STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site															
Subject: Operation of the MultiRAE Multi-Gas Monitor															
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1.0 PURPOSE

This Standard Operating Procedure (SOP), presents the methodology for operation of the MultiRAE Plus Multi-Gas Monitor, is to be employed when performing general area or workplace at the FUSRAP Maywood Superfund Site (FMSS).

This SOP describes the procedures for calibrating, performing daily response checks, and documenting workplace surveys using the MultiRAE Plus. This SOP also addresses basic maintenance of the instrument.

2.0 SCOPE

This procedure presents the proper methods of collecting data using the MultiRAE Plus. The MultiRAE Plus is capable of detecting combustible gases, most ionizable gases, O₂, CO, and H₂S at the low-ppm level. Selection of site-specific sampling locations and specific sampling technique(s) is dependent on the health and safety requirements/data objectives for a specific task.

Consult the task-specific Safety and Health Plan or other applicable work plan(s) for atmospheric sampling locations and techniques. Field changes to this SOP shall be discussed with the Project Chemist and Site Safety and Health Officer (SSHO) prior to implementation and shall be documented in project field logbooks. All changes shall be made in accordance with the Maywood Contractor Quality Control Plan.

3.0 REFERENCES

Rae Systems, "Operation and Maintenance Manual", May 1999.
 Ness, S., "Air Monitoring for Toxic Exposures", Van Nostrand Reinhold, 1991
 US Army Corps of Engineers, EM-385-1-1, Safety and Health Requirements Manual, Sept. 1996
 FMSS Site Safety and Health Plan

4.0 DEFINITIONS

Photoionization Detector (PID)

A survey instrument consisting of a pump or fan that draws an air sample past a sealed UV light source that emits photons with an energy level high enough to ionize many organic and some inorganic compounds. The ion current produced by the sample is proportional to mass and thus concentration.

Ionization Potential (IP)

The energy required to displace an electron and ionize a compound, measured in electron volts (eV). For example, benzene has an IP of 9.24 eV. The IPs of contaminants of concern must be less than the energy of the UV lamp of the PID (typically 10.6 eV) in order for them to be detected by the PID.

Parts per million (ppm) by volume

A common unit of concentration meaning one unit volume contaminant per million unit volumes of clean air.

Response, or “bump” test

Action in which a reference standard gas, or “span gas”, of known concentration is introduced to a survey instrument. If the instrument responds within a predetermined range of acceptability, then the instrument is ready for field use. If the instrument fails the bump test, then a formal calibration (see below) is required before using the instrument.

Calibration (specific to this instrument)

A calibration is required if the instrument fails the bump test. This involves placing the instrument in calibration mode and applying the applicable gas(es). The instrument then “returns” any errant sensors to respond within the acceptable range which has been present upon initial receipt of the instrument (see Attachment 2, “Span Gas Reading” line for acceptable ranges).

5.0 RESPONSIBILITIES

5.1 SITE SAFETY AND HEALTH OFFICER (SSHO)

All field activities must be carried out in accordance with the SSHP. The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.2 RADIATION SAFETY OFFICER (RSO)

- Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

- Reviews and approves industrial hygiene training programs involving direct-reading air monitoring instrumentation.
- Reviews completed air monitoring paperwork and directs corrective action, if needed.

5.3 PROJECT RADIATION PROTECTION TECHNICIANS (RPTs)

- Ensure proper performance of direct-reading air monitoring instrumentation through daily inspections and response checks.
- Perform workplace surveillance activities using direct-reading air monitoring instrumentation when required by project procedures, as directed by the RSO or SSHO, or when requested by site personnel to investigate an unusual occurrence.
- Properly document workplace surveillance activities on the appropriate paperwork.
- Are familiar with established alarm protocols and alert site personnel to any potential hazards in case of a release of volatile chemical compounds.
- Perform and document required maintenance on direct-reading air monitoring instrumentation to the extent allowable by the manufacturer.

6.0 PROCEDURE

6.1 PRECAUTIONS AND LIMITATIONS

The MultiRAE Plus has been classified as intrinsically safe in areas classified as hazardous due to the presence of flammable gases and vapors. Only properly trained and authorized personnel are permitted to operate industrial hygiene instrumentation.

6.1.1 Combustible Gas Measurement

Oxygen-deficient atmospheres may cause readings of combustible gas lower than actual concentrations. Oxygen-enriched atmospheres may cause readings of combustible gas higher than actual concentrations.

6.1.2 Photionization Detector (PID)

A PID is a general survey instrument only. It is capable of detecting a large number of volatile airborne contaminants but cannot distinguish between them. For most areas within the FMSS assume an atmosphere with a mixture of unknown contaminants at unknown concentrations.

Alarm protocols should be determined by a trained professional, e.g. CIH, CSP. Safety and health technicians shall be trained to correctly interpret PID readings.

PID's are affected by high humidity environments and may take longer to stabilize in such conditions and may be under or over-responsive to airborne contaminants.

The PID is limited by the ionization energy of its UV lamp. Compounds with an ionization potential (IP) greater than the energy of the UV lamp will be very poorly detected, if at all, by the PID

6.2 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR MULTIPLE GAS AIR MONITORING (DIRECT READING)

The following is a list of equipment & material which is commonly used during air sampling activities. Refer also to related SOP equipment & material requirements to ensure completeness.

- MultiRAE Plus Multi-Gas Monitor
- Standard reference calibration gas (typically isobutylene for PID check, quad gas "cocktail" for LEL, O₂, CO, and H₂S) cylinders
- Appropriate flow regulators for gas cylinders
- Tedlar sampling bags, Tygon tubing, and calibration adapter (supplied with instrument)
- Appropriate paperwork for documentation of field checks and survey data
- SSHP. To be read and signed by all site personnel prior to site activities
- Personal Protective Equipment

6.3 GENERAL AIR MONITORING PROCEDURES

6.3.1 Instrument Setup

1. Ensure that the instrument has been sufficiently charged (overnight) to operate throughout an average workday. A fully charged instrument should run up to ten hours continuous operation.
2. Perform a visual inspection of the instrument making sure all components are in sound condition and that alarming LEDs and buzzers are functioning normally.
3. Press the [ON] key to activate the unit. Allow about a minute for the instrument to complete its self-diagnostics routine.
4. During the self-diagnostics routine, the instrument will display the current time and date. Verify the accuracy of the time and date. Refer to Section 6.5.5 if the time and date are not correct.

5. After the self-diagnostics routine, the MultiRAE will place itself in normal run mode in which instantaneous gas concentration readings for all installed sensors will be displayed. Allow the MultiRAE to run normally for a few minutes in a clean atmosphere before making a background determination.

6.4 INSTRUMENT RESPONSE CHECKS

6.4.1 Daily Response, or “Bump” Test

1. Background Determination:

- Use clean, ambient air for a background reference. The interior atmosphere of the instrument trailer may be appropriate for a background reference. Record these ambient atmosphere measurements in the “Background” readings sections of the “IH Field Check Form” (see Attachment 2).

2. Bump Test – VOC:

- Obtain a cylinder of standard reference gas (typically 100 ppm isobutylene) equipped with a flow regulator and a length of Tygon tubing fitted with the MultiRAE calibration adapter.
- Connect the tubing to the gas inlet probe of the PID, open the flow regulator on the cylinder, and view the instrument’s display. Allow a few seconds for the readings to stabilize.
- The acceptable range of the instrument’s response is the concentration of the span gas + 20%. For example, for 100 ppm isobutylene, the acceptable instrument reading range is 100 ppm – 120 ppm.

3. Bump Test – O₂, LEL, CO, H₂S:

- Obtain a Tedlar bag filled with “quad” gas.
- Attach a calibration adapter to the inlet of the MultiRAE.
- Attach a length of Tygon tubing to the Tedlar sample bag and connect to the calibration adapter. Open the Tedlar bag and allow the monitor to sample the quad gas.
- After about one minute, the instantaneous gas concentration readings should be stabilized. Verify that the LEL, CO, H₂S, and O₂ readings are within acceptable limits. Acceptable ranges for these sensors are defined on the “IH Field Check Form”.

- If the instrument does not properly respond during the “bump” test, then a formal calibration must be performed. (see Section 6.4.2 below)

Refer to Section 6.6 for documentation requirements of these aforementioned procedures.

6.4.2 Calibration

- Background Zeroing: From the normal run mode, press the [MODE] key while holding down the [N/-] key. After about four seconds, a message will appear in the display “Calibrate Monitor?”
- Press the [Y/+] key to initiate calibration.
- The message, “Fresh Air Calibration?” will appear in the display. Ensure that the instrument is in a truly clean ambient atmosphere before zeroing. Press the [Y/+] key to begin the automatic fresh air calibration. The instrument will display all installed sensor values adjusted to zero and 20.9% oxygen.
- The instrument will automatically cycle into the next step of the calibration with the displayed message “Multiple Sensor Calibration?”. Press the [Y/+] to continue calibration. The sensors to be calibrated (all but the VOC) will be displayed onscreen as well as the prompt “OK?”. Press the [Y/+] to continue.
- Connect a Tedlar bag containing the quad gas described above to the instrument via the calibration adapter. Open the valve and allow the monitor to calibrate—a one minute process.
- The monitor will display all recalibrated sensor readings which should fall within the acceptable ranges listed on the “IH Field Check Form”. Record these values on this form.
- The monitor will then display “Single Sensor Calibration?”. Press the [Y/+] key. The instrument will then display all the installed sensors on the screen. Move the blinking cursor to the “VOC” position by pressing the [MODE] key. Press the [Y/+] key again to begin the calibration.
- Follow the instructions in the display, connecting the isobutylene supply to the calibration adapter.
- Document calibration events on the “IH Instrumentation Maintenance Log.” (see Attachment 3).

6.5 INSTRUMENT OPERATION

6.5.1 Selecting On-Screen Displays

- The MultiRAE is placed into “Program” mode upon receipt to the site. This mode allows the user to display all available information, perform calibrations, and change parameters, if necessary. In this mode, the instrument will display twelve different screens in “round robin” order when the [MODE] key is pressed.

Instantaneous=>sensor names=>peak values=>minimum values=>STEL>
TWA=>battery voltage=>clock=>datalog options=> LEL/VOC =>printer
=>PC communication=>instantaneous

- To choose a specific reading, press the [MODE] key repeatedly until the desired screen is displayed. .

6.5.2 Datalogging: Datalogging operation of the MultiRAE is manually initiated.

- Toggle through the display menu by pressing the [MODE] key until the “Start Datalog?” prompt message is displayed.
- Press the [Y/+] key to activate datalogging.
- Press the [Y/+] key while the “Stop Datalog?” message is displayed to turn off datalogging.
- Recorded data can be downloaded to a PC after field use using the supplied software.
- To clear all previously stored data, turn the unit on while pressing the [MENU] key. The display will show “CLr” to indicate that the data has been cleared.

6.5.3 Alarm Limits and Signals

- The MultiRAE Plus has been programmed at the factory and on-site with alarm limits specific to the FMSS Site Safety and Health Plan.

Gas	TWA ppm	STEL ppm	Low Alarm	High Alarm
O ₂	N/A	N/A	19.5%	23.5%
LEL	N/A	N/A	10%	20%
CO	35	100	35 ppm	200 ppm
H ₂ S	10	15	10 ppm	20 ppm
VOC	5	10	5 ppm	10 ppm

6.5.4 Backlighting

- To activate the display backlight, press the [N/-] key for one second in normal operation. To deactivate the backlight, press the [N/-] key again. Use the backlight only when necessary as it is a significant drain on the battery.

6.5.5 Time Set

If the battery is completely drained or is disconnected from the monitor for more than 30 minutes, the internal real time clock will be lost and must be reset using the following procedure.

- From the normal operating mode, press the [MODE] key while holding down the [N/-] key. After about four seconds, the display will prompt “Calibrate Monitor?” Press the [N/-] key, and twice again until the display prompts, “Change Monitor Setup?”. Press the [Y/+] key.
- Press the [N/-] key four times until the menu display prompts “Change Real Time Clock?” Press the [Y/+] to begin clock set.
- Press the [Y/+] or [N/-] key to adjust characters in the time and date highlighted by the blinking cursor.
- After the correct time and date have been set, press the [MODE] key to complete. The display will prompt “Save?”. Press the [Y/+] key.
- Press the [MODE] key twice to return to the normal measurement mode.

6.6 DOCUMENTATION

6.6.1 Field Checks

- Record pre- and post-use survey results on “IH Field Check Form” (see Attachment 2). Ensure that all sections of the form are complete. Submit to immediate supervisor for review.

6.6.2 Workplace Surveys

- Record workplace survey results on “Air Monitoring Data Sheet (see Attachment 1). Ensure that all sections of the form are complete. It may be necessary to reference HWP Access Registers to obtain employees’ hours inside a radiologically controlled area. Submit to immediate supervisor for review.

6.7 MAINTENANCE

6.7.1 Battery

- When the display flashes “bAt”, the battery requires recharging. To recharge the unit, turn off power to the unit.
- Open the rubber cover on the bottom side of the unit and connect the AC adapter to the jack. When the LED indicator turns green, the unit is fully charged.
- A fully charged MultiRAE should provide ten hours of continuous operation.

6.7.2 Sensor Replacement

- The MultiRAE provides an automatic warning if any of the installed sensors are nearing the end of their operating lives.
- Replace expired sensors following the procedures described in Section 7.2 of the MultiRAE Operation and Maintenance Manual.

6.7.3 Water and dust trap replacement

- Visually inspect the water/dust trap filter connected to the gas inlet port about once a week for residue build-up.
- If dirty, remove the water trap/dust filter and insert a new one into the inlet port ensuring a snug fit.
- Reattach probe assembly and check for air leakage.

6.7.4 PID Lamp

If the lamp does not turn on or there is excessive film build-up on the lamp window, the unit will display a message of “Lamp” to indicate that a cleaning or replacement of the lamp may be required. Refer to Section 7.4 of the MultiRAE Plus Operation and Maintenance Manual for lamp cleaning and replacement instructions.

7.0 ATTACHMENTS

1. “Air Monitoring Data Sheet”
2. “IH Field Check Form”

[illegible]

[illegible]

ATTACHMENT 2

IH FIELD CHECK FORM
DIRECT READING INSTRUMENTS

Site Name: FMSS Date: _____

Instrument Model: Multi Rae Serial #: _____

Battery Check: sat ____ unsat ____ Alarm Check: sat ____ unsat ____

Pre-use Check Time: _____ Post-use Check Time: _____

Calibration Gas: Isobutylene Concentration: 100 ppm
Bkg/Zero Reading: _____ Bkg/Zero. Reading: _____
Span Gas Reading: _____ (100-120 ppm) Span Gas Reading: _____ (100-120 ppm)

Calibration Gas: LEL (Methane) Concentration: 29%
Bkg/Zero Reading: _____ Bkg/Zero. Reading: _____
Span Gas Reading: _____ (29%- 35% OK) Span Gas Reading: _____

Calibration Gas: Oxygen Concentration: 15.0 %
Bkg/Zero Reading: _____ Bkg/Zero. Reading: _____
Span Gas Reading: _____ (13%-17% OK) Span Gas Reading: _____

Calibration Gas: Carbon Monoxide Concentration: 60 ppm
Bkg/Zero Reading: _____ Bkg/Zero. Reading: _____
Span Gas Reading: _____ (60 - 72 ppm OK) Span Gas Reading: _____

Calibration Gas: Hydrogen Sulfide Concentration: 10 ppm
Bkg/Zero Reading: _____ Bkg/Zero. Reading: _____
Span Gas Reading: _____ (10-12 ppm OK) Span Gas Reading: _____

Remarks: _____

Technician (s): _____ (print) Signature (s): _____

Technician (s): _____ (print) Signature (s): _____

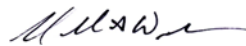
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STANDARD OPERATING PROCEDURE

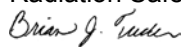
FUSRAP Maywood Superfund Site

Subject: Operation of the TVA-1000 Photoionization / Flame Ionization Detector

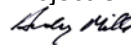
APPROVED:

 9/30/2003

Mike Winters
Radiation Safety Officer Date

 9/30/2003

Brian Tucker
Project Chemist Date

 9/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This Standard Operating Procedure (SOP), Operation of the TVA-1000 Photoionization / Flame Ionization Detector, is to be employed when performing general area screening for potential chemical contaminants of concern (COCs) at the FUSRAP Maywood Superfund Site (FMSS).

This SOP describes the procedures for calibrating, operating, and maintaining the TVA-1000 Photoionization / Flame Ionization Detector, and documenting general area screening for COCs.

2.0 SCOPE

This SOP describes the procedures for calibrating, operating, and maintaining the TVA-1000 Photoionization / Flame Ionization Detector, and documenting general area screening for COCs. Field changes to this SOP shall be discussed with the Project Chemist and Site Safety and Health Officer (SSHO) prior to implementation and shall be documented in project field logbooks. All changes shall be made in accordance with the Maywood Contractor Quality Control Plan.

3.0 REFERENCES

Foxboro, Instruction Book 3455, August 1993.

Foxboro, Foxboro Response Factor Manual.

Foxboro, Foxboro DustTrak Operation and Service Manual

Ness, S., Air Monitoring for Toxic Exposures, 1991.

4.0 DEFINITIONS

Photoionization Detector – A survey instrument consisting of a pump or fan that draws an air sample past a sealed UV light source that emits photons with an energy level high enough to ionize

many organic and some inorganic compounds. The ion current produced by the sample is proportional to mass and thus concentration.

Flame Ionization Detector - A survey instrument consisting of a stainless steel burner in which hydrogen is mixed with incoming sample air and ignited. Ionized carbon fragments are collected on a negative platinum electrode. As positive ions are collected, a proportional current is generated on the input electrode, which is then translated to an analog or digital readout.

Parts Per Million (ppm) by volume - A common unit of air concentration meaning one unit volume contaminant per million unit volumes of clean air.

Response of "Bump" Test - Action in which a span gas of known concentration is introduced to a survey instrument. If the instrument's readout falls within an acceptable range, the instrument is responding correctly. If the instrument's readout does not fall within an acceptable range, then a calibration (see below) must be performed.

Calibration - The process by which a user of the instrument physically adjusts the instrument's electronics to respond to a span or reference gas at a level selected by the user.

5.0 RESPONSIBILITIES

5.1 SITE SAFETY AND HEALTH OFFICER (SSHO)

All field activities must be carried out in accordance with the Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the task.

6.0 NOTES AND PRECAUTIONS

- Only properly trained and qualified personnel are authorized to operate this instrument unless in training with a qualified supervisor.
- The TVA-1000 is a general screening instrument only. It is capable of detecting a large number of airborne contaminants but cannot distinguish between them. For most FUSRAP sites, assume an atmosphere with a mixture of unknown contaminants at unknown levels. Use a value of 5 ppm above background as a point where work in the affected area is halted and the situation is re-evaluated.
- PIDs are sensitive to humidity extremes. The PID will take longer to stabilize in humid conditions and may be under-responsive or over-responsive to organic contaminants. Deactivate the PID portion of the TVA-1000 in environments with a relative humidity greater than 95%.

- Although the TVA-1000 has been approved by three nationally recognized industrial hygiene certification laboratories for use in areas classified as hazardous due to the presence of flammable gases or vapors, NEVER connect any electrical device (such as battery charger, analog output, personal computer, or auxiliary port device) to the instrument in an area classified as hazardous due to the presence of flammable gases or vapors.

7.0 INSTRUMENT SET-UP, OPERATION, AND DOCUMENTATION

7.1 REQUIRED EQUIPMENT

Span gases, typically isobutylene for PID and methane for FID.

Documentation: IH Field Check Form, FUSRAP S-023 "Air Monitoring Data Sheet" (see Attachment 1).

7.2 SET-UP

- Ensure that the battery has been charged overnight and that the hydrogen tank has been filled before setup and calibration.
- Press ON to activate the unit and begin internal diagnostics check.
- Press the CONTROL key after the self-test diagnostics is completed and after the main menu is displayed. From the CONTROL MENU, select '1' to turn pump on and allow to run for at least one minute.
- If FID operation is desired, turn the hydrogen supply valve to the 'ON' position and let instrument run for at least 30 seconds. Next, press the CONTROL key again and select '2' from the menu to ignite the FID. You will hear a brief pause in pump operation as the flame is being lit. Should the flame extinguish during operation, a beep will sound and a warning message will be displayed on the analyzer case. Press CONTROL again, and repeat above process. The Main Menu will be then be displayed.
- Select '2' from the Main Menu to enter the SETUP mode. Press '2' from the SETUP menu to verify correct alarm levels settings or adjust, if necessary. Typically, a High Ceiling alarm level of 5 ppm is sufficient for general workplace monitoring in unknown atmospheres (See Section 6.0, bullet 2). Verify alarm levels with the Site Safety and Health Officer (SSHO) or Radiation Safety Officer (RSO). Press EXIT to back out of submenus and return to the SETUP mode main display.
- Verify User ID, date, and time of day settings by selecting '5' from the SETUP menu. To change settings, follow the menu prompts, entering the correct information one character at a time on the alphanumeric touchpad on the analyzer case. If an error is made during a setting change, press EXIT to erase the last mistake and continue the entry.
- Press '3' to access the Datalogging submenu of the SETUP menu. This section specifies the datalogging mode and rate. See the TVA-1000 instruction manual (pp. 36 – 39) for specific instructions on datalogging. Typically, automatic data logging is not necessary unless constant air monitoring is required such as in a

confined space entry. Again, press EXIT to return to the SETUP menu to begin calibration.

7.3 CALIBRATION

- Calibrate the TVA-1000 before and after each day's use. Press '1' from the SETUP menu to access the calibration submenu.
- NOTE: The TVA-1000 must be on and warmed up for approximately 30 minutes prior to calibration. If the FID will be used, the flame must be ignited throughout this warm-up period.
- The factory default setting is AUTO calibration mode and the following steps assume this mode.
- Calibrate a ZERO or BACKGROUND reference point: From the SETUP menu, press '1' to access the CALIBRATION submenu. Press '1' if a zero gas is to be used for the zero reference point or press '2' if clean ambient air is to be used. Typically, clean ambient air is used as a zero reference point on most FUSRAP sites. The menu display will then prompt the user to specify the detectors to be calibrated. Press '1', '2', or '3' to select FID and PID, PID only, or FID only, respectively. If using both detectors, set the zero reference point for both at the same time. The menu will then prompt the user to apply the zero (or background) gas. Press ENTER to start. Wait for the 'ACCEPTED' message to appear in the display and the CALIBRATION menu to reappear. [NOTE: The FID should be re-zeroed every time the hydrogen supply valve is turned on.]. Record the background readings on the Air Monitoring Data Sheet (Attachment 1) under the appropriate headings.
- Calibrate a reference point with a known span gas: Press '3' from the CALIBRATION menu to access the Span Cal submenu. This procedure is very similar to the zero reference setting, except that span gases are used instead of a zero gas. If using both detectors, two separate span reference settings must be performed, using isobutylene for the PID's span reference and methane as the FID's span reference. Press '2' to span reference the PID. The menu display will prompt the user to apply span gas. Apply isobutylene to the sampling probe via Tygon tubing attached to a clean Tedlar sampling bag filled with isobutylene. Press ENTER to start the calibration and wait for the 'ACCEPTED' message. Quickly press EXIT twice to back up to the Main Menu, then press '1' to enter 'Run' mode. Document the PID reading on the Air Monitoring Data Sheet as the Span Gas Reading value. If an FID is being calibrated, press '2' to enter the SETUP menu, then '1' to access the 'Calibration' submenu, then '3' to enter 'Span' submenu, then '3' again to span reference the FID. Perform activity same as above, except use methane as the span gas. After the calibration is accepted, quickly press EXIT twice to return to the Main Menu, then press '1' to enter 'Run' mode. Record the FID reading on the Air Monitoring Data Sheet.
- Define the span gas concentration: From the calibration menu display, press 4 = Gas Conc. Verify the span gas concentration values for the detector(s) being calibrated. Unless the instrument is being used for the first time, or a new type of span gas is used, this parameter should already be correctly entered into the instrument's memory. Follow the on-screen prompts if the value needs to be changed.

- Define the response factor: If the TVA-1000 will be used to monitor for a single gas other than the span gas used for each detector, the response factor for the chemical of interest (located in the Foxboro Response Factor Manual) should be entered into the TVA-1000's settings. Press '5' from the CALIBRATION menu display, to access the Response Factor submenu. Follow the on-screen prompts to change response factors for one or both detectors. Press EXIT three times to return to the Main Menu. Press '1' to enter the RUN mode. The TVA-1000 should now be properly configured for surveying activities.

7.4 OPERATION

While operating this instrument in the field, you normally carry the TVA-1000 at your side, using the shoulder strap. After proper setup and calibration, with the pump on, detector ignited, and the unit warmed up, you direct the probe at suspect areas within the survey area. You can toggle the display between detector types by pressing the DET button on the probe. Press the LOG button to begin logging the survey data (if desired). The probe display may be backlit by pressing the lamp button. To use the TVA-1000 for continuous analysis of gases, place the instrument in a convenient location, turn on the unit and pump, and set an alarm level. Activate datalogging mode if a continuous record of survey data is required (see last bullet of Section 7.2).

7.5 DOCUMENTATION

Record survey readings on FUSRAP Form S-023 , "Air Monitoring Data Sheet" (see Attachment 1). Ensure that all sections of the form are complete, especially employees present, employee's company, hours present in area, description of work activity, instrumentation information, survey location and remarks, time of survey, and the organic vapor levels. Obtain employees' hours in area from the Controlled Area Access Register.

8.0 MAINTENANCE

From time to time, you must remove and renew several components of the TVA-1000 analyzer. Some components may be replaced as normal maintenance functions performed by operating personnel. The components that may be maintained or replaced by operating personnel as part of normal operation are:

1. Battery – Charge the battery in or out of the instrument or replace it with a charged battery.
2. Hydrogen Tank – Remove the tank to refill it. If unfamiliar with the hydrogen refill procedures, refer to pp. 48 – 50 of the TVA-1000 instruction manual (See Section 3.0, References). Observe all safety precautions. Allow no leaks during refilling.
3. PID Cartridge – Remove and clean frequently. Replace when needed.
4. FID Cartridge – Remove and clean frequently. Replace when needed.
5. Sintered Metal Filter in the sampler assembly and sidepack assembly – Clean or replace frequently.
6. Sample line tubing – Replace when dirty.
7. FID End Cap and Flame Arrestor – Remove and clean frequently. Replace when required.

8. FID Cavity – Clean periodically.

9. PID Cavity – Clean periodically.

All other maintenance should be performed by trained or factory personnel.

9.0 ATTACHMENT

Attachment 1 – Air Monitoring Data Sheet

SITE:		WEATHER CONDITIONS:		DATE:	
PERSON PERFORMING MONITORING:					
EMPLOYEES PRESENT:		HRS PRESENT:	EMPLOYEE'S COMPANY:	INSTRUMENT INFORMATION	
				TYPE	SERIAL NO.
INSTRUMENTS CALIBRATION		PPE IN USE:		PROCESS:	
YES [] NO []					

[illegible]

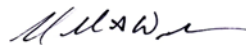
[illegible]

STANDARD OPERATING PROCEDURE

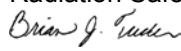
FUSRAP Maywood Superfund Site

Subject: Operation of the TSI DustTrak™ Aerosol Monitor

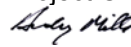
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This Standard Operating Procedure (SOP), Operation of the TSI DustTrak™ Aerosol Monitor, is to be employed when performing general area or workplace surveys at the FUSRAP Maywood Superfund Site (FMSS).

This SOP describes the procedures for calibrating, operating, and maintaining the DustTrak™ aerosol monitor and documenting workplace surveys.

2.0 SCOPE

This procedure presents the proper methods of collecting data using the DustTrak™ Aerosol Monitor. Selection of site-specific sampling locations and specific sampling technique(s) is dependent on the objectives of the health and safety requirements for a specific task. Consult the task-specific Safety and Health Plan or other applicable work plan(s) for atmospheric sampling locations and techniques. Typical situations in which dust or aerosol monitoring is performed include perimeter compliance monitoring, health and safety coverage during excavations, dust control evaluations, and assessment of the adequacy of PPE. Field changes to this SOP shall be discussed with the Project Chemist and Site Safety and Health Officer (SSHO) prior to implementation and shall be documented in project field logbooks. All changes shall be made in accordance with the Maywood Contractor Quality Control Plan.

3.0 REFERENCES

FMSS Site Safety and Health Plan (SSHP), August 1999.

Ness, S., Air Monitoring for Toxic Exposures, 1991.

TSI DustTrak™ Aerosol Monitor, Operation and Service Manual, 1999.

U.S. Army Corps of Engineers, EM 385-1-1, Safety and Health Requirements Manual.

4.0 DEFINITIONS

Aerosol Monitor - A direct-reading (or “real-time”) survey instrument used as a screening device to estimate total or respirable dust levels. The DustTrak™ is a light-scattering aerosol monitor which continuously senses the intensity of light from the combined scattering of the population of particles present within the sensing volume at a given angle relative to the incident beam as they pass through a sensor cell of defined volume.

Milligrams per cubic meter (mg/m³) - A common unit of air concentration meaning one milligram (1 mg) of airborne particulate per one cubic meter (1 m³) of air.

Calibration (specific to this instrument) - The DustTrak™ is factory calibrated to the respirable fraction standard ISO 12103-1, A1 test dust. This standard test dust is used because of its wide particle size distribution. This makes the internal factory calibration representative of an average of most types of ambient aerosols.

A customized field calibration to a specific aerosol of interest requires a determination of true mass concentration through gravimetric analysis.

5.0 RESPONSIBILITIES

5.1 SITE SAFETY AND HEALTH OFFICER (SSHO)

All field activities must be carried out in accordance with the SSHP. The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.2 RADIATION SAFETY OFFICER (RSO)

- Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.
- Reviews and approves industrial hygiene training programs involving direct-reading air monitoring instrumentation.
- Reviews completed air monitoring paperwork and directs corrective action, if needed.

5.3 RADIATION PROTECTION TECHNICIANS (RPTs)

- Ensure proper performance of air monitoring instrumentation through daily inspections and response checks.
- Perform workplace surveys using the aerosol monitor when required by procedures, as directed by the SSHO, or when requested by sire personnel to investigate an unusual occurrence.
- Properly document workplace surveys on the appropriate paperwork.
- Are familiar with established aerosol action levels and alert sire personnel to any potential hazards in case of a release of airborne particulates.

- Perform and document required maintenance on aerosol monitoring instrumentation to the extent allowable by the manufacturer.

6.0 PROCEDURES

6.1 PRECAUTIONS AND LIMITATIONS

- Only properly trained and authorized personnel are permitted to operate industrial hygiene instrumentation.
- The temperature operating range for the DustTrak™ is 32°F to 120°F.
- The DustTrak™ has been designed to satisfy the requirements for intrinsically safe operation in methane-air mixtures. However, never recharge the DustTrak™ battery pack in a combustible or hazardous atmosphere.
- Exposure to harmful laser radiation may occur if the instrument is opened up. There are no user-serviceable parts inside the instrument. Internal servicing is to be performed by the manufacturer.

6.2 INSTRUMENT SET-UP

1. The user should familiarize himself / herself with the instrument's display, key and switch positions, and connection jacks before operating. Refer to **Figure 1-1 and Figure 1-2** of the DustTrak™ Operation and Service Manual.
2. Ensure that the instrument has sufficient battery reserves by recharging the unit overnight or otherwise as required. The percentage of battery life is displayed after the DustTrak™ completes its self-diagnostic routine after being turned on. A fresh battery pack (100%) provides about 16 hours of continuous operation.
3. Verify correct time and date.
 - Press the ON/OFF key to power unit. The instrument will display the current time and date during the power up.
 - If the time / date is incorrect, press and hold the SAMPLE key while the instrument is displaying the time / date. Release when the instrument beeps.
 - Use the ↑↓ keys to change a setting. Use the SAMPLE key to store each setting and advance to the next one.
4. Perform a visual inspection of the instrument unit making sure all components are in sound condition.

6.3 INSTRUMENT CALIBRATION

1. Zero, or background, level update.

A zero check should be performed each day before the DustTrak™ is used, before running any extended tests, and after the instrument experiences a significant environmental change such as temperature changes and aerosol concentration fluctuations.

- Put the DustTrak™ in Survey mode. The DustTrak™ automatically places itself in Survey mode after initial self-check routine.
- Put zero filter on aerosol sample inlet.
- Set the time constant to 10 seconds. Do this by pressing and holding the TIME CONSTANT key until “10” is displayed, then release.
- Wait 10 – 60 seconds for displayed values to settle to zero. (NOTE: If the zero value cannot be achieved in the allotted time frame, this is an indication that internal maintenance / cleaning is required. The instrument should be tagged “out of service” and returned to the manufacturer for servicing.

2. Factory Calibration

- The manufacturer, TSI, recommends that the DustTrak™ be returned to the factory once a year for cleaning and calibration. This annual “check-up” helps ensure that the DustTrak™ is always in good operating condition.

3. Custom Calibrations

- The DustTrak™ is capable of custom calibrations. However, these types of calibrations require the user to accurately measure the aerosol concentration of interest, typically through gravimetric analysis. These analyses are not anticipated to be performed at the FMSS unless directed and overseen by the SSHO or a project Certified Industrial Hygienist.

6.4 INSTRUMENT OPERATION

6.4.1 Initiating routine measurement operation

- Press the ON/OFF switch. The DustTrak™ will then begin an internal self-check, eventually displaying battery percentage and current time of the internal clock. When the self-check is complete, the DustTrak™ will be in survey mode.
- Measurement readings, in mg/m^3 , are updated every second.

6.4.2 Datalogging

- While in Survey Mode, press the SAMPLE key to initiate a sampling period for which the instrument will compute statistical information such as average, minimum, and maximum concentration values as well as the elapsed time of the sampling period.
- To terminate a sampling period, press the SAMPLE key again. The statistical data for this sample will remain in the instrument’s memory until the next sampling period is initiated.
- The statistical data for the last sampling period may be accessed by pressing the STATISTICS key repeatedly to cycle through the values. Turning the instrument off does not erase this data.

- The operator of the instrument must record the data from the last sampling period before initiating a new sampling period as the old data will be erased and replaced by the new data.

6.4.3 Alarm Limits and Signals

- The DustTrak™ has no alarming buzzers or LEDs. Therefore, the operator of this instrument must be vigilant of instantaneous aerosol concentrations and must be aware of site-specific dust concentration action levels prescribed in the SSHP to prevent possible overexposure to personnel.

6.5 INSTRUMENT MAINTENANCE

Note: There are no user-serviceable parts inside the DustTrak™.

6.5.1 Cleaning

- Wipe the outside of the instrument with a soft, clean cloth. Never use solvents or cleaning solutions of any type.

6.5.2 Battery Pack

- When the DustTrak™ battery pack is discharged, remove the battery cover and slide the battery holder out of the compartment.
- Remove the depleted batteries and replace with 4 C size batteries.
- Hold the wires out of the way and slide the battery holder back into the compartment.
- Tuck the wires in and then re-install the battery cover (see Figure 2-1 in the DustTrak™ Operation Manual).

6.5.3 Sample Tube Cleaning / Internal Filter

- The DustTrak™ keeps track of the accumulated amount of aerosol drawn through it since its last cleaning.
- When sample tube cleaning is due, the display shows the message, "SERVICE 4." Refer to the Maintenance chapter in the Operations Manual for detailed instructions.

6.5.4 Replacement Parts

- A list of replacement parts can be found in Chapter 1 (p.1) of the DustTrak™ Operation and Service Manual.

7.0 ATTACHMENT

Attachment 1 – Air Monitoring Data Sheet

Procedure No.
Revision No.
Date of Revision
Last Issue Date
Page

SOP 403
01
September 2003
October 2002
6 of 7

ATTACHMENT 1
AIR MONITORING DATA SHEET
(DIRECT READING)

SITE:		WEATHER CONDITIONS:		DATE:	
PERSON PERFORMING MONITORING:					
EMPLOYEES PRESENT:	HRS PRESENT:	EMPLOYEE'S COMPANY:	INSTRUMENT INFORMATION		
			TYPE	SERIAL NO.	
INSTRUMENTS CALIBRATION YES [] NO []		PPE IN USE:	PROCESS:		

MONITORING DATA

LOCATION AND REMARKS	TIME	DUST (mg/m ³)	OV (PPM)	LEL (%)	O ₂ (%)	CO (ppm)	H ₂ S (ppm)

ADDITIONAL COMMENTS/OBSERVATIONS/CALCULATIONS

[illegible]

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Calibration and Maintenance of Turbidimeter

APPROVED:

Brian J. Tucker

09/30/2003

Brian Tucker
Project Chemist

Date

Andrew Mills

09/30/2003

Andrew Mills
Project Manager

Date

1.0 PURPOSE

The purpose of this procedure is to provide instructions for obtaining a turbidity measurement of environmental aqueous samples such as groundwaters and surface waters. Turbidity measurements are often used as one of several indicators that tell a sampler when to proceed with sample collection. The turbidity level provides a direct correlation to the amount of suspended solids.

2.0 SCOPE

A Hach Model 16800 Portable Turbidimeter will be used for all turbidity measurements. The Hach 16800 will be operated in the range of 0 to 100 nephelometric turbidity units (NTU). A nickel / cadmium battery with approximately ten hours operating time per charge is built into the 16800 meter. Readings are repeatable to within $\pm 1\%$ of full scale.

3.0 REFERENCES

Hach Model 16800 Portable Turbidimeter Instrument/Procedure Manual

4.0 DEFINITIONS

None.

5.0 RESPONSIBILITIES

5.1 FIELD PERSONNEL

It is the responsibility of the field technicians to understand how to operate, calibrate, and maintain the turbidimeter. The field operations leader must be capable of answering questions about the turbidimeter and reviewing data generated by the turbidimeter.

6.0 PROCEDURE

6.1 STANDARDIZATION

To ensure consistently accurate results, the time during which the turbidimeter is calibrated shall be standardized and documented.

1. Turn the instrument off and check the mechanical zero setting. Adjust the screwdriver adjustment control on the meter face if necessary to obtain a zero-NTU reading.
2. Press the power switch to ON and perform a battery check by pressing the BATT CHECK switch and verifying that the meter indicates in the BATTERY CHECK area. If not, charge the battery pack.
3. Place the focusing template into the cell holder. The focusing template will block all light from reaching the detector and allow the instrument to be zeroed electronically in Steps 4 and 5.
4. Press the 1.0 range switch and adjust the ZERO control for a reading of zero NTU.
5. Press the 10 range switch and verify that the meter still indicates zero NTU. Re-adjust the ZERO control if necessary.
6. Remove the focusing template and place the 90 NTU turbidity standard into the cell holder. Use the black dot on the standard vial to orient the vessel in the same position each time, thereby eliminating variations due to rotation.
7. Place the light shed over the turbidity standard and allow the meter to stabilize.
8. Adjust the SPAN control for a reading of 90 NTU. Remove the light shield and turbidity standard. The instrument is now ready for use.

6.2 TAKING THE TURBIDITY MEASUREMENTS

1. Press the appropriate range switch. Select the range that will exceed the expected turbidity of the sample under test.
2. Place the focusing template into the cell holder and adjust the ZERO control for a reading of zero NTU. Remove the focusing template. In the 100 range, place the cell riser into the cell holder before inserting the test sample.
3. Fill a clean sample cell to the white line with the sample to be measured and place it into the cell holder. Use the white dot on the sample cell to orient the cell in the same position each time. Cover the sample cell with the light shield and allow the meter to stabilize. Read the turbidity of the sample.

6.3 OPERATIONAL NOTES

Appropriate field procedures are as follows:

1. The sample size for all turbidity measurements should be 18 ml. Use the line on the sample cell as a level indicator. Variations in sample volume can affect the accuracy of the determinations.

2. When operating the instrument under bright ambient light conditions, protect the detector between measurements by inserting the focusing template or covering the cell holder with the light shield.

7.0 MAINTENANCE

1. The battery pack will be recharged overnight subsequent to its use in the field.
2. Broken or highly scratched sample cells will be replaced. Small, slight scratches may be covered with a light coat of silicone oil. Cells with a build up of matter which cannot be removed will be discarded.
3. Lamp and focusing adjustments are not considered routine maintenance and will be performed only when the instrument readings are suspect.

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Calibration and Maintenance of Orion Platinum Eh Electrode

APPROVED:

Brian J. Tucker

09/30/2003

**Brian Tucker
Project Chemist**

Date

Andy Mills

09/30/2003

**Andy Mills
Project Manager**

Date

1.0 PURPOSE

The purpose of taking Eh measurements of environmental aqueous samples is for use as a qualitative indicator for characterization and modeling of the environmental aqueous media.

2.0 SCOPE

An Orion Model 260A/260S pH/mV/temperature meter will be used for on-site oxidation-reduction potential (redox) measurement. The 260A/260S meter has resolution capability to 0.1 mV. This procedure describes the operation, including calibration, and maintenance of this meter.

3.0 REFERENCES

Thermo Orion Model 260A/260S pH/mV/temperature meter Operation/Maintenance Manual

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 FIELD PERSONNEL

It is the responsibility of the field technicians to understand how to operate, calibrate, and maintain the Eh meter. The field operations leader must be capable of answering questions about the Eh meter and reviewing data generated by the Eh meter.

6.0 PROCEDURE

Measurements are obtained with an Eh meter to determine the electrochemical potential of aqueous environmental media. The Eh voltage value provides a qualitative indication of the electrochemical nature of the medium; i.e., to what extent the medium is oxidizing or reducing. Checking the electrode is necessary only when there is evidence of malfunction that cannot be

traced to other causes. Fill the electrode with ORION Cat. No. 900011 filling solution for checking procedure. If calibrating, note the time during which the equipment was calibrated.

1. Prepare solution A (0.1 M potassium ferrocyanide and 0.05 M potassium ferricyanide): weigh out 4.22 g reagent-grade $\text{K}_4\text{Fe}(\text{CN})_6 \cdot 3\text{H}_2\text{O}$ and 1.65 g reagent-grade $\text{K}_3\text{Fe}(\text{CN})_6$. Place in a 100 ml volumetric flask. Add about 50 ml distilled water and swirl to dissolve solids. Dilute to volume with distilled water.
2. Prepare solution B (0.01 M potassium ferrocyanide and 0.05 M potassium ferricyanide, and 0.36 M potassium fluoride): weigh out 0.42 g reagent-grade $\text{K}_4\text{Fe}(\text{CN})_6$, 1.65 g reagent-grade $\text{K}_3\text{Fe}(\text{CN})_6$, and 3.39 g reagent-grade $\text{KF} \cdot 2\text{H}_2\text{O}$. Add 50 ml distilled water and swirl to dissolve solids. Dilute to volume with distilled water.
3. Transfer solution A to a 150 ml beaker. Place electrode in the solution and wait until the reading stabilizes. The potential should be about 234 mV.
4. Rinse electrode and repeat the measurement with solution B. The potential should be about 66 mV greater in solution B than in solution A.

7.0 MAINTENANCE

1. When not in use the electrode may be kept in water or air. If left in air, remove salt crystals on the outside of the electrode sleeve by rinsing with distilled water, drain filling solution from chamber, flush out with distilled water, store dry. See cleaning procedure.
2. The electrode can be routinely cleaned without disassembling. To remove precipitate that forms on the outside wall or tip of the electrode, rinse with distilled water. If sample or precipitate clogs the space between the electrode sleeve and the inner cone, clean the chamber by flushing out the filling solution. To do this, invert the electrode to moisten the O-ring. Holding the electrode by the cap with one hand, push the outer sleeve up into the cap with the other hand, allowing filling solution to drain from the chamber. If the chamber is not completely clean, repeat. Fill with filling solution.
3. To remove salt deposits formed inside the electrode:
 - Fill wash bottle to half with distilled water.
 - Invert electrode so that glass membrane points up.
 - Invert the wash bottle so that its bottom points up.
 - Insert nozzle of wash bottle into electrode filling hole and squeeze bottle. Filling will drain out of chamber.
 - Fill chamber with distilled water from wash bottle. Repeat steps 2-4.
 - Continue to repeat steps 2-4 until all salts have been removed.
4. To change the filling solution in the reference chamber, simply clean the electrode and fill with the new solution, using the following procedure:
 - Tip the electrode to moisten the O-ring. Holding the electrode by the cap with one hand, push the sleeve up into the cap with the other hand allowing solution to drain from the chamber.

- Fill the electrode with distilled water and then drain the reference chamber by retracting the sleeve, as explained above. Now perform this filling and draining procedure twice with the new filling solution.
- Fill the electrode with the new solution. Although the electrode is ready for use, readings may drift slightly for about a half hour while the electrode equilibrates with the new solution.

8.0 DOCUMENTATION

All instrument calibrations will be documented by recording the meter readings before and after the meter has been adjusted. The electrode filling solutions used to calibrate the meter will also be documented. This is important to establish maintenance schedules and component replacement.

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Calibration and Maintenance of In-Situ Hermit Environmental Data Logger

APPROVED:

Brian J. Tucker

09/30/2003

**Brian Tucker
Project Chemist**

Date

Andy Mills

09/30/2003

**Andy Mills
Project Manager**

Date

1.0 PURPOSE

An In-Situ HERMIT Environmental Data Logger, Model SE1000B or equivalent, will be used on site in conjunction with an In-Situ pressure transducer (PXD-260, PTX-160D or PTX-161D), to record water level changes during pump testing.

2.0 SCOPE

The scope of this procedure is measurement of water levels during pump testing phase of well development.

3.0 REFERENCES

In-Situ HERMIT Environmental Data Logger, Model SE1000B or equivalent
Operations/Maintenance Manual

4.0 DEFINITIONS

None.

5.0 RESPONSIBILITIES

FIELD PERSONNEL

It is the responsibility of the field technicians to understand how to operate, calibrate, and maintain the data logger. The field operations leader must be capable of answering questions about the data logger and reviewing data generated by the data logger.

6.0 OPERATION

The front panel controls of the HERMIT consist of a five digit liquid crystal display and an eight key keypad. The keys are divided into two groups: the white keys for basic operations and the blue keys for data entry and modification. Basic operations include CLOCK, XD (short for transducer) and DATA; each of which can be accessed with a single keystroke. Data modifying

operations such as START, STOP and changing test parameters require a sequence of keystrokes to prevent their accidental use.

7.0 MAINTENANCE

There are no customer serviceable parts inside the SE1000B. The unit should require no calibration or periodic maintenance during its service life. It should not be necessary to clean the connectors or cable contacts. The action of installing the cables is normally sufficient to clean contamination from the contacts. The front panel may be wiped clean with a soft, damp cloth.

8.0 BATTERY REPLACEMENT

The battery pack used in the SE1000B is of special design, requiring that the unit be returned to In-Situ's customer service facility for replacement. Permanent damage to the unit can result from improper replacement packs and procedures. When the low battery indicator appears in the display, the unit has approximately ten hours of "wake" time left. External power may be used to supplement battery power until the unit can be returned for a replacement pack.

9.0 SERVICE

The SE1000B may need to be returned for service if any of the following symptoms appear:

1. A display of the form "Err.20" indicates that the unit does not pass its internal self tests. The unit will not permit itself to be used for data collection, and data already stored in the unit are inaccessible (upon waking up, the unit will display the error and immediately go back to sleep).
2. An unusually high number of watchdog counts may indicate an intermittent problem. The unit may be used for data collection but should be returned for a checkup as soon as possible.
3. A low battery condition is indicated in the display. The unit will typically finish the current test and store the data. Long term tests should not be started when the unit is in this condition.

If symptoms other than these are apparent, check the cable interconnections and the programming of the SE1000B before requesting service on the unit. One incorrect scale factor or coefficient setting can cause incorrect data results.

STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site

Subject: Calibration and Maintenance of Solinst Interface Meter

APPROVED:

Brian J. Tucker

09/30/2003

**Brian Tucker
Project Chemist**

Date

Andy Mills

09/30/2003

**Andy Mills
Project Manager**

Date

1.0 PURPOSE

The purpose of this procedure is to provide instructions for measurement of the location of the air-water interface within a groundwater monitoring well.

2.0 SCOPE

This procedure is applicable to all Maywood groundwater monitoring wells.

3.0 REFERENCES

Solinst Model 121 Interface Meter Operations/Maintenance Manual

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

FIELD PERSONNEL

It is the responsibility of the field technicians to understand how to operate, calibrate, and maintain the interface meter. The field operations leader must be capable of answering questions about the interface meter and reviewing data generated by the interface meter.

6.0 PROCEDURE

The Solinst Model 121 Interface Meter works with an infrared circuit that detects the presence of a liquid. A conductivity circuit differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or DNAPL product).

Before commencing any measurements, carry out the following electronics and battery condition checks.

1. Turn the main switch on (main switch is a toggle switch on reel faceplate). The steady tone and two lights will be activated (as long as the probe switch is off, but the main switch is on).
2. Remove the probe from the holder and turn the probe switch on (probe switch is the knurled ring at the top of the probe). A steady tone and illumination of two lights indicate that the device is activated.
3. The infrared circuit is checked by inserting the cleaning brush into the base of the probe until it reaches the zero measurement point (the zero measurement point is the junction between the stainless steel body of the probe and the brown Teflon/Delrin base plug). This cuts the infrared beam causing the steady tone and two lights to activate.
4. The conductivity circuit is checked by inserting the probe into normal tap water, as far as the measurement zero point. This causes a single and intermittent tone to activate.

7.0 MAINTENANCE

After each use, the tape should be wiped clean and carefully rewound onto the reel. The probe should be cleaned as follows:

1. Wash probe thoroughly with Alconox detergent;
2. Using a cleaning brush through the side and base holes to remove all product from the inner part of the probe;
3. Use steel wool to scrub the bottom pin;
4. Rinse the probe thoroughly with distilled water and wipe dry; and
5. Return the probe to the holder, ensuring that both switches are turned off.

NOTES:

- Battery will drain rapidly if probe is left on.
- Do not drop probe; damage to probe tip may result.
- O-ring seals may be affected by the use of cleaning fluids other than detergent and water.

To replace battery inside reel:

1. Remove three screws in faceplate and carefully lift to one side to prevent damage to wiring.
2. Replace with specified battery, noting proper polarity.
3. Replace faceplate and three screws, being careful to keep all wires within the hub.

To replace probe battery:

1. Remove three screws (Phillips type) at top of probe.
2. Gently pull body apart to expose the batter holder.
3. Remove and replace battery with type specified.
4. Ensure correct polarity.
5. Check O-rings for damage and replace if necessary.
6. Lubricate O-rings lightly with non-petroleum based lubricant prior to reassembly and push

probe body back together ensuring that the three wire connector is placed below the battery in the slot provided prior to reassembly of the probe.

7. Replace Phillips screws but do not over tighten.

WARNING:

LOW BATTERY IN PROBE CAN RESULT IN WATER LIGHT STAYING “ON”.

NOTE:

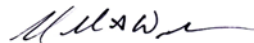
ALWAYS REPLACE BOTH BATTERIES AT THE SAME TIME.

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: On-site Water Quality Testing

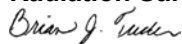
APPROVED:



09/30/2003

Mike Winters
Radiation Safety Officer

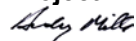
Date



09/30/2003

Brian Tucker
Project Chemist

Date



09/30/2003

Andy Mills
Project Manager

Date

1.0 PURPOSE

This Standard Operating Procedure (SOP) includes methods for conducting onsite water quality testing at the FUSRAP Maywood Superfund Site (FMSS). This Procedure provides the methods for identifying and quantifying water quality characteristics so that the appropriate level of protection may be determined. The purpose of this procedure is to ensure that onsite water quality testing is conducted using well-developed techniques and methods consistently at the FMSS.

2.0 SCOPE

This procedure describes the methods required to measure the following parameters in an aqueous field sample:

- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen (DO) Concentration

3.0 REFERENCES

Horiba Model U-10 Water Quality Checker Operations Manual, Horiba Inc., 2003.

4.0 DEFINITIONS

pH

The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration.

pH Paper

Paper that turns different colors depending on the pH of the solution to which it is exposed. Comparison with color standards supplied by the manufacturer will then give an indication of the solution pH.

Resistance

The measure of a solution's ability to oppose the passage of electrical current. For metals and solutions, resistance is defined by Ohm's law, $E = IR$, where E is the potential difference, I is the current, and R is the resistance.

Electrolytic Cell

An electrochemical cell in which chemical energy is spontaneously converted to electrical energy. The electrical energy produced is supplied to an external circuit.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

The Project Manager, in consultation with the Project Geochemist, is responsible for determining which on-site water quality measurements can contribute to the Remedial Investigation, when these measurements shall be made, and the data quality objectives (DQOs) for these measurements. The Project Operations Plan (POP) shall contain details of type, frequency and locations of the desired measurements.

5.2 PROJECT HYDROGEOLOGIST

The Project Hydrogeologist is primarily responsible for determining the type, frequency and locations for on-site water quality measurements as presented in the POP and for interpreting the results, including determination of which measurements are unrepresentative.

5.3 PROJECT SUPERINTENDENT

The Project Superintendent is responsible for implementing this SOP, and also for deciding under what field conditions a particular on-site measurement will be unrepresentative or unobtainable.

5.4 PROJECT ENVIRONMENTAL SAMPLERS

The Project Environmental Samplers are responsible for the actual analyses that take place, including calibration, quality control and recording of results, as well as for the care and maintenance of the equipment in the field.

6.0 GUIDELINES

6.1 MEASUREMENT OF PH

6.1.1 pH Paper (Litmus paper)

pH measurement using pH papers relies on a chemical reaction of hydrogen ions (acidity) or hydroxide ions (basicity) in the solution with a given indicator compound on the pH paper. The indicator compound defines the pH range of interest. Below this range, the paper will turn a certain color when a drop of the solution is applied to it, and a different color when the solution pH is above the range. Within the range itself, the color transitions between the two. A variety of different indicator compounds, and thus color ranges, can be used. Typical indicators are weak acids or bases, or both. Process chemistry and molecular transformations leading to the color change are variable and complex.

Indicator paper should be used when only a rough estimate of the pH is required. The response of pH paper is unaffected by solution interferences from color, turbidity, and colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered.

6.1.2 pH Meter

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to hydrogen ion concentration across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to hydrogen ion concentration can be generated and measured.

6.1.2.1 Procedure

Immerse the electrode(s) in a pH-7 buffer solution. Adjust the temperature compensator to the proper temperature, and adjust the pH meter to read 7.0. Remove the electrode(s) from the buffer and rinse well with demineralized water. Immerse the electrode(s) in a pH-4 or pH-10 buffer solution (depending on the expected pH of the sample) and adjust the slope control to read the appropriate pH. For best results, the standardization and slope adjustments shall be repeated at least once.

The response of a pH meter can be affected to a slight degree by high levels of colloidal or suspended solids, but the effect is usually small and generally of little significance.

6.2 MEASUREMENT OF SPECIFIC CONDUCTANCE

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, while the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not disassociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on the ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on the instrument type) to a measurement of specific conductance.

Calibrate a portable conductivity meter using a potassium chloride solution with a specific conductance closest to the values expected in the field. Maywood conductivities have typically been in the range of 1000-4000 micromhos/cm. Therefore, either a 0.01 molar (M) or 0.03M potassium chloride (KCl) solution is recommended the following table of conductivity of 0.01M KCl solution versus Temperature is available for this purpose. The conductivity values for the 0.03M solutions will be exactly 3 times that of the 0.01M values.

Temperature (degrees C)	Conductivity of 0.01M KCl solution (micromhos/cm)
12	1062
14	1116
16	1170
18	1224
20	1278

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance.

6.3 MEASUREMENT OF TEMPERATURE

Temperature measurements may be taken with alcohol-toluene, mercury filled or dial-type thermometers. In addition, various meters such as specific conductance or dissolved oxygen meters, which have temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

The instrument (thermometer, meter, or probe) shall be calibrated according to manufacturer's recommendations.

Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). Failure to wait may result in inaccurate readings.

6.4 MEASUREMENT OF DISSOLVED OXYGEN CONCENTRATION

Dissolved oxygen probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is

positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH^-) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode.

Probes differ as to specifics of use. Refer to the manufacturer's instructions to obtain an accurate calibration method.

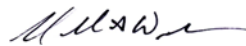
Dissolved oxygen probes are relatively free of interferences. Interferences that can occur are reactions with oxidizing gases (such as chlorine) or with gases such as hydrogen sulfide which are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field log book and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic compensation is normally provided by the manufacturer.

STANDARD OPERATING PROCEDURE

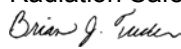
FUSRAP Maywood Superfund Site

Subject: Groundwater Level Measurement

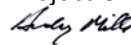
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This Standard Operating Procedure (SOP), Groundwater Level Measurement, is to be employed when an accurate water depth measurement is required at the FUSRAP Maywood Superfund Site (FMSS) where groundwater contamination is known or suspected.

Accurate groundwater level measurements are essential data in any hydrogeologic investigation. Groundwater level measurements are taken to determine the elevation of the potentiometric surface in a monitoring well, observation well, or piezometer at a particular point in time. Single event measurements, multiple-time measurements, or continuous-time measurements may be taken with appropriate equipment.

2.0 SCOPE

This SOP details the materials, equipment, and methods common to performing groundwater level measurements. Always consult state-specific or program-specific requirements as well as manufacturer's instructions for equipment use to ensure compatibility of this SOP with project requirements. Field changes to this SOP shall be discussed with the Project Manager prior to implementation and shall be documented in project field logbooks.

3.0 REFERENCES

ASTM Standard, No. D 4750 - 87, "Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)," Jan 1988.

The Massachusetts Department of Environmental Protection No. WSC-310-91. "Standard References for Monitoring Wells."

New Jersey Department of Environmental Protection and Energy, "Field Sampling Procedures Manual," May 1992.

SW-MWD-506-0, Decontamination.

SW-MWD-505-0, Cuttings and Fluids Management.

4.0 SW-MWD-303-0, MONITORING WELL INSTALLATION AND DEVELOPMENT.DEFINITIONS

Borehole - A hole of circular cross-section made in soil or rock to determine the nature of the subsurface materials. It is usually advanced using an auger, a drill, or casing with or without drilling fluid.

FSP - Field Sampling Plan.

Groundwater Level -The level of the water table surrounding a borehole or well. A depth below ground surface or an elevation can represent the groundwater level.

SSHP – Site Safety and Health Plan.

Liquid Level -The level of liquid in a borehole or well at a particular time. The liquid level can be reported as an elevation or as a depth below the top of ground surface. If the liquid is groundwater it is known as water level.

Potentiometric Surface - A surface which is defined by the levels to which water will rise in wells which are screened or open in a specified zone of an unconfined or confined aquifer.

SOP - Standard Operating Procedure.

Stabilize - To remain essentially constant with time.

Water Table - The depth in a formation where the pressure at the surface of an unconfined water body equals atmospheric pressure.

Well Casing - A pipe through which liquid levels can be measured and from which groundwater samples can be collected. Well casings are typically constructed from PVC or steel and are found in monitoring wells.

5.0 4.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for purging task.

5.3 4.3 PROJECT SUPERINTENDENT

Responsible individual designed by the Project Manager to supervise and investigate activities by Stone & Webster and related subcontracting personnel at FMSS for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in conducting the method to measure groundwater levels in

accordance with the project requirements, this SOP, and related SOPs. Assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin. Assures that all necessary personnel are mobilized on time. Maintains a daily log of activities each workday.

Coordinates and consults with Project Manager on decisions relative to unexpected encounters during measurements of groundwater levels and deviation from this SOP.

5.4 SITE PERSONNEL

All employees who are engaging in groundwater level measurement activities are required to read and sign the task specific Site Safety and Health Plan (SSHP) and to follow the procedures in this SOP, unless superseded by project specific requirements. All groundwater level measurement activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

5.5 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a task-specific Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

6.0 5.0 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR GROUNDWATER LEVEL MEASUREMENTS

The following is a list of equipment and material that is commonly used for groundwater level measurements. Refer also to Section 7 for the method-specific equipment requirements and related SOP equipment and material requirements to ensure completeness.

- SSHP. To be read and signed by all site personnel prior to site activities.
- Personal Protective Equipment
- Field Logbook(s)
- Volatile organic compound vapor meter
- Field Data Forms – See Section 10
- Decontamination supplies – See SOP, Decontamination and FSP
- Well keys for site well locks
- Additional well locks
- Bolt cutters (for frozen or keyless locks)
- Tool Box, including well key
- Indelible markers
- Six-foot ruler

- Groundwater level measuring device with a measuring tape having graduations that can be read to the nearest 0.01 foot and shall not have a stretch more than 0.05 percent under normal use. Interface probe, if needed.
- Duct tape
- Paper towels
- Clean, disposable bailer
- See Method-Specific Equipment List for Chosen Groundwater Level Measurement Method in Section 7

7.0 GENERAL GROUNDWATER LEVEL MEASUREMENT PROCEDURES

Groundwater level measurements may be performed with any of the following: an electric water level indicator, a weighted chalked steel tape, and a weighted tape with attached sounding device (“popper”). Depending on site conditions and / or the specific needs of the project, one of these methods will be chosen. Section 6.1 contains considerations for groundwater level measurements; Sections 6.2 and 6.3 contain the procedures that are common to all methods for groundwater level measurements. These steps should be followed in addition to the steps required for each method discussed in Section 7.

7.1 GROUNDWATER LEVEL MEASUREMENT CONSIDERATIONS

The frequency of water-level measurement is project-related. At a minimum, for those projects involving the installation of any monitor wells, at least one complete set of static water-level measurements should be made over a single, consecutive 10- to 12-hour period for all project-related wells, both newly installed and specified existing wells. These measurements should be taken at least 24 hours after development or sampling. Observations should extend over enough time to determine that the water level in the well has stabilized. Groundwater levels may vary significantly over the year, and from year to year. Observations over periods sufficiently long to include one or more such cycles may be desirable and records or presentations should clearly indicate limitations. Observations of the groundwater level in borings, even if left to stabilize for several days, cannot be depended upon except in very pervious soils. It is desirable, however, to note where groundwater was first encountered and record the water level in each boring every morning before starting work for that day. Static levels in borings not converted to wells should be included if practical and technically appropriate. This set of measurements should include a notation for the presence of any streams, lakes, and / or open water bodies (natural and man-made) within proximity, i.e., about 300 ft, of these wells.

Monitoring wells that are subject to tidal fluctuations should be read in conjunction with a tidal chart or preferably in conjunction with readings of a tide staff or tide level recorder installed in the adjacent water body. The Project Manager shall establish the frequency of the readings.

It must be noted that submergence of a weighted measuring tape and the tape itself may temporarily cause a liquid-level rise in wells having a very small diameter. This effect may be significant if the well is in materials of very low hydraulic conductivity.

7.2 PRE-GROUNDWATER LEVEL MEASUREMENT ACTIVITIES

The following activities will be performed and recorded in the field logbook immediately prior to measuring groundwater levels:

1. Choose a groundwater level-measuring device selected for the project conditions.
2. Prior to going to the field, check that the groundwater level measuring equipment has been decontaminated and is functioning properly and that it is in good repair. Refer to Section 7 for the specific groundwater level indicator.
3. Upon arrival at the monitoring well location, record the date and weather conditions.
4. Check the well for proper identification and location.
5. Inspect the well head for any signs of forced entry that could invalidate the groundwater level sampling data. *If the well shows signs of damage or forced entry, report finding to the Project Superintendent and / or Project Manager before proceeding further.*
6. Measure and record the height of protective casing.
7. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using the organic vapor analyzer. If organic vapor levels exceed 200 PPM in the well mouth, check well for the presence of free-floating petroleum hydrocarbons using a clear, disposable bailer or interface probe (if on site). If unanticipated hydrocarbons are found to be present, report finding to the Project Superintendent and / or Project Manager before proceeding further.

Record any unusual sounds, odors, staining, damage, or other observations. The well may produce a popping or sucking sound when the well cap is removed, if the well casing is not properly vented. If the well is not adequately vented, the groundwater level may take a while to stabilize once the cap is removed, especially in low permeability soils.

8. Measure and record the distance between the top of the well casing and the top of the protective casing. This measurement shall be made between reference points located at the top of the well casing and the top of the protective casing. If changes are noted with time, it is an indication that the reference point on the well casing or the protective casing has moved. A measuring point for all groundwater level measurements must be established and consistently maintained from the reference point of the well casing. The reference point on the well casing shall be stable and have a professionally surveyed elevation to the nearest 0.01 foot. See Section 6.2.10 below describing the reference point. If the groundwater level is measured in a borehole and the borehole is cased, measure the height of the innermost casing and use this as a reference point for groundwater level measurements.
9. Ensure that all equipment that will come in contact with well water has been pre-cleaned in accordance with the decontamination procedures specified in SW-MWD-506-0, Decontamination prior to introduction into site wells.
10. Locate the reference point at the top of the well casing from which depth measurements shall be made. If not present, a reference point for these measurements shall be made prior to groundwater level measurement. This reference point on the well casing shall consist of either a "V"-cut or indelible mark,

made on the highest point of the well casing; an indelible mark shall be made at the top of the protective casing.

7.3 GENERAL GROUNDWATER LEVEL MEASUREMENT PROCEDURES

1. With the selected groundwater level measurement device, carefully lower the decontaminated groundwater level measuring probe from the well casing's reference point into the well casing. When the probe is at the surface of the water in the well casing, record the actual reading obtained from the instrument. Depending on the type of groundwater level measurement device, measure and record (to the nearest 0.01 foot) the distance from the top of the groundwater to the reference point at the top of the well casing. The observer should make two measurements. If two measurements of static liquid level made within a few minutes do not agree within about 0.01 or 0.02 ft (generally regarded as the practical limit of precision) in boreholes or wells having a depth less than 200 feet, continue to measure until the reason for the lack of agreement is determined or until the results are shown to be reliable. Where water is dripping into the hole or covering its wall, it may be impossible to get a good watermark on the chalked tape. If petroleum hydrocarbons are found to be present on the water level measuring device or if a strong petroleum odor exudes from the device, check well for the presence of free-floating petroleum hydrocarbons using a clear, disposable bailer or interface probe, if on site. If unanticipated hydrocarbons are found to be present, report finding(s) to the Project Superintendent and/or Project Manager before proceeding further.
2. Determine the groundwater level by subtracting the recorded height of the well casing from the measured distance obtained in Section 6.3.1. Compute and record the groundwater level measurement and time of measurement in the field logbook. The groundwater level measurement shall be checked against past data to verify accuracy. Refer to Attachment A for suggested format of groundwater level measurements.
3. Using the groundwater level indicator, measure and record the depth to the bottom of the well casing from the well casing's reference point. This is accomplished by slowly dropping the measurement probe down into the well casing until slack is felt in the line. The measured well depth is compared to the recorded well depth on the well construction diagram. The difference between the measured and recorded well depth is due to the amount of, if any, siltation at the bottom of the well casing.
4. Remove the instrument from the well, replace cap, and secure well.
5. To prevent cross contamination between wells, all equipment that will be re-used at another well for Groundwater Level Measurement must be cleaned in accordance with SW-MWD-506-0, Decontamination.

8.0 METHOD-SPECIFIC GROUNDWATER LEVEL MEASUREMENT PROCEDURES

There are several methods for determining groundwater levels in monitoring wells and boreholes. Four methods of groundwater level measurement are described with their advantages and disadvantages. The Project Manager shall select an effective groundwater level measuring method for the particular site conditions.

8.1 GROUNDWATER LEVEL MEASUREMENT WITH ELECTRIC WATER LEVEL INDICATOR

Electric Water Level Indicators consist of a spool of small-diameter cable and a weighted probe attached to the end of the cable. When the probe comes in contact with the water, an electrical circuit is closed and a meter, light, and / or buzzer electronically attached to the spool will activate the water contact.

There are a number of commercial electric sounders available, none of which is entirely reliable under all conditions likely to occur in a contaminated monitoring well. Refer to manufacturer's directions for any unique procedures regarding its operation.

8.2.1 Electric Water Level Indicator – Specific Equipment List

- Decontaminated electric water level indicator with length graduations on tape
- Sufficiently charged battery pack

8.2.2 Electric Water Level Indicator Procedures for Groundwater Measurement

The following groundwater level measuring procedures shall be used if an electric water level indicator is used to measure the groundwater level:

1. Turn on previously decontaminated electric water level indicator and check proper operation of the instrument by inserting the tip into water and noting if the contact between the tip and the surface is registering properly. Follow instructions of the electric water level indicator for the sensitivity adjustment and setting.
2. The tip of the probe shall be dried. Slowly lower the tip into the well casing until the light and / or buzzer lights and / or buzzes. This signal indicates that the tip has contacted the surface of the liquid.

For devices with measurement graduations, note and record the reading at the reference point. This is the liquid-level depth below the reference point of the well or borehole.

NOTE: The length of the electric line should be checked by measuring with a steel tape after the line has been used for a long time or after it has been pulled hard in attempt to free the line.

8.2.3 Advantages / Disadvantages of Groundwater Level Measurement with the Electric Water Level Indicator

The advantages of choosing an electric water level indicator to measure groundwater is that it:

- Can measure groundwater levels to the nearest 0.01 foot.
- Is dependable if a non-aqueous liquid is absent at the groundwater surface.
- Is able to fit into small diameter (1/4- to 1/2-inch) well casings.
- Is relatively simple to operate.
- Performs multiple readings during slug and pump tests without removing tape from well.
- The individual tape length is the only depth limitation.

- Has no problem with background noise, especially if a light indicator is included.

The disadvantages of electric water level indicators are that they:

- Will not work with a non-aqueous phase liquid layer on the water surface.
- Cause false readings if cascading water is entering well or if steel well casing is used.
- Cause inaccurate readings if surface water is turbulent in well casing.
- Cause inaccurate readings if groundwater has a high specific conductance.
- Are not suited for wells with PCBs or other dielectric fluids.
- Are subject to electrical failures.

8.2 GROUNDWATER LEVEL MEASUREMENT WITH WEIGHTED CHALKED TAPE

Groundwater Level measurements with the weighted chalked steel tape provide one of the most accurate means to measure groundwater levels. The water indicator paste/gel acts as a colorimetric test method when the paste comes in contact with water. However, before usage of the chalked steel tape make certain that the gel does not affect the groundwater chemistry of the well and that it is permissible for use by project and/or state regulations.

This method is not recommended in wells that are also being used for water quality sampling because the chalk may introduce impurities into the well.

8.3.1 Weighted Chalked Tape – Specific Equipment List

- A measuring tape with an attached weight of known dimensions and displacement
- Paste or gel to apply to bottom of weighted tape

8.3.2 Weighted Chalked Tape Procedures for Groundwater Level Measurement

1. Chalk the lower few feet of the tape with colored carpenter's chalk or use specific chalking materials when floating product is anticipated and depth to interface is required.
2. Lower the clean weighted measuring tape slowly into the well casing until the liquid surface is penetrated.
3. Withdraw the tape from the borehole and observe the lower end of the tape. The tape must be withdrawn from the well rapidly to prevent drying of the wetted portion. The demarcation of the wetted and unwetted portions of the chalked tape should be apparent.
4. Observe and record the distance from the end of the measuring tape to the unwetted - wetted interface.
5. Subtract the distance from the end of the measured tape to the interface from the measurement made at the well casing's reference point.

NOTE: If a floating product (i.e., oil or gasoline) is present in the well, a water-detector paste is available commercially. The paste will show the top of the oil as a wet line and the top of the water as a distinct color change.

8.3.3 Advantage / Disadvantage of Groundwater Level Measurements with Weighted Chalked Tape

The advantages of employing a weighted steel chalked tape to measure groundwater levels are:

- One of the most accurate methods to measure groundwater levels if conditions are suitable and procedures are performed correctly.
- Chemically sensitive chalks or coatings can be used to determine the presence and thickness of fluids other than water, such as gasoline. The depth and thickness of the different liquid media (water and floating product) can be determined from the color change on the tape. If a floating product is present, this method is most accurate unless the product is highly emulsified, and therefore, difficult to distinguish from water.
- Not subject to mechanical or electrical failure.

The disadvantages of employing a weighted steel chalked tape to measure groundwater levels are:

- This method is not recommended in wells that are also being used for water quality sampling because the chalk may introduce impurities into the well.
- The tape has to be withdrawn from the well quickly because water has a tendency to rise up the chalk due to capillary action.
- In cold regions, the wetted portion of the tape freezes and is difficult to read if measuring tape is not withdrawn rapidly.
- Depths are limited by the inconvenience using heavier weights to properly tension longer tape lengths.
- Ineffective if well casing or borehole is wet or water inflow is occurring above the static water level.
- Difficult to chalk tape during periods of precipitation.
- Chalking the tape is time consuming.
- Requires subtracting the wetted length for total measurement - not a direct reading method.

8.3 GROUNDWATER LEVEL MEASUREMENT WITH TAPE AND WEIGHTED SOUNDING DEVICE (POPPER)

Groundwater level measurements performed with tape and sounding weight is probably the least accurate of the three methods described. This device usually consists of a small weighted cylinder with a concave undersurface. When the concave undersurface hits the water, it generates a plopping sound.

8.3.1 Tape and Weighted Sounding Device – Specific Equipment List

- Measuring tape (steel or fiberglass) with graduations of 0.01 feet
- A metal cylinder that is 1/2 to 1 inch in diameter by 2 to 3 inches in length containing a concave undersurface which is fastened to the end of the tape

8.3.2 Tape and Weighted Sounding Device Procedures for Groundwater Level Measurement

The following groundwater level measurement procedures shall be used if a weighted sounding device is used to measure the groundwater level in a well:

1. Lower a clean weighted sounding device attached to the end of a measuring tape into the well casing until the liquid surface is encountered; the exact length of the sounding device shall be known prior to groundwater level measurement. An audible splash or “pop” sound and a noticeable decrease in downward force on the tape indicate the surface of the liquid.
2. Observe and note this reading at the reference point of the well casing.
3. Repeat this process until the readings are consistent to the accuracy desired.
4. The final reading shall be measured from the well casing’s reference point. The depth to the water from the reference point is the measurement at the well casing reference point plus the length of the weighted sounding device.

NOTE: A direct reading of the depth to water can be obtained if the tape has been shortened a distance equal to the length of the weighted sounding device.

8.3.3 Advantages / Disadvantages of Groundwater Levels Measured with Tape and Weighted Sounding Devices

The advantages of employing a weighted sounding device to measure groundwater levels are:

- Simple to design.
- Simple and inexpensive to construct.
- Can be dedicated to a well.
- Generally unaffected by most groundwater contaminants.
- A direct reading of depth to groundwater level can be obtained with a tape length modification.
- Sufficiently accurate on sites where hydraulic gradients are fairly steep.

The disadvantages of employing a weighted sounding device to measure groundwater levels are:

- Will not work if a non-aqueous phase liquid layer exists.
- Not suitable for deep measurements.
- Not suitable if the well contains dampening substances (i.e., high percentage of sediments or viscous liquids).
- Unadjusted tape is a source of error.

- Not effective when the top of the water in the well casing intersects the screened well section.
- Tape may adhere to side of well casing, especially in deep wells.

8.4 GROUNDWATER LEVEL MEASUREMENT WITH ELECTRONIC INTERFACE PROBE

Electronic Interface Probes are used when a light non-aqueous phase liquid (LNAPL) layer is known to exist on the groundwater surface or at the bottom of the water column in a well for a dense non-aqueous phase liquid (DNAPL). This probe uses an optical sensor to determine if the probe is in liquid and a conductivity sensor to determine if the probe is in water. The thickness of the non-aqueous phase liquid and the groundwater level can be measured. Refer to manufacturer's directions for any unique procedures regarding its operation.

8.4.1 Electronic Interface Probe-Specific Equipment List

- Electronic interface probe
- Sufficiently charged battery pack
- Extra paper towels to wipe off non-aqueous phase liquid

8.4.2 Electronic Interface Probe Procedures for LNAPL Thickness Determination and Groundwater Level Measurement

The following groundwater level measurement procedures are used if an electronic interface probe is used to measure groundwater level or to determine the thickness of light non-aqueous phase liquids (i.e., hydrocarbons):

1. The electronic interface probe shall be decontaminated prior to usage in accordance with SW-MWD-506-0 - Decontamination.
2. Check the operation of the probe with the manufacturer's procedures. Completely submerge the probe into water and verify that the probe emits an oscillating tone. Typically, a continuous tone is emitted for hydrocarbons and an oscillating tone for water. Check specific operating procedures in manufacturer's manual.
3. To determine the air-hydrocarbon interface, slowly lower the interface probe down into the well casing and obtain the measurement from the well casing's reference point to the hydrocarbon-air interface. When this interface is encountered, a continuous electronic sound will be emitted. Note and record the depth to the air-hydrocarbon interface (to the nearest 0.01 foot) from the reference point at the top of the well casing.
4. To determine the hydrocarbon-water interface, a different approach is used. This measurement shall be taken ascending up from the water to the hydrocarbon layer. This technique prevents hydrocarbons from coating the conductivity probe that would enhance the hydrocarbon thickness reading.
5. To minimize the contact time of the interface probe in the hydrocarbons, the probe shall be quickly lowered through the hydrocarbon layer into the water. An oscillating tone will sound once the probe has detected the water.
6. After the probe has been submerged in the water, the probe shall be slowly removed until the tone changes from an oscillating to a continuous tone. At

the instant the change in tone occurs, the operator shall measure and record the reading from the reference point at the top of the well casing. Items 3 through 7 shall be repeated until the desired accuracy is obtained. The accuracy of this method is approximately 0.05 feet.

8.4.3 Electronic Interface Probe Procedures for DNAPL Thickness Determination and Groundwater Level Measurement

The following groundwater level measurement procedures are used if an electronic interface probe is used to measure groundwater level or to determine the thickness of dense non-aqueous phase liquids:

1. The electronic interface probe shall be decontaminated prior to usage in accordance with SW-MWD-506-0 - Decontamination.
2. Check the operation of the probe with the manufacturer's procedures. Completely submerge the probe into water and verify that the probe emits an oscillating tone. Typically, a continuous tone is emitted for hydrocarbons and an oscillating tone for water. Check specific operating procedures in manufacturer's manual.
3. Slowly lower the interface probe down into the well casing and obtain a water level measurement measured from the well casing's reference point. When the surface water is encountered, an oscillating tone will be emitted at the surface from the interface probe. Note and record the depth to water (to the nearest 0.01 foot) from the reference point at the top of the well casing.
4. To determine the DNAPL-water interface in the well, continue lowering the probe into the water column until the electronic signal changes from an oscillating tone to a continuous tone.
5. At the instant the change in tone occurs, the operator shall measure and record the reading from the reference point at the top of the well casing. Repeat item 4 and this step until the desired accuracy is obtained. The accuracy of this method is approximately 0.05 feet.

8.4.4 Advantages / Disadvantages of Groundwater Level Well Measurement with the Electronic Interface Probe

The advantages of groundwater level measurement with an electronic interface probe are:

- Permits measurement of the depth and thickness of separate phase liquids, as well as water levels.
- Can be used for groundwater level measurement alone.
- Allows a direct reading for groundwater level.
- Simple to operate.

The disadvantages of groundwater level measurement with an electronic interface probe are:

- Battery-operated and subject to electrical failures.

- Probe (diameter is approximately 1 1/4 inches) may not fit into small-diameter wells.
- Probe may be affected by decontamination solutions.
- Difficult to decontaminate.

9.0 ATTACHMENTS

Attachment A – Groundwater Level Data Record Sheet

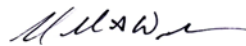
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STANDARD OPERATING PROCEDURE

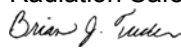
FUSRAP Maywood Superfund Site

Subject: Conducting Field Audits

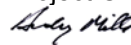
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This field audit procedure is to be used for the auditing of field sampling events at the FUSRAP Maywood Superfund Site (FMSS) to verify adherence to the Field Sampling Plan (FSP) and to document any deviations from prescribed procedures. A field audit is the verification of a sampling team's performance during a sampling episode.

2.0 SCOPE

This guideline is to provide general reference information on the aspects of performing a field audit at the FMSS. (Note: In most cases the auditor will be the Contractor Quality Control System Manager (CQCSM), however this SOP has been prepared for any Auditor to use).

These limitations apply to all field audits during any sampling event excepting requirements of project-specific plans for field audits.

3.0 REFERENCES

U.S. EPA Region II CERCLA Quality Assurance Manual. Part II, Quality Control Handbook for CERCLA Sampling and Analysis, Section XV. October 1989, Rev. 1.

NJ Department of Environmental Protection – Field Sampling Procedures Manual. February 1988.

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform field audits.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the auditor has been properly briefed and is prepared for conducting field audit tasks.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a site-specific Site Safety and Health Plan (SSHP). The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed, and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designed by the Project Manager to supervise and investigate activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on conducting field audits in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each workday.

6.0 PROCEDURE

A copy of the approved work plan should be reviewed by the auditor prior to going in the field. The auditor should be familiar with the number of samples, parameters, sampling methodology, decontamination procedures, etc. to be utilized at the site prior to performing the field audit.

The auditor should review the Site Safety and Health Plan and be prepared for the level of personnel protection specified in the task-specific work plan. This means that the auditor should have the necessary PPE equipment available for use in his or her vehicle prior to going in the field.

It is recommended that prior to performing a field audit, the auditor will contact the Project Manager and discuss the audit. This type of pre-sampling conference with the Project Manager has proven to be an effective tool to ensure proper preparation for the sampling event has, in fact, occurred. This will avoid project delays and time wasted by staff auditors.

If the sampling episode is going to occur over an extended period of time, the auditor should specify the dates he or she wishes to be on-site to witness sample collection. In addition, directions to the sampling location should be obtained.

The auditor should verify the sample matrix and equipment that the sampling team plans to use. If necessary, discuss the sampling technique to be utilized with the Project Manager or Project

Chemist in the event that last minute substitutions might occur. If this situation arises, the auditor must evaluate if the changes proposed will compromise the objectives of the task-specific FSP and if necessary, advise the project management team of potential delays.

6.1 DOCUMENT REFERENCES IN THE FIELD

The auditor should have the following documents available for reference in the field when performing quality control field audits:

1. Copy of the approved work plan and any relevant memos, correspondence or addenda.
2. Copy of the pertinent field sampling procedures and / or the USEPA Groundwater Monitoring Technical Enforcement Guidance Document.
3. Appropriate bound field logbook (in an 8 x 11 format).
4. Appropriate field audit checklist.
5. List of telephone numbers for project personnel and emergency numbers.
6. Camera (optional).

Note: The field audit checklist should be 100% complete prior to leaving the site where the sampling event has occurred.

6.2 CORRECTIVE ACTION IN THE FIELD

Besides observing and reporting, the auditor is responsible for initiating steps for the start-up of corrective action procedures.

If the auditor witnesses discrepancies in the field between the approved work plan and the performance of the sampling team, then the auditor has several options available for corrective action. These options are dependent upon the type of infraction observed.

Infractions observed and the corrective action taken must be documented in the auditor's logbook.

6.3 TYPES OF INFRACTIONS

Any deviation from the procedures described in the approved work plans or SOPs being audited is considered an infraction.

- **Minor Infractions**

Minor infractions are problems that are observed by the auditor and immediately brought to the attention of the party conducting the investigation. The auditor and the party conducting the investigation should discuss the problem and agree upon what corrective action is necessary. This will allow for the infractions to be corrected immediately in the field.

Impact, if any, to the data generated can be easily eliminated and procedures can be corrected and/or repeated to achieve the desired result.

Examples of minor infractions would include: not wearing disposable gloves, insufficient well evacuation, and not filling volatile organic sample containers completely.

- Major Infractions

Major infractions are events or procedures that substantially deviate from approved work plans, administrative documents, the USEPA Groundwater Monitoring Technical Enforcement Guidance Document, or will otherwise result in increased project costs not previously approved.

Upon witnessing a major infraction, which would cause work to cease, the auditor shall inform the party conducting the investigation of the problem. They should then discuss what steps are necessary for corrective action. During this time all work on site should stop until a resolution is agreed upon.

If the party conducting the investigation refuses to cease work or take the necessary steps for corrective action, then the auditor shall inform the party that samples obtained will potentially cause data critical to the environmental evaluation of a project to be qualified or become suspect. This type of infraction has the potential to cause total or partial rejection of samples submitted to the laboratory.

Examples of major infractions would include: no trip or field blanks, improper decontamination procedures, and change in sampling location and procedures.

When infractions are observed, the results of the audit should be immediately communicated in writing to the Project Quality Control Manager.

6.4 PREPARATION OF A FIELD AUDIT REPORT

The quality control field audit report provides a means of relaying the events of a sampling episode to key personnel. These events could possibly affect the sample integrity (QA/QC) and therefore they are important to the decisions that are made in regards to analytical data.

A quality control field audit report will usually contain the following information:

1. Date and location of field audit.
2. Sample matrices witnessed.
3. Name of personnel conducting the sampling.
4. Summary of sample methodology.
5. Description of any infractions that occurred and the corrective actions taken.
6. Conclusions
7. Recommendations
8. Map of sample locations.
9. Table of samples witnessed by the auditor.
10. Quality control field audit checklist (refer to attachments)

7.0 ATTACHMENTS

Quality Control Field Audit Report

ATTACHMENT

QUALITY CONTROL FIELD AUDIT REPORT

SUMMARY INFORMATION

1. PROJECT NAME:

2. PROJECT ADDRESS:

3. PRELIMINARY ASSESSMENT ☐ RI/FS ☐ RD ☐ CONSTRUCTION

OTHER

4. DATE(S) OF QC FIELD AUDIT

5. AUDITOR'S NAME PHONE

6. FACILITY CONTACT PHONE

7. CONTRACTOR CONTACT PHONE

8. PERSONNEL ON-SITE

NAME	REPRESENTING	PHONE

9. AUDITOR'S COMMENTS:

10. WEATHER CONDITIONS:

SUNNY PARTLY SUNNY PARTLY CLOUDY CLOUDY RAIN DRIZZLE SNOW SLEET
 TEMPERATURE _____ WIND SPEED _____ WIND DIRECTION _____

11. LEVEL OF PERSONNEL PROTECTION REQUIRED IN WORK PLAN

LEVEL OF PERSONNEL PROTECTION ACTUALLY DONNED:

A B C D A B C D

12. FIELD SURVEY EQUIPMENT:

INSTRUMENT MODEL CHECK CALIBRATION STANDARD CALIBRATION SETTING SPAN

CONDUCTIVITY METER _____

DISSOLVED OXYGEN METER _____

pH METER _____

COMBUSTIBLE GAS INDICATOR (LEL/O₂) _____

FLAME IONIZATION DETECTOR (OVA) _____

PHOTOIONIZATION DETECTOR (HNU) _____

TOTAL GAS INDICATOR (CO, H₂S) _____

OTHER _____

OBSERVATIONS

13. DID THE SAMPLING TEAM TAKE PERIODIC SURVEYS OF THE AMBIENT AIR CONDITIONS? YES NO N/A

14. DID THE SAMPLING TEAM PROVIDE A DECON ZONE DESIGNATING CLEAN AND CONTAMINATED AREAS? YES NO N/A

15. WERE PHOTOGRAPHS TAKEN? YES NO

16. AUDITOR'S COMMENTS:

MONITORING WELL SAMPLING SETUP AND EVACUATION**EVACUATION PROCEDURES**

1. WELL CASING CONSTRUCTION STAINLESS STEEL TEFLON PVC OTHER
2. DIAMETER OF WELL CASING 2" 4" 6" OTHER
3. LOCKING CAPS ON THE WELLS YES NO N/A PROTECTIVE CASING YES NO N/A
4. METHOD UTILIZED TO DETERMINE THE STATIC WATER LEVEL WATER LEVEL INDICATOR OTHER
5. REFERENCE POINT THAT THE STATIC WATER LEVEL WAS MEASURED FROM:
- | | SURVEY POINT | TOP OF
INNER CASING | CASING | TOP OF
PROTECTIVE
GROUND SURFACE | HEIGHT OF
CASING ABOVE
GROUND SURFACE |
|--|--------------|------------------------|--------|--|---|
|--|--------------|------------------------|--------|--|---|
6. WAS THE WATER LEVEL INDICATOR DECONTAMINATED ACCORDING TO STANDARD PROCEDURES BETWEEN EACH WELL?:
- YES NO N/A

IF NO, METHOD UTILIZED:

7. EVACUATION METHOD:

BAILER	CENTRIFUGAL PUMP	PERISTALTIC PUMP	BLADDER PUMP	SUBMERSIBLE PUMP
GAS DISPLACEMENT PUMP		GAS LIFT PUMP	OTHER	

8. TYPE OF HOSE UTILIZED:

POLYETHYLENE (ASTM DRINKING WATER GRADE 2239)	TEFLON	SILASTIC	N/A
OTHER			

9. WAS THE HOSE DEDICATED TO EACH WELL LOCATION?: YES NO N/A

IF NO, METHOD OF DECONTAMINATION

10. WAS THE PUMP DEDICATED TO EACH WELL LOCATION?: YES NO N/A

11. WAS THE PUMP: LABORATORY DECONTAMINATED FIELD DECONTAMINATED N/A

12. WAS THE PUMP DECONTAMINATED ACCORDING TO STANDARD CERCLA PROCEDURES?: YES NO

IF NO, METHOD OF DECONTAMINATION

13. WAS THE PUMP HEAD OR END OF HOSE WITHIN 6 FEET OF THE DYNAMIC WATER LEVEL DURING EVACUATION?:

YES NO N/A

14. WAS THE DECONTAMINATION AREA LOCATED AWAY FROM THE SOURCE OF CONTAMINATION?: YES NO N/A

15. AUDITOR'S COMMENTS:

AQUEOUS SAMPLING PROCEDURES

1. AQUEOUS MATRIX SAMPLED:

POTABLE WELL GROUNDWATER SURFACE WATER LEACHATE RUNOFF STORM SEWER
SANITARY SEWER OTHER: _____

2. TYPE OF SAMPLE: GRAB COMPOSITE IF COMPOSITE, # SAMPLES/COMPOSITE _____

3. WAS THE VOA SAMPLE COLLECTED FIRST: YES NO N/A

4. TYPE OF SAMPLING EQUIPMENT:

	MATERIAL OF CONSTRUCTION			
	STAINLESS STEEL	TEFLON	GLASS	OTHER
BAILER	_____	_____	_____	
BLADDER PUMP	_____	_____	_____	
SAMPLER	_____	_____	_____	
COLIWASA	_____	_____	_____	
KEMMERER DEPTH SAMPLER	_____	_____	_____	
WHEATON DIP SAMPLER	_____	_____	_____	
TUB SAMPLER	_____	_____	_____	
BACON BOMB	_____	_____	_____	

5. TYPE OF LEADER LINE THAT COMES IN CONTACT WITH THE WELL WATER:

TEFLON TEFLON-COATED STAINLESS STEEL N/A OTHER _____

6. LENGTH OF THE LEADER LINE: _____

7. WAS THE SAMPLING EQUIPMENT DEDICATED?: YES _____ NO

8. WAS THE SAMPLING EQUIPMENT: LAB DECONTAMINATED FIELD DECONTAMINATED

9. WAS THE SAMPLING EQUIPMENT DECONTAMINATED ACCORDING TO STANDARD PROCEDURES?: YES NO

IF NO, METHOD OF DECONTAMINATION: _____

10. WAS THE DECONTAMINATION AREA LOCATED AWAY FROM THE SOURCE OF CONTAMINATION?: YES NO N/A

11. ARE DISPOSABLE GLOVES WORN AND CHANGED BETWEEN EACH SAMPLE LOCATION?: YES NO

12. AUDITOR'S COMMENTS: _____

NON-AQUEOUS SAMPLE INFORMATION

1. NON-AQUEOUS MATRIX SAMPLED:

SOIL SEDIMENT SLUDGE CHEMICAL SOLIDS WASTE PILE
OTHER _____

2. TYPE OF SAMPLE: GRAB COMPOSITE IF COMPOSITE, # SAMPLES/COMPOSITE _____

3. WAS THE VOA SAMPLE COLLECTED FIRST FROM A DISCRETE LOCATION PRIOR TO HOMOGENIZATION?: YES NO N/A

4. WAS THE SAMPLE HOMOGENIZED PRIOR TO ACQUISITION INTO THE SAMPLE CONTAINERS?: YES NO

5. TYPE OF SAMPLING EQUIPMENT:

	STAINLESS STEEL	MATERIAL OF CONSTRUCTION TEFLON	GLASS	OTHER
SPOON/SPATULA	_____	_____	_____	_____
TROWEL/SCOOP	_____	_____	_____	_____
BUCKET AUGER	_____	_____	_____	_____
SPLIT SPOON	_____	_____	_____	_____
SHELBY TUBE	_____	_____	_____	_____
TRIER	_____	_____	_____	_____
PONAR DREDGE	_____	_____	_____	_____

6. WAS THE DRILL RIG, AUGER FLIGHTS, RODS, ETC. DECONTAMINATED ACCORDING TO STANDARD PROCEDURE BETWEEN EACH SAMPLE LOCATION?:

YES NO N/A

IF NO, METHOD OF DECONTAMINATION _____

7. IF MUD ROTARY DRILLING WAS UTILIZED WHAT WAS THE SOURCE OF THE WATER?: _____

8. WAS THE SAMPLING EQUIPMENT DEDICATED?: YES _____ NO

9. WAS THE SAMPLING EQUIPMENT: LAB DECONTAMINATED FIELD DECONTAMINATED

10. WAS THE SAMPLING EQUIPMENT DECONTAMINATED ACCORDING TO STANDARD PROCEDURES?: YES NO

IF NO, METHOD OF DECONTAMINATION:

11. WAS THE DECONTAMINATION AREA LOCATED AWAY FROM THE SOURCE OF CONTAMINATION?: YES NO N/A

12. ARE DISPOSABLE GLOVES WORN AND CHANGED BETWEEN EACH SAMPLE LOCATION?: YES NO

13. AUDITOR'S COMMENTS: _____

QA/QC INFORMATION

1. LABORATORIES:

NAME _____ PHONE _____

NAME _____ PHONE _____

CONTACT PERSON _____

CLP CLP CAPABLE CERTIFIED OTHER

2. SAMPLE INFORMATION:

MATRIX	PARAMETER	PRESERVATIVE	CONTAINER DESCRIPTION
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

3. WHAT ORDER, BY ANALYTICAL PARAMETER, ARE SAMPLES COLLECTED: _____

4. FIELD BLANKS: YES NO N/A FREQUENCY _____

METHOD: _____

WAS IDENTICAL BOTTLE TO BOTTLE TRANSFER OF WATER UTILIZED?: YES NO

5. TRIP BLANKS: YES NO N/A FREQUENCY _____

MS/MSDS YES NO N/A FREQUENCY _____

6. WHAT WAS THE SOURCE OF THE BLANK WATER?: LABORATORY DEMONSTRATED ANALYTE-FREE OTHER _____

7. SAMPLE PACKAGING AND HANDLING:

SAMPLE CONTAINERS LABELED	YES	NO	N/A
COC FORMS COMPLETED	YES	NO	N/A
CUSTODY SEALS	YES	NO	N/A
SAMPLES PRESERVED TO 4°C:	YES	NO	N/A

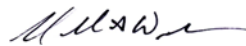
8. AUDITOR'S COMMENTS:

STANDARD OPERATING PROCEDURE

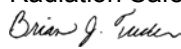
FUSRAP Maywood Superfund Site

Subject: Overburden Drilling Methods

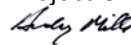
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This Standard Operating Procedure - Overburden Drilling Methods is to be employed when drilling through overburden materials with known or suspected soil and/or groundwater contamination at the FUSRAP Maywood Superfund site (FMSS).

2.0 SCOPE

This procedure details the materials, equipment, and methods common to Overburden Drilling activities. Consult the site-specific project plans for proposed boring locations and special drilling techniques. Always consult state-specific or program-specific requirements as well as manufacturer's instructions for equipment use to ensure compatibility of this SOP with project requirements. Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field logbooks.

3.0 REFERENCES

Atlas Copco - Sandvik Rock Tool Catalog: Sweden.

Boart Longyear Company, Sonic Drilling, Environmental Drilling Division, Catalog, Revision 1.

Hix, G. L., Casing advancement methods for drilling monitoring wells, WWJ, May, 1991, p. 60-64.

Keely, J. F., and Kwasi Boateng, Monitoring well installation, purging, and sampling techniques - Part 1: Conceptualizations, Ground Water, v. 25, no.3, 1987, pp. 300-313.

SW-MWD-506-0 – Decontamination.

SW-MWD-308-0 - Soil Borings and Sampling.

SW-MWD-203-0 - Rock Coring.

SW-MWD-307-0 - Surface and Shallow Subsurface Soil Sampling.

SW-MWD-504-0 - Labeling, Packaging, and Shipping Environmental Samples.

SW-MWD-303-0 - Monitoring Well Installation & Development.

SW-MWD-505-0 - Cuttings and Fluids Management.

United States Army Corps of Engineers, Monitor Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites, Engineering Manual 1110-4000, August 1994.

USEPA, A Compendium of Superfund Field Operation Methods, Document EPA/540/P-87/001, December 1987.

4.0 DEFINITIONS

Anchor - a device which adheres to soil-like material and acts as a anchor for transference of loads to a tie-back.

Borehole - a circular open or uncased subsurface hole created by drilling.

Casing - pipe, finished in sections with either threaded connections or beveled edges to be field welded, which is installed temporarily or permanently to counteract caving, to advance the borehole, or to isolate the zone being monitored, or combination thereof.

FSP - Field Sampling Plan

Groundwater - the water contained in interconnected pores located below the water table in an unconfined aquifer or located in a confined aquifer.

SSHP – Site Safety and Health Plan

Hollow Stem Auger - a steel, hollow, spiral-shaped driller's tool used to advance a borehole in unconsolidated materials.

Interface Probe - a hand-held, battery operated instrument used for measuring the thickness of separate phase non-aqueous phase liquids in a well.

Permeability - the capacity of a porous rock, sediment, or soil for transmitting a fluid.

Slurry - a highly fluid mixture of water and finely divided material.

Split-Spoon Sampler - a 2-inch (OD) steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. This device is driven into resistant materials for collection of a soil sample using a 140 lb. drive weight mounted in the drilling string.

Tieback - a device that is used to support a structure through strands of wires or rod which are connected to an anchoring system inside soil-like material.

Tremie Pipe - a pipe or tube that is used to transport filter pack materials and annular sealant materials from the ground surface into the borehole annulus or between casings and casings or riser pipe of a monitoring well.

Water table - the surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for overburden drilling activities.

5.3 PROJECT SUPERINTENDENT

The Project Superintendent is individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in monitoring overburden drilling activities in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin. The Project Superintendent assures that all necessary personnel are mobilized on time and maintains a daily log of activities each workday. The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected occurrences during overburden drilling activities and deviation from this SOP.

5.4 SITE PERSONNEL

All employees who are engaging in overburden drilling activities are required to read and sign Maywood Site Safety and Health Plan (SSHP) and to follow the procedures in this SOP, unless superseded by project-specific requirements. All overburden drilling activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

5.5 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a SSHP. The Site Safety and Health Officer (who may also serve as an observer of overburden drilling activities) is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

6.0 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR OVERBURDEN DRILLING

The following is a list of equipment & material which is commonly used on all projects when exploration drilling is performed in the overburden. Refer also to related SOP equipment and material requirements to ensure completeness. Sampling methods for soil and rock are not described in this SOP.

Items required by subcontractor:

- Drilling Machine - of appropriate size and drilling and sampling capabilities. Provided by subcontractor. See Section 7 for information on choosing drilling method.
- Drilling tools used to advance boring (i.e., drill rods and augers).

- Drilling tools that support the borehole walls while advancing hole (i.e., drill casing and augers).
- Fluid Pump - capable of delivering sufficient volume and pressure for the diameter and depth of hole to be drilled.
- Environmentally-safe lubricants.
- Adequate supply of clean drilling water (water tanks filled prior to start time).
- Cement/bentonite supply for grouting.
- Suitable grout mixers and grout pumps.
- Soil sample collection and logging supplies - See SW-MWD-308-0 - Soil Borings and Sampling.
- Rock coring and rock core logging supplies - See SW-MWD - 203-0 - Rock Coring.
- Empty, clean 55 gallon drums with sealable covers, if required.

Items carried by Stone & Webster on-site personnel:

- SSHP. To be read and signed by all site personnel prior to site activities.
- Personal Protective Equipment
- Field logbook(s)
- Clipboard
- Pencils
- Six-foot-ruler
- Pocket knife
- Camera (optional), check with Project Manager if required.
- Volatile organic compound vapor meter
- Site boring logs
- Blank boring logs
- Decontamination supplies - See SW-MWD-506-0 - Decontamination and FSP
- Weighted measuring tape
- Water level measuring device - See SW-MWD-410-0 - Groundwater Level Measurement, Interface probe, if needed.
- Paper towels

7.0 PRE-DRILLING ACTIVITIES AND OVERBURDEN DRILLING ACTIVITIES

7.1 GENERAL CONSIDERATIONS

Prior to selecting the drilling method for a specific project, the objectives of the field investigation program must be established. The program objectives may include any or all of the following:

- Soil or rock evaluation - If undisturbed or representative samples are required, the drilling technique must be able to accommodate the appropriate type of sample collection.
- Characterization of hydrogeologic conditions - the drilling technique should allow for the characterization of each stratigraphic zone, water level measurements, and water collection.
- Evaluation of soil or ground water contamination - the drilling technique must provide the appropriate sample collection methods, must not introduce contaminants into the borehole or otherwise alter the existing soil or groundwater chemistry, and should not result in subsurface cross contamination during or after drilling.
- Installation of monitoring wells - the drilling method must permit appropriate well construction and minimize the disturbance to both the borehole and the well.

One of the best resources for selecting an appropriate drilling technique is an experienced drilling contractor. Items that should be considered in the drilling method selection process include the following:

- Geologic Conditions:
 - Number of holes to be drilled
 - Unconsolidated or consolidated
 - Type of material, including fill material
 - Presence of boulders or cobbles
 - Depth to bedrock if bedrock is to be cored
- Site Access:
 - Property ownership
 - Terrain and vegetative cover
 - Wet areas
 - Size of working area
 - Weather conditions
 - Weight and size restrictions
 - Need for barge equipment
 - Location of drilling water source
- Seasonal Conditions Affecting Access:
 - Effect of freezing temperatures, mud, and snow on drilling progress
 - Use of water
 - Need to add antifreeze to pumps when not in use under freezing conditions
 - Antifreeze must be flushed out of hoses and pumps

- High water conditions
- Existence of Contamination:
 - Utilize decontamination protocols
 - Minimize disturbance and cross-contamination
 - Minimize impact on site chemistry
 - Control fluid drilling discharge
 - Reduce volume of contaminated spoils
 - Sampling requirements
 - Minimize crew's exposure to hazards
- Required Hole Size and Plumbness:
 - Single-level or multi-level well installations
 - Large-diameter wells
 - Installation of instruments and downhole equipment
 - Availability of drilling equipment
 - Adequate annular space for well installation
 - Use of packers

7.2 PRE-DRILLING ACTIVITIES

Prior to drilling the borehole, several pre-drilling activities should be performed. These activities, which include both pre-mobilization office tasks and pre-drilling field tasks, are discussed below. Once the pre-drilling activities are completed, drilling may commence.

7.2.1 Pre-Mobilization Tasks

1. Acquire as much geologic and hydrogeologic information about the site as possible. This information may include possible soil and groundwater contamination present, groundwater table depths and fluctuations, surficial and bedrock geology, approximate thickness of overburden, depth to top of weathered rock, depth to competent rock, and site access.
2. If possible, check and verify that the staked boring location corresponds to the location on the project plans.
 - Using field judgment, determine what type of drill rig (i.e., all terrain vehicle, track-mounted, truck mounted rig, skid rig) is required.
 - Check to see if visible structures will prevent a hole to be drilled at the proposed boring location.
3. Using the known information about the site, review Section 7 and choose the proper type of drilling method for your site.
4. Once the drilling contractor and method is chosen, contact the drilling contractor. Prior to drilling activities, let the driller know what equipment is required to perform the job successfully. One should indicate the length of casing, type of casing shoes, length of augers, the number of auger cutting heads, and number and type of split spoon samplers required.

NOTE: The first communication with drilling subcontractor concerning scope of work for the drilling program shall always be performed prior to on-site activities.

5. Ensure that all utilities in the vicinity of the proposed boring(s) have been cleared by the appropriate authorized parties (i.e., Dig Safe, owner, etc.) or, if utilities exist, are visibly marked on the ground surface in the area of the proposed boring. In addition, keep a safe working distance from overhead utilities. NOTE: The drilling specification should identify the party responsible for having utilities cleared. If the responsible party is not clearly identified then establish the responsible party. Ensure that utilities have been cleared prior to drilling.
6. Potable water shall be used for drilling fluid unless an alternative source has been approved and identified in the project plans. Locate a nearby, convenient, clean water supply that can be utilized throughout the drilling program for decontamination and drilling purposes. If permits are required to connect up to nearby or on-site hydrants, they shall be acquired prior to the driller's mobilization on site. The water source should be tested if water quality samples are to be obtained later from the borehole or the monitoring well. Any testing shall be approved by the Project Manager prior to conducting the test.

7.2.2 Pre-Drilling Field Tasks

1. Construct a suitable decontamination pad for the steam cleaning of the drill rig, drilling equipment, and tools in accordance with SW-MWD-506-0 -

Decontamination. The drilling related equipment shall be decontaminated on site prior to drilling activities.

2. Communicate with the driller the requirements of the drilling program and what geologic and environmental information you require (This information should be a review for the driller, but, in fact, he/she may not have knowledge of the drilling program's details). Depending on the project drilling program, environmental samples may or may not be taken. If sampling will be conducted, inform the driller of the environmental sampling program that the project shall follow. This information includes sampling frequency, sampling depths, type of sample required (soil or groundwater), proposed depth to bottom of borehole, special sampling techniques, and amount, if any, of bedrock to be cored. Inform the driller if a monitoring well is to be installed and, if known, the depth of the screened interval. Ensure casing for holes in overburden have an inside diameter sufficient to accommodate the size of bit required for drilling in rock. Ensure that proper drilling fluids and proposed grout mixes to be used are in accordance with the project specifications.

7.3 GENERAL OVERBURDEN DRILLING METHOD PROCEDURES

The following sections outline general procedures used while drilling in overburden materials:

1. Assuming a vertical test boring, set the drill rig over the proposed boring location. Level the drill rig and ensure that the drill rods used to advance the hole are in a vertical drilling position directly above the hole.
2. The inspecting geologist / engineer shall obtain and record measurements of tools to be used for drilling operations for depth and borehole diameter determination. Down-hole measurements taken by the drillers shall be to the nearest 0.1 foot.
3. Begin sampling or advancement of borehole to the desired depth utilizing one of the appropriate drilling methods described below. If conventional samples are to be taken, use sampling and logging procedures and sampling tools in accordance with the project sampling program, and S&W-MWD-308-0 - Soil Borings and Sampling procedures.
4. Prior to obtaining a conventional soil sample, the bottom of the sampler should go to the correct sampling depth without resistance. If the sampler does not go to the correct sampling depth, cave-in material, wash material, or blow-in material may be resting at the bottom. If the amount of this "loose material" is more than a few inches in thickness, the hole should be flushed clean. If the loose material is sampled in addition to the representative native soil, it shall be removed and not used in the soil description. NOTE: When using augers for the purpose of using little or no water, do not flush the borehole with water.
5. When the borehole advancement tools are lowered into the borehole, the logger shall keep track of tool lengths to check driller's stated depth of borehole.
6. The logger shall make certain that the driller is performing depth measurements with a ruler and known tool lengths and not visually judging ("eyeballing") casing and

tool projections above the ground. The logger shall maintain a mental note of depth to bottom of borehole by keeping track of the lineal feet of tools in and above the ground. By mentally subtracting the "stick-up" above the ground, the logger can maintain a constant approximate check on the hole depth and driller's indicated depths.

7. The breathing zone and return drilling fluids (water or compressed air) shall be screened for volatile organic compounds (VOCs) using an organic vapor analyzer designated by the project. A lower explosive limit meter (L.E.L.) shall be employed if required in SSHP. Record the measured readings at the depth and time of reading on the boring log.
8. During drilling activities, record drilling production, mechanical and/or drilling difficulties and sequences of drilling activities. Also record drill rig mobilization time, drill rig set-up time, and drilling commencement and completion times. This information should be recorded in a field log book. Pertinent details shall also be recorded on the borehole log (See SW-MWD-308-0 - Soil Borings and Sampling). Refer to Attachment A for blank boring log. Boring log details should include type of soil sample and all related information, type of drilling fluid, if used, various sizes of casings or advancement tools if borehole was telescopically advanced, approximate depth of strata change boundaries, borehole problems; i.e., hole squeezing, sudden tool drops, excessive grout takes, drilling fluid losses, etc. Note and record any changes in color of drilling fluids at their corresponding depths. Note and record readings on organic vapor meter during drilling operations.
9. For borings penetrating the water table, water level observations shall be measured and reported in accordance with SW-MWD-410-0 - Groundwater Level Measurement. Observations should be made at the following times:
 - Following a period of suspended operations, even if the water level has not stabilized.
 - Before casing or augers are pulled
 - If the borehole remains open, immediately after the casing or augers are pulled
 - If no free standing water is observed in the bottom of the boring at the specified completion depth, state that: "No water encountered" on applicable boring log.
10. Refusal of drilling advancement tools (i.e., roller bit refusal, auger refusal, or casing refusal) is encountered when the borehole cannot be advanced using regular drilling advancement methods. Generally, refusal can be identified by the following characteristics:
 - Advancement of borehole is not noticeable or is very slow.
 - A grinding noise is felt by the augers and sometimes the drill rig oscillates in a particular, repeatable fashion as the augers are rotating. If on a wood obstruction, a grinding noise won't be heard, but the rig may have a spongy feel.

- Cuttings returned to the surface may have, wood, concrete or rock chips, or fragments of steel.
- If casing is driven, the number of casing blows increases significantly.
- The drilling downpressure may be significantly higher than under "normal" drilling conditions. The drill rig may be lifted off the ground surface.

If refusal is encountered in the boring, refer to the Soil Borings and Sampling for specific instructions. Determine if the borehole can be advanced with a core barrel. If the borehole cannot be cored, relocate the borehole in a direction approximately 5 feet distant from the original location. Measure the distance and direction and record this information on the boring log and in a field logbook.

NOTE: The actual distance of movement necessary may be greater depending on the site conditions. If the required movement is excessive, contact the Project Manager.

11. When the final depth is encountered and if an observation well is not to be installed, the borehole shall be properly backfilled or grouted using suitable cement / bentonite / water mix ratios. Prior to grouting, ensure that the FSP is followed for specific instructions regarding backfilling and soil cuttings disposal. The following are general borehole grouting procedures.

- a. Calculate the theoretical volume of grout required to fill the annulus from the bottom of the hole to the ground surface.
- b. Prepare a suitable cement-based or bentonite-based grout mix based on the geologic formations encountered, hydrogeologic properties of the formations, and project requirements. Estimate at least 20 percent more than the theoretical volume of grout calculated in step 1 above.

For typical cement-based grouts, properly mix the grout as follows:

- Add one 94 pound(lb) bag of Type I or Type II Portland cement to every six to seven gallons of water. Thoroughly mix the cement and water in a container until the slurry is free of lumps.
- Add two to ten percent unaltered bentonite powder to retard shrinkage and provide plasticity. The bentonite powder is added dry to the cement-water slurry without first mixing it with water. Thoroughly mix the grout until free of lumps.

For typical bentonite-based grouts, properly mix the grout as follows:

- Bentonite powder must be the first additive placed in the water through a venturi device. Use approximately one to 1.25 lb of unaltered bentonite to each gallon of water.
 - After the bentonite-water mix is allowed to hydrate, add up to two lb of Type I Portland cement (per gallon of water) to stiffen the mix.
- c. Repeat step b until the desired volume of grout has been obtained. It is recommended that extra grout be mixed to account for grout losses in the formation and at the ground surface.

- d. With the casing or augers at the top of the divider seal, lower a tremie or grout pipe equipped with a side discharge to the required depth, slightly above the divider seal.
 - e. Inject grout through the tremie pipe to the top of the divider seal. The tremie pipe should be kept full of grout from start to finish with the discharge end of the grout pipe completely submerged as it is slowly and continuously lifted. Tremie the grout down the grout pipe in one continuous operation until grout of similar density discharges from the annular space at the ground surface. Approximately five to ten feet of grout pipe should remain submerged in the grout until the grouting is complete. If casing or auger removal does not commence until grout injection is completed, then additional grout shall be tremied in the annular space, as needed during casing removal, to maintain a continuous column of grout up to the ground surface.
 - f. Once grouting is complete, pumps and hoses shall be flushed with clean water, after removing tremie pipe from borehole.
 - g. Record total grout volume used for annular seal and compare with calculated grout volume.
12. Soil cuttings and drilling fluids shall be sampled and disposed of in accordance with project specifications and SW-MWD- - Cuttings and Fluids Management. When the borehole is completed and the area is cleaned up, all contaminated equipment, including down-hole tools, hand tools, and drill rig shall be decontaminated in accordance with SW-MWD-506-0 - Decontamination at the designated project decontamination pad prior to further drilling activities.
 13. Place a stake at the location of the boring or monitoring well and locate the as-built location on the project drawings. If the boring was relocated, note and record in which direction and the amount the boring was relocated.

8.0 METHOD-SPECIFIC OVERBURDEN DRILLING METHOD PROCEDURES

There are numerous overburden drilling methods available and research for new drilling techniques is continually developing. In this section, the procedures for six different overburden drilling methods have been outlined.

8.1 HOLLOW STEM AUGER DRILLING METHODS

Drilling shallow borings (less than 30 feet in depth) are typically conducted, at least initially, using hollow stem auger (HSA) drilling techniques (HSA). Representative soil samples may be obtained with a sampler through the center of the lead auger. Commonly, the inside auger diameter is four to six inches, and the augers produce a borehole eight to 12 inches in diameter. Auger rigs can be truck-, track-, or skid-mounted. The use of hollow stem augers as the method of overburden drilling are limited by groundwater conditions, soil characteristics, and the equipment used.

8.1.1 Hollow Stem Auger-Specific Equipment List

- Hollow stem auger flights with minimum inside diameter of 2.5 inches
- Hollow stem auger bolts to attach augers to one another

- Hollow stem auger plug
- Drill rods to attach to hollow stem auger plug
- Auger bit with extra teeth
- Water and mud tub (used if obstruction is encountered)
- Sampling tools

8.1.2 Procedures for Drilling with Hollow Stem Augers

1. Obtain soil sample at ground surface if applicable. Screw an auger plug onto a drill rod, lower it to the bottom of the hole and secure it to inside the auger cutting head if sampling is to be performed and/or if a groundwater monitoring well is to be constructed in the boring. The auger plug will remain in the cutting head as the augers are advanced. The plug follows the advancement of the augers. This plug will help keep unwanted soils from entering through the bottom of the augers.
2. With the first hollow stem auger flight and auger bit attached to the drill rig, rotate the auger into the ground surface to the desired penetration depth, to the limit of the auger flight, or to refusal. Augers are generally 5 feet in length (from top to bottom of joint). Drill cuttings are compressed laterally and carried upwards on the auger flights. If conventional soil sampling methods are not to be used, gather cuttings from the soil pile and describe soil cuttings. SAFETY NOTE: Sample auger cuttings only with the driller's permission and awareness. Do not remove cuttings from soil pile with augers rotating.
3. Prior to sampling, the auger plug is slowly removed from the bottom of the borehole by decoupling the plug from the cutting head (by counter rotation) and raising the drilling rods. After sampling, the drilling rod and drilling plug are replaced, another hollow stem auger flight and drilling rod section are added and this process is continued until the desired depth is reached. If an obstruction is encountered, and depending on the requirements of the project's drilling program, the driller may attempt to employ one of the following (with the geologist's/engineer's approval):
 - Switch to drive and wash methods.
 - Grout and abandon the hole.
4. If the desired depth has been reached and an observation well will not be installed, tremie grout the borehole following the procedures in Section 7.3 Item 11.

NOTE: Hollow stem augers should not be filled with drilling water on hazardous waste sites. Drilling muds should be avoided.

8.1.3 Advantages / Disadvantages of Drilling with Hollow Stem Augers

The advantages of drilling with hollow stem augers are:

- Simplicity of procedure.
- Relatively inexpensive.
- Can be used to obtain soil samples from a wide range of conditions.
- Drilling fluids are generally not required.

- Equipment is readily available.
- The center auger plug can be removed an observation well installed.
- Split-spoon samplers can be used readily.

The disadvantages of drilling with hollow stem augers are:

- Good seals around the top of filter sand packs may be difficult to achieve due to the large annular space when augers are removed.
- Difficulty in penetrating soils with large percentage of cobbles or boulders.
- Difficult to sample unconsolidated granular soils below the water table.
- Cannot be used to drill hard rock formations.
- Generally incapable of drilling much deeper than 100 feet.
- Potential for blow-ins are possible if the material at the bottom of the augers is loose sand or silt and when the head differential between the outside and inside of the casing is large.
- The augers tend to smear the sides of the borehole walls in fine-grained materials which may reduce or modify the permeability of a proposed monitoring well installation and provide well development difficulties.
- As the cuttings are brought upwards, there is potential for cross contamination.

8.2 DRIVE AND WASH DRILLING METHOD PROCEDURES

Drive and wash drilling is begun by driving a hollow casing equipped with a hardened steel casing shoe at the bottom. The casing is driven using repeated blows of a 300 lb. weight repeatedly dropped from at fixed height onto the casing assembly. Casing is normally driven in five foot depth intervals. The casing is then washed out with the advancement of a roller bit. The washing is accomplished by attaching the roller bit to the bottom of the drill rods and rotating the drill rods. The unconsolidated material loosened by the roller bit rises to the ground surface in the space between the roller bit and the casing by means of liquid drilling fluid. This process is repeated until the depth in interest is achieved.

A soil sample is collected by lowering a sampling device (usually a split spoon sampler), attached to drilling rods, to the bottom of the cleaned out casing. The sampler is in turn driven into the subsurface below the bottom of the casing by using a weight drop method. The casing is then driven to the next sampling point and the sequence is repeated. When the unconsolidated materials consist of very dense material, the roller bit may be advanced ahead of the casing to loosen the material prior to driving casing. A monitoring well can be constructed and installed inside the temporary steel casing. The steel casing is removed during well construction. A large quantity of drilling fluid may require collection and disposal.

Drive and wash drilling techniques can help prevent borehole wall collapse and lost circulation. However, lost circulation will probably occur when the materials consist of fractured bedrock or cobbles and boulders.

8.2.1 Drive and Wash-Specific Equipment List

- Steel drill casings
- Tricone roller bits
- Hardened steel casing drive shoes
- Hollow drill rods
- Sampling tools
- Clean water supply, water tank and pump

8.2.2 Procedures for Drilling with Drive and Wash Methods

1. Obtain a soil sample at the ground surface with an appropriate sampler if applicable. Drive a five-foot length of casing to the next sampling point or to the bottom of the casing. The casing shall be driven with a 300-lb. hammer using a hammer drop of 24 inches. The casing blows may be recorded for discrete intervals of casing penetration; changes in strata may be detected by changes in casing blows per foot, especially in shallow borings.
2. After the casing is driven to the desired depth, the casing is removed from the drill rig's drive head and is replaced with hollow drill rods and a tricone roller bit. Water is forced down through the rotating hollow drill rods and exits the side-discharge tricone roller bit at the bottom of the casing. The soil cuttings are dislodged and are carried to the surface for temporary collection into a mud tub. In loose silts and sands, it is suggested that the casing be filled with water to the top of the casing during drilling operations to obtain representative soil samples. The drill rods and sampler should be lifted off the bottom slowly, while maintaining a head of water to the top of casing if conditions dictate. Recirculation of drilling fluid is unacceptable if the boring is contaminated.
3. After a soil sample is obtained, steps 1 and 2 are repeated until the desired depth is obtained.
4. If the desired depth has been reached and an observation well will not be installed, tremie grout the borehole following the procedures in Section 7.3 Item 11.

8.2.3 Advantages / Disadvantages of Drilling with Drive and Wash Methods

The advantages of drilling with drive and wash methods are:

- An open borehole during drilling is assured because of the presence of the casing.
- Clean, relatively undisturbed borehole walls are produced.
- Method allows for inspection of the cuttings throughout the washing process enabling strata changes.
- Method allows for installation of monitoring wells inside the casing.
- In-situ horizontal and vertical hydraulic conductivity measurements can be made.
- Method allows for collection of split-spoon or similar representative samples.

- It is a superior method for monitoring well installation.

The disadvantages of drilling with drive and wash methods are:

- A substantial source of water is required and a drilling water discharge is produced if drilling fluids cannot be recirculated.
- The method is relatively slow; footage rates of 30 to 60 feet per day are common in New England soils.
- The water table and water-bearing zones may be difficult to recognize due to the addition of water into the system during drilling.
- Water circulation may be difficult to maintain in highly permeable, unsaturated soils.
- This method is difficult for very coarse sands and gravels and cobbles and boulders.
- There is a very slight chance for potential for cross-contamination due to flow along the outside of the casing.

8.3 SONIC (ROTARY-VIBRATORY) DRILLING METHODS

The sonic drilling method is one of the most recent development in drilling technology. It is a drilling system that employs the use of high frequency mechanical vibration and rotation to obtain continuous core samples of overburden and most bedrock formations.

NOTE: Most of the information contained in this procedure was taken directly from a Boart Longyear catalogue on Sonic Drilling.

Principle of Sonic Drilling

This drilling technique vibrates the entire drill string at a frequency rate between 50 and 150 cycles per second. The word "sonic" describes the drilling method because this frequency falls within the lower range of sound vibration that can be detected by the human ear.

The sonic drill rig looks and operates much like any conventional top-drive rotary or auger drill rig. The significant difference is that a sonic drill rig has a specially designed hydraulically powered drillhead or oscillator, which generates adjustable high frequency vibrational forces. The sonic head is attached directly to the core barrel, drill pipe or outer casing, sending the high frequency vibrations down through the drill steel to the face of the drill bit.

The oscillator uses two eccentric, counter rotating balance weights or rollers that are timed to direct 100 percent of the vibration at zero degrees and 180 degrees. There is an air spring system in the drill head that insulates or separates the vibration from the drill rig itself.

The vibrational frequency is controlled to suit operating conditions and to achieve optimum drilling rates. When the vibrations coincide with the natural resonant frequency of the steel drill rod or casing a natural phenomenon called resonance occurs. Resonance allows the rig to transfer the vibrational energy into the top of the drill string, and as the drill string starts to resonate it acts like a flywheel or a spring delivering tremendous amounts of energy directly to the bit face. In addition, the fact that soil particles along the side of the drill string tend to move away from the drill string allows for very fast penetration rates.

Sonic Borehole Advancement

Process

The processes which result in borehole advancement are fracturing, shearing and displacement. Drilling through cobbles, boulders and rock is caused by fracturing of the material by the inertial moment of the drill bit. Shearing takes place in dense silts, clay and shales, provided the amplitude of the drill bit is high enough to overcome the elasticity of the formation material. Displacement occurs when unconsolidated formation material is moved away by the vibrating drill bit. The drill bit face is designed for three cases which are as follows:

- "Crowd in" - moves all the bit face material into the core barrel
- "Crowd out" - moves all the bit face material into the borehole wall
- "Neutral" - lets the bit face material seek the path of least resistance

NOTE: This method typically generates approximately 10 to 20% of the volume created by hollow stem auger, rotary or cable tool methods, small percentage of soil cuttings; and it may not need a drilling fluid medium to carry cuttings to the surface unless it is for a well installation. Depending on the stability of the materials to be drilled, the inner core barrel can be advanced ahead of the casing. Both the inner core barrel and the outer casing penetrate the subsurface using vibratory methods, they may or may not be rotating.

Operation

Optimum penetration rates are obtained when the vibration frequency and down-pressure work in harmony. Experienced drillers have a "feel" when this occurs, and it is monitored by observing the oil pressure gauges in the system. The driller watches the pressure gauges and modifies the frequency of the vibration being generated, the rotation, or the down pressure for conditions encountered. Adjustments to the frequency are accomplished with a lever which controls two hydraulic motors that drive the counter- rotating rollers.

8.3.1 Sonic-Specific Equipment List

- Sonic vibratory head mounted on sonic drill rig
- Clean water supply
- Air compressor
- Water pump
- Steel outer casing
- Core barrel and inner casing
- Drill pipe rack
- Drilling platform
- Rotating and vibrating drill bit (three different types)

8.3.2 Procedures for Drilling with Sonic Methods

1. Choose the type of sleeve used for sample collection if samples are to be collected. A sleeve used for the inner core barrel is selected depending on the quality of soil sample to be recovered. The sample can be extruded into a clear plastic sleeve or into a stainless steel tray. If less sample disturbance is required, a clear plastic liner or stainless steel split liner can be placed inside the inner core barrel.

2. Water, air, drilling mud, or lack of drilling fluid medium are various choices available to drill the borehole. Determine the most suitable drilling fluid based on the expected conditions and advantages / disadvantages of the available drilling fluid(s).
3. Drill the inner core barrel into overburden to the desired depth. The driller shall watch his pressure gauges and make the necessary adjustments. Remove the core barrel at the desired core length and extract core sample. If the hole collapsed prior to core barrel's replacement into the hole, spin the outer casing to the bottom of the cored hole. Immediately follow coring operations with the outer casing if the overburden materials collapse around the cored interval. If a monitoring well is to be installed, the outer casing shall be drilled to the bottom of the borehole or to the bottom of the well screen.
4. Repeat steps 1 through 3 until the desired depth is reached. Install a monitoring well if required.
5. Tremie grout the borehole in accordance with Section 7.3, Item no. 11.

8.3.3 Advantages / Disadvantages of Drilling with Sonic Methods

The advantages of drilling with sonic drilling methods are:

- Ability to obtain large diameter (3- to 10-inch) continuous core samples of almost any type overburden without the use of air, fluid, additives, and with or without rotation.
- It can drill through various types of construction debris (i.e., wood, concrete, and boulders).
- Wireline or hammer system available for bedrock coring.
- Capable of drilling with three to ten inch-diameter core barrel and can advance up to 12-inch diameter well casing.
- Flexible drilling (air or water is available).
- The outer casing prevents cross contamination and formation mixing and allows for controlled placement of wells.
- Core samples can be taken directly from the core barrel by extruding it into a plastic sleeve, stainless steel tray or other suitable receptor. For less sample disturbance, samples can be collected with clear plastic or stainless steel split liners which are placed in the core barrel.
- It can drill faster than conventional drilling methods.
- Appears to be cost effective on larger projects where the boreholes are greater than 500 feet in depth or where scores of shallow boreholes are drilled.
- When compared to other drilling methods, sonic drilling methods substantially reduce investigation derived waste and produces uniform boreholes with minimum drift.

The disadvantages of drilling with sonic drilling methods are:

- Expensive. Requires at least one 500-foot deep hole or approximately thirty ten-foot deep holes to make it cost effective.
- Bedrock consisting of sandstone is difficult to core.
- Sonic drilling experience is crucial for proper operations.
- If major mechanical failures occur, replacement parts may not be readily available.
- Drill rigs are larger and use a flat bed truck for a drill pipe platform

8.4 PROCEDURES FOR DRILLING WITH ODEX SYSTEM

The ODEX drilling method has been adapted from an air percussion drilling method used in the construction industry to install earth anchors and tie-backs. The standard percussion drilling equipment has been modified to allow for the installation of a heavy-duty temporary casing. The ODEX method is capable of drilling three- to six-inch diameter holes in unconsolidated materials and bedrock. Conventional sampling is possible with a slight modification of the drilling equipment. The ODEX drilling system is suitable for most soil conditions, although the bit has a tendency to plug in cohesive and granular soils with fines.

The borehole is advanced to a required depth using compressed by a combination of pilot and reamer bits. The pilot bit advances the borehole and then it is enlarged with an eccentric reamer bit to the desired depth. Temporary steel casing is installed directly behind the advancement of the eccentric reamer bit. The compressed air is sent down into the borehole from the surface through a hollow center rod. The cuttings are forced upward between the outside diameter of the hollow rod and the inner wall of the outer casing.

8.4.1 ODEX System-Specific Equipment List

- Pilot bit
- Eccentric reamer bit
- Sampling tools
- Steel drill casings with hardened steel drive shoe welded to leading edge the drive casing
- Compressed air supply with hoses
- Down-hole hammers
- Hardened steel drive shoes

8.4.2 Procedures for Drilling with ODEX System Drilling Method

1. Advance the boring to the required depth by a combination of pilot and reamer bits. This method incorporates simultaneous advancement of the boring with the pilot bit and enlargement with an eccentric reamer bit immediately followed by a driven temporary steel casing. The casing is driven into place by a percussive motion without rotation.
2. When the sampling depth or desired depth is reached, rotate the pilot bit in the opposite direction and align the pilot bit with the eccentric reamer.

3. Withdraw the drill tools from the hole after the bit and reamer are aligned; and finish driving the steel casing to the bottom of the borehole.
4. Proceed to take a representative soil sample inside the casing.
5. Remove sampler (if samples are taken) and repeat steps 1 through 4.
6. At the completion of the hole the steel casing can be removed. If a monitoring well is desired and the temporary steel casing is at least approximately 4 inches in diameter, a smaller diameter monitoring well casing can be installed inside the steel casing. The steel casing is removed upon well installation. Refer to SW-MWD - Monitoring Well Installation & Development for monitoring well installation procedures.
7. Grout the hole in accordance with Section 7.3, Item 11.

8.4.3 Advantages / Disadvantages of Drilling with ODEX System Drilling Methods

The advantages of drilling with the ODEX system drilling methods are:

- Drilling method is fast and extremely cost effective.
- Provides for the installation of temporary and/or permanent casing.
- Small rigs can be used on most terrains and under most weather conditions.
- Borings can be used to install monitoring wells or instrumentation.
- Standard soil samples can be taken.

The disadvantages of drilling with the ODEX system drilling method are:

- Soil sampling may result in a significant reduction in drilling rate.
- Requires an air compressor; air must be filtered to minimize volatile contamination.
- Specialized equipment may not be readily available; requires experienced operator.
- Not suitable for fine-grained soils due to problems with the bit plugging.
- Air emissions may be a problem at contaminated sites due to volatile and aerosol material discharged to the work environment.

8.5 DUAL ROTARY ADVANCEMENT DRILLING METHOD PROCEDURES

The dual rotary advancement drilling method is a unique method of rotating and advancing casing while simultaneously drilling. The DR machine rotates standard mild steel casing ranging from six to 24 inches in diameter while simultaneously drilling out the inside material with either a down hole hammer or a tricone roller bit. Compressed air is generally used for borehole bailing; however, mud rotary drilling can also be performed.

A carbide studded steel drive is welded to the bottom of the first joint of the steel casing. This carbide ring cuts through boulders and overburden material while being rotated either to the left or right. A lower drive assembly chucks hydraulic jaws around the casing to provide the rotating torque. A similar, but smaller top drive assembly rotates four- through 12-inch-diameter drill rods inside the outer casing. Each drive unit acts independently and allows drilling inside and ahead of the casing. Drill cuttings are returned in the annular space

between the drill rods and the outer casing. However, DR rigs must have a rotating discharge swivel that allows the cuttings to go to a cyclone that separates the compressed air from the drill cuttings. Split spoon samples are an optional sampling tool.

8.5.1 Dual Rotary Advancement-Specific Equipment List

- Dual rotary drill rig
- Air compressor
- Carbide studded drive shoe
- Steel casings
- Drill rods
- Separation cyclone
- Cuttings containment unit
- Down hole air hammer or tricone bit
- Discharge swivel

8.5.2 Procedures for Drilling with Dual Rotary Advancement Drilling Method

1. Obtain split spoon surface at ground surface if samples are required.
2. Advance casing and drill bit (tricone roller bit or down hole hammer) simultaneously or independently of one another to the desired depth. Compressed air can be used above and below the water table. The down hole hammer and the roller bit are used with compressed air, and air or water as drilling fluids, respectively. NOTE: If split-spoon or other sampling method is to be employed, the hole should be free of undisturbed material below the bottom of the casing (i.e., the drill bit should penetrate to the bottom of the casing, but not below the bottom of the casing).
3. Check the cuttings in the cuttings containment unit once through the cyclone separator to determine soil characteristics as drilling proceeds.
4. Repeat step nos. 2 and 3 until the desired depth is encountered.
5. If a monitoring well is not to be installed, grout the hole in accordance with [Section 7, Item 17](#).

8.5.3 Advantages / Disadvantages of Dual Rotary Advancement Drilling Methods

The advantages of drilling with dual rotary advancement drilling methods are:

- Capable of drilling and advancing casing simultaneously.
- Drills faster and more reliably than most other drilling methods.
- Cased holes in unconsolidated materials in excess of 500 feet.
- Monitoring wells from two- to 16-inch-diameter well casings can be constructed with up to 24-inch filter pack.
- Air or water can be used as a drilling fluid.
- Instant return of cuttings for soil description.
- Conventional split-spoon samples or cyclone samples can be obtained.

- Method suitable for gravels, cobbles, boulders and weathered bedrock.

The disadvantage of drilling with dual rotary advancement drilling methods is that welding and cutting of the casings is time consuming.

8.6 GEOPROBE®-TYPE DRILLING SERVICES

The GEOPROBE® is a hydraulically powered percussion drilling machine used for small diameter subsurface investigations. It can obtain continuous soil cores, discreet soil samples, groundwater samples and vapor samples along with installation of permanent sparge points. It is ideally suited for initial subsurface screening purposes.

8.6.1 Geoprobe® Drilling Services-Specific Equipment List

- Geoprobe® drill apparatus mounted on four wheel drive vehicle (vehicle could be a Bobcat Loader)
- Decontamination equipment
- Small diameter drill rods
- Sampling tools designed for Geoprobe®

8.6.2 Procedures for Drilling with Geoprobe® Drilling Equipment

- The following presents a procedure for collecting soil samples using Geoprobe® (direct push) technology.
- Determine that there are no utilities above or below the sampling location.
- Set up a staging area near the sampling location with plastic sheeting for sample collection.
- Decontaminate the soil sampling device.
- Push the sampling device to the desired depth. Retrieve the sample, remove the acetate sleeve from the sampling device, and cut open the acetate sleeve to expose the soil sample.
- Screen the soil sample with the photo ionization detector (PID) to detect organic vapors.
- Describe the soil sample on a geologic log according to the Burmister Soil Classification system.
- Collect the soil sample in labeled containers provided by the laboratory.
- Place the soil samples in a cooler maintained at 4 degrees centigrade.
- When the sampling device has reached the final depth, remove the soil sampling device and fill the borehole with neat cement grout.
- Restore the surface as necessary (i.e.; cold patch blacktop surfaces).
- Decontaminate sampling tools before each boring, after collecting each soil sample, and after each boring.

8.6.3 Advantages / Disadvantages of Geoprobe®-Type Drill Rig

The advantages of drilling with Geoprobe®-type equipment are:

General Advantages:

- Low overall costs
- Accessible to limited areas, low profile

For Soil Sampling:

- No cuttings generated
- Continuous coring
- Discrete interval sampling
- Split barrel sampler
- Brass, stainless steel, or acetate liners available on some rigs

Soil Vapor Sampling:

- Some rigs are EPA and RWQCB accepted
- Depths to 50 feet
- Inert 1/8-inch sampling tubing
- Easy to decontaminate

Groundwater Sampling:

- Stainless steel screen
- Installation of temporary "Mini-wells"
- Vertical water gradients

The disadvantages of drilling with Geoprobe®-type equipment are:

- Capable depth of only approximately 50 feet
- Experienced drillers are necessary
- Not appropriate for formations with cobbles or boulders
- Cannot core rock
- Only small diameter wells can be installed

9.0 ATTACHEMENTS

Attachement A – Blank Boring Logs

Attachment A, Sheet 1 of 2

Stone & Webster Engineering Corporation				BORING LOG				Boring J.O. Sheet 1 of	
Site: Client: Coordinates: Groundwater Depth/Date: Contractor:						Logged by: Date Start - Finish: / / - / / Ground Elevation: ft Total Depth Drilled: ft Rig Type:			
Methods: Drilling Soil: Sampling Soil: Drilling Rock:						Casing Used:			
Comments:									
Elev (ft)	Depth (ft)	Sample Type No.		Blows or Recovery RQD	SPT N Value	USC Symbol Drill Rate (min/ft)	Sample Description		
Legend/Notes • Datum is • ▽ indicates groundwater level. • ■ indicates location of samples. • Blows = number of blows required to drive 2" O.D. sample spoon 6" or distance shown using 140 pound hammer falling 30". • () = inches of sample recovery. • Recovery = % rock core recovery. • RQD = Rock Quality Designation. • SPT N = Standard Penetration Test resistance to driving, blows/ft. • USC = Unified Soil Classification system. • * indicates use of 300 pound hammer.									
							Sample Type:		
							Approved: Date:		

Attachment A, Sheet 2 of 2

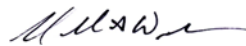
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STANDARD OPERATING PROCEDURE

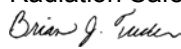
FUSRAP Maywood Superfund Site

Subject: Labeling, Packaging, and Shipping Environmental Samples

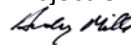
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This Standard Operating Procedure (SOP) - Labeling, Packaging, and Shipping Environmental Samples is to be employed at the FUSRAP Maywood Superfund site (FMSS) when samples are to be collected for laboratory analysis.

The purpose of this SOP is to provide detailed guidance on how to label, package and ship samples of various matrices for analysis by a fixed-based laboratory. It also provides guidance on how the samples should be labeled and how the Chain-Of-Custody (COC) form that accompanies the samples should be filled out.

2.0 SCOPE

This SOP details the materials, equipment, and methods common to all sample labeling, chain-of-custody, packaging, and shipping activities for groundwater, surface water, soil, and sediment samples. Actual sample collection or addition of chemical preservatives to samples are not addressed in this SOP. See the Maywood task-specific Sampling and Analysis Plan (SAP) for this information. For guidance on shipment of radioactive samples, see Maywood SOP 508, Procedure for Shipping Radiologically Contaminated Environmental Samples. Always consult program-specific requirements for labeling, packaging, and shipping (see Section 3.1.6 of the Maywood Field Sampling Plan (part of the Chemical Data Quality Management Plan) to ensure compatibility of this SOP with project requirements. Field changes to this SOP shall be discussed with the Project Manager or Project Chemist prior to implementation and shall be documented in project field logbooks.

Samples classified as Poison A, Poison B, radioactive, corrosive, or oxidizer, or remediation wastes are not covered in this SOP.

3.0 REFERENCES

FUSRAP Maywood Superfund Site Chemical Data Quality Management Plan, Stone & Webster, May, 1999.

4.0 DEFINITIONS

COC - Chain-Of-Custody form

Matrix - The physical description of the medium being sampled e.g. soil (solid), aqueous (liquid)

SOP - Standard Operating Procedure

QA - Quality Assurance

QC - Quality Control

CQCSM – Contractor Quality Control System Manager

CQAB – Chemical Quality Assurance Branch

LIMS – Laboratory Information Management System

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates the USACE's requirements into technical direction of project. Reviews and approves technical progress, ensures that Contractor Quality Control System Manager (CQCSM) has been properly briefed and is prepared for packaging and shipping task.

5.3 CONTRACTOR QUALITY CONTROL SYSTEM MANAGER (CQCSM)

The CQCSM, or his designee ensures that field personnel have been briefed in COC, sample packaging and shipping in accordance with the project requirements, this SOP and related SOPs. Assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin. Assures that all necessary personnel are mobilized on time. Maintains daily log of activities during each day of fieldwork.

The CQCSM, Project Chemist, or their designee is also responsible for determining that samples are properly packaged and shipped, and for determining that COC procedures are implemented from the time the samples are collected to their release to the shippers.

Should field conditions necessitate changes in the number and/or type of samples collected, or changes in sample shipment dates, the CQCSM must notify the Project Manager and the Project Chemist of the changes prior to completion of field activities.

The CQCSM coordinates and consults with the Task Manager or Project Superintendent on decisions relative to unexpected occurrences or deviations from this SOP during the packaging and shipping phase.

The CQCSM shall notify the Project Chemist of the number and type of samples and approximate collection, shipment, and delivery dates for all samples prior to leaving for the field.

5.4 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with the Maywood General Site Safety and Health Plan (SSHP). Ensuring the fulfillment of the requirements of the SSHP is the responsibility of the Site Safety and Health Officer (who may also serve as a sample packer and shipper).

5.5 PROJECT CHEMIST

The Project Chemist is responsible for coordinating sample shipment with the laboratories to minimize holding times and assure proper handling of all samples.

The Project Chemist shares responsibility with the CQCSM for determining that samples are properly packaged and shipped, and that chain-of-custody procedures are implemented from the time the samples are collected to their release to the shippers.

5.6 SITE PERSONNEL

All employees who are engaging in sample packaging and shipping activities are required to read and sign the SSHP and to follow the procedures in this SOP, unless superseded by project specific requirements. All sample packaging and shipping activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

Field sampling personnel are expected to carry out the sample packaging and shipping activities. They are responsible for the care and custody of the samples collected until they are properly disposed or dispatched. The CQCSM or Project Chemist should be contacted if any problems arise during this phase of the sample collection process.

Personnel assigned to a project team with the task of collecting and shipping samples will be trained in specific techniques of sample collection and shipment.

6.0 PROCEDURE

6.1 EQUIPMENT

The following is a list of equipment & material commonly used for labeling, packaging and shipping samples:

- Nylon filament tape
- COC forms
- COC seals
- Styrofoam, and/or bubble wrap
- Resealable plastic bags
- Permanent felt tip marker

- Pen (black permanent ink)
- Ice
- Shipping coolers
- Labels
- Metal cans (if high hazard samples are anticipated)
- Absorbent pads
- Transparent shipping tape
- Trash bags
- Duct tape (seals off openings in coolers)
- Knife or scissors to cut tape

6.2 SAMPLE LABELING

Prior to sample removal from the sampling location and packaging and shipment to an offsite laboratory, all sample containers will be assigned a permanent sample label with a unique sample identification number assigned from the project specific database. All notations on the label will be marked using indelible ink. Use prepared sample labels (whenever possible) to document all information necessary for effective sample tracking. In the case of soil samples, the boring number and the depth at which the sample was taken should also be included on the label. The information on the label will include the following:

- Date and time of sample collection (use military 24-hour format for the time)
- Sample ID number
- Project identification
- Type(s) of analysis to be performed
- Preservation method used for sample

The sample label can be modified to satisfy USACE/project specific requirements. For example, all sample labels and COCs associated with samples shipped to the USACE QA laboratory shall have a Chemical Quality Assurance Branch (CQAB) assigned number corresponding to the numbering sequence in the CQAB laboratory's Laboratory Information Management System (LIMS).

A set of labels will be prepared and numbered to correspond with unique samples to be collected. For certain projects requiring strict quality control, blank, duplicate, or field spikes, the QC sample type shall not be identified as such on the label as this may compromise the quality control function. In those instances, assign a unique sample number to each QC sample and record the type of QC sample collected in the field logbook. In all other instances, assign a sample number using the Sample ID System for all Maywood Sites (from Table 3-1 of the Maywood FSP) as follows:

XXXX-AAmmNNNNn-##### - to be used for data base reporting

XXXX##### - to be used for sample collection and delivery to lab

XXXX = Site Designator

Maywood Interim Storage Site = MISS

Stepan Property = STEP

Sears Property = SEAR

New Jersey Vehicle Inspection Station = NJVS

etc. (others as needed)

AAA = Area/Activity Designator

Pilot Test = PT1
Burial Pit 1 = BP1
Background = BKG
etc. (others as needed)

mm = Media

Surface Soil = SS
Subsurface Soil Boring = SB
Sediment = SD
Ground Water = GW
Surface Water = SW
Storm Water = ST
Aquatic Biota = AB
Terrestrial Biota = TB
Air Filter = AF
Radon Detector = RD
TLDs = TD
Quality Control = QC
etc. (as new media types are identified)

NNNN = Station Number

Unique station identifier

n = Sample Type

Regular = 0, Trip Blank = 3, Duplicate = 1,
Equipment Rinsate = 4, Split = 2, Site Source Water Blank = 5

= Sequential Sample Number

Unique for each sample

6.3 CHAIN-OF-CUSTODY

Stone & Webster has established a program of sample custody that shall be followed during sample handling activities from the particular Maywood property to the laboratory. This program is designed to ensure that each sample is accounted for at all times.

- The objective of the sample custody identification and control system is to ensure, to the extent practicable, that the following conditions are met.
- Samples scheduled for collection are uniquely identified
- The correct samples are analyzed and are traceable to their records
- Important sample characteristics are preserved
- Samples are protected from loss or damage
- Any alteration of samples (e.g., filtration, preservation) is documented
- USACE confidentiality is maintained
- Sample COC shall be maintained through sample collection, shipment, storage, and analysis as a legal record and auditable trail of sample possession.

- Possession will be traceable by means of a COC record. The COC bears the signatures of the persons in possession of the samples. The COC shall remain with the samples at all times until receipt by the laboratory.

The appropriate sampling and laboratory personnel shall complete COC records for each sample. The following COC protocol shall be employed by sampling crews and recorded on the COC for each sample:

- Maywood Sample ID number (as described in the Labeling Section of this SOP). Use a separate column (or line depending on the configuration of the particular COC being used) for each parameter to be tested for a given sample number.
- Bottle types and sizes
- Analytical test parameters or test parameter method (in Analysis/Remarks Section); e.g., EPA Method 8270. Also indicate lab QC sample, if applicable; e.g., MS/MSD.
- Specific instructions to the lab; e.g., unique turnaround times, specific analytes or other special instructions for analysis
- Number of containers corresponding to each sample ID number and parameter,
- Preservatives used (if any),
- Specific sample collection method (grab or composite)
- Type of matrix
- Date and time of each sample collection
- Name(s) of the sampler(s) and signature of the person shipping the samples
- Date and time that the samples were sealed for delivery
- Names of those responsible for receiving the samples at the laboratory (to be filled out at the laboratory).

The COC record shall be completed in triplicate using black waterproof ink. If any changes or corrections are made, they should be made by drawing a single line through the entry, initialing and dating the change, and entering the correct information. One copy shall accompany the samples to the laboratory, another is kept by the sample crew chief and transferred to the Project Chemist, and the last copy shall be maintained in the project file. Additional copies shall be provided as needed for the project. Whenever collocated or split samples are collected for comparison analysis by the USACE QA Laboratory or a government agency, a separate chain-of-custody is prepared for those samples and marked to indicate with whom the samples are being split.

After shipment, the laboratory sample receiver signs and records the date and time of receipt on the COC, completing the sample transfer process.

6.4 SAMPLE PACKAGING

Sample containers are generally packed in insulated coolers for shipment. Appropriate packing materials are bubble wrap and styrofoam. Bottles are packed tight so that they cannot move during shipment. The following steps shall be followed:

- To eliminate the chance of breakage during shipment, approximately one inch of inert cushioning material shall be placed in the bottom of the cooler.
- Place each sample container tightly inside its own plastic bag and seal, as a precaution against cross-contamination due to leakage or breakage.
- Place containers upright in the cooler in such a way that they will not touch during transport.
- After samples have been packed, ice shall be placed in double Ziplock bags and added to the cooler. Use enough ice to ensure that the temperature of the cooler contents are $\leq 4^{\circ}\text{C}$. Also make sure the entire cooler is packed tightly so no containers shift during shipping, thus avoiding breakage.
- Include all paperwork in a separate Ziplock bag taped to the inside lid of the cooler.

Chain-of-Custody documents will accompany all shipped samples

For courier pickup - COC forms will be completed by the sampler and courier and placed in the cooler (see Sections 6.3 and 6.5).

For sample shipment - COC forms will be completed by the sampler and placed in the cooler (see Section 6.3).

1. Duct-tape cooler lid seal and drains. Tape the cooler shut with strapping tape.
2. Affix numbered, signed, and dated custody seals to ensure that samples have not been disturbed during transport. Cover custody seals with clear tape.
3. If not already there, the lab address will be written on the top of the cooler with indelible ink.

6.5 SAMPLE SHIPPING

After collection, all samples shall be transported to the contract laboratory in such a manner as to preserve their integrity. To maintain the required level of sample custody, overnight carrier shipping manifests are normally employed. Field samples that require shipment shall be sent to the laboratory by an overnight courier service within 24 hours of their collection. No sample shall remain on site for more than 24 hours after collection unless previous arrangements have been made with the laboratory, i.e., weekend sampling.

Courier Pickup of Environmental Samples

If the laboratory is located within a reasonable distance from the site, arrangements may be made to have the laboratory pick up the samples. Most laboratories have their own courier service and will pick up samples if the site is within 200 miles of their facility. Coordinate with the receiving laboratory prior to sample collection events to ensure that the desired pick-up will occur on time.

When the samples are transferred to a laboratory courier, the sampler shall:

- Sign, date, and enter the time in the “Relinquished by” entry location of the COC form.
- Make sure that the courier receiving the sample signs the “Received by” entry of the COC form.

Shipping Environmental Samples

Environmental samples requiring shipment to a laboratory shall be sent next-day delivery by Federal Express or an equivalent overnight carrier. The receiving laboratory shall be given advance notice by the Stone & Webster CQCSM no later than 48 hours before sample shipment.

If Friday sampling is unavoidable and Saturday delivery is not possible, samples shall be properly stored (custody and sample preservation must be maintained) over the weekend. If prompt shipping and laboratory receipt of samples cannot be guaranteed, the samplers will be responsible for proper storage of samples until adequate transportation arrangements can be made or sample collection schedules will be modified by the CQCSM. If holding times would be exceeded by storing samples over the weekend (e.g., if there are 24 hour turnaround requirements), alternative arrangements must be made by the CQCSM for sample collection and shipment or pickup.

Note: Overnight carriers usually will not accept responsibility for signing COC forms. Therefore, the Sampler shall sign, date, enter the time in the "Relinquished by" entry location of the COC form, place inside a zip-lock bag inside the sample container, and seal the container as specified in Section 6.4 - Sample Packaging.

7.0 ATTACHMENTS

Attachment A – Sample Label

Attachment B – Example Chain-of-Custody

ATTACHMENT A
Sample Label

Stone & Webster

Sample ID: 12b - 024778

Depth: _____

Sample Designator: 12b-EMP-MW-000 -GW-4-024778

Analysis: TAL Metals+Li/B

Collector: _____

Company: _____

Date: _____ **Time:** _____

Preservative: HNO3

Attachment: 5

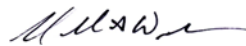
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STANDARD OPERATING PROCEDURE

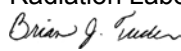
FUSRAP Maywood Superfund Site

Subject: Cuttings and Fluids Management

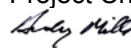
APPROVED:

 09/30/2003

Mike Winters
Radiation Laboratory Manager Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This standard operating procedure (SOP) presents the management options for handling investigation-derived waste (IDW) at the FUSRAP Maywood Superfund site (FMSS).

2.0 REFERENCES

U.S. Environmental Protection Agency, Region IV, Engineering Support Branch Standard Operating Procedure and Quality Assurance Manual, 1986.

U.S. Environmental Protection Agency, A Compendium Superfund Field Operations Methods, EPA/540/P-87/001.1, 1987.

U.S. Environmental Protection Agency, Guide to Management of Investigation-Derived Wastes, 9345.3-03FS, January 1992.

4.0 GENERAL

4.1 DEFINITIONS

Hazardous Waste - Waste that is a RCRA regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity, or toxicity.

4.2 RESPONSIBILITIES

The Project Superintendent is responsible for ensuring that all investigation derived waste (IDW) procedures are conducted in accordance with this SOP. The Project Superintendent is also responsible for ensuring that handling IDW is in accordance with site-specific requirements as per the Maywood Environmental Protection Plan (EPP).

4.3 APPLICABILITY

4.4 REQUIRED EQUIPMENT

IDW Containers

5 5.0 PROCEDURES

5.1 APPLICABILITY

Field investigation activities result in the generation of waste materials that may be characterized as hazardous waste. IDW may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials generated from collection of samples; residues from testing treatment technologies and pump and treat systems; contaminated personal protective equipment (PPE); and solutions (aqueous or otherwise) used to decontaminate non-disposable protective clothing and equipment. The management of IDW must comply with (or waive) regulatory requirements that are applicable or relevant and appropriate requirements (ARARs), such as the Land Disposal Restriction Regulations and treatability study exemptions.

During site investigations where materials are known (via field instrumentation or visual observation) or suspected (historic information) to be contaminated, sampling activity (i.e., soil boring or installation monitoring wells) will produce waste intrinsic to the site. The activities associated with disposition of this material must not contribute further to environmental degradation or pose a threat to public health or safety.

The three general options for managing IDW are (1) collection and on-site disposal; (2) collection and off-site disposal; and (3) collection and storage. The option selected should take into account the following factors:

Type and quantity of IDW (soil, sludge, liquid, debris).

IDW minimization, and consistency with the IDW remedy and the site remedy.

5.2 ON-SITE DISPOSAL

For the Maywood project, significant on-site disposal is not anticipated.

5.3 OFF-SITE DISPOSAL

5.3.1 Soil / Sludge / Sediment

Soil / sludge / sediment will be field characterized as per Section 2.5.1 of the Chemical Data Quality Management Plan (CDQMP). This characterization may be used to determine disposal options.

Before sending offsite to a TSDF, analysis is required. Also manifests may be required. Confirm that the TSDF and transporter are permitted for the respective wastes.

5.3.2 Aqueous Liquids

Aqueous liquids will be field characterized. This characterization may be used to determine disposal options.

When the final site remedy requires off-site treatment/disposal, the IDW may be stored (e.g., mobile tank or drums) or returned to its source until final disposal. The management option selected should take into account other relevant site-specific factors including weather, storage space, and public concerns/perceptions).

Before sending offsite to a TSDF, aqueous liquids must be analyzed and manifests must be filled out. Confirm that the TSDF and transporter are permitted for the respective wastes. See the Maywood Material Handling/Transportation and Disposal Plan (MHTD) for further details.

5.3.3 Disposable PPE

Field judgement on level of contamination will be made and an appropriate disposal method will be selected. If offsite disposal at a regulated facility is required, analysis of soil and water in contact with PPE may be used to determine disposal options.

5.4 INTERIM MEASURES

- Storing IDW on-site until the final action may be practical in the following situations:
 1. Returning wastes (especially sludges and soils) to their on-site source area would require reexcavation for disposal in the final remediation alternative.
 2. Interim storage in containers may be necessary to provide adequate protection to human health and the environment.
 3. Off-site disposal options may trigger land disposal regulations under RCRA. Storing IDW (e.g., drummed, covered in a waste pile) until the final disposal of all wastes from the site will eliminate the need to address this issue more than once. The management option selected should take into account relevant site-specific factors including weather, storage space, and public concerns / perceptions.
- Segregate and containerize all waste for future treatment and / or disposal.
 1. Containment options for soil/sludge/sediment includes drums or covered waste pile in area of concern.
 2. Containment options for aqueous liquids include mobile tank or drums.
 3. Containment options for PPE include drums or roll-off boxes.

6.0 RESTRICTIONS / LIMITATIONS

The Project Superintendent shall consider the following parameters to determine the most appropriate disposal option for aqueous liquids and protect health and safety of site workers and the public:

- The volume of IDW
- The contaminants present in the groundwater
- The presence of contaminants in the soil at the site

- Whether the groundwater or surface water is a drinking water supply
- Whether the groundwater plume is contained or moving

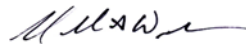
Special disposal/handling may be needed for drilling fluids because they may contain significant components.

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

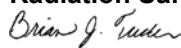
Subject: Decontamination

APPROVED:

 **09/30/2003**

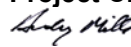
Mike Winters **Date**

Radiation Safety Officer

 **09/30/2003**

Brian Tucker **Date**

Project Chemist

 **09/30/2003**

Andy Mills **Date**

Project Manager

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe techniques for removing contamination from personnel and sampling equipment before and after sampling events at the FUSRAP Maywood Superfund Site (FMSS). Decontamination is necessary to prevent spread of contaminants, to prevent cross-contamination of samples, and to protect the Safety and Health of site personnel.

2.0 SCOPE

This SOP provides information on the proper methods for decontamination of personnel and sampling equipment.

3.0 REFERENCES

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, DHHS (NIOSH) 85-115, October 1985.

Field Standard Operating Procedures (FSOP) 7, "Decontamination of Response Personnel", USEPA, January 1995.

29 CFR Part 1910, "Hazardous Waste Operations and Emergency Response", March 1989.

U.S. Environmental Protection Agency, Compendium of ERT Soil Sampling and Surface Geophysics Procedures, EPA/540/P-91/006, January 1991.

4.0 DEFINITIONS

None.

5.0 RESPONSIBILITIES

Personnel requirements for decontamination activities will vary depending upon the size and scope of the sampling effort. Designated field personnel are responsible for implementing all aspects of this SOP. In addition, all field activities must be carried out in accordance with a Maywood Site Safety and Health Plan (SSHP). Ensuring the fulfillment of the requirements of the SSHP is the responsibility of the Site Safety and Health Officer (SSHO) who may also perform sampling and decontamination activities.

6.0 PROCEDURE

6.1 APPLICABILITY

This procedure serves as guidance on the proper methods of decontaminating personnel and sampling equipment. These procedures can be modified or expanded to meet specific Maywood project requirements. Such changes should be documented with the task-specific Sampling and Analysis Plan or SSHP.

6.2 EQUIPMENT AND MATERIALS

In selecting decontamination equipment, consider whether the equipment itself can be decontaminated for reuse or easily disposed. The recommended equipment for decontamination of personnel, personal protection equipment (PPE), and equipment are:

- Appropriate personnel protective clothing (as required by SSHP).
- Field Sampling Plan (FSP)
- Site Safety and Health Plan (SSHP). To be read and signed by all site personnel prior to site activities.
- Field Logbook(s)
- Non-phosphate detergent.
- Selected solvents (e.g., nitric acid (for non-metallic equipment only), acetone, hexane, or methanol), deionized water and tap water.
- Brushes
- Spray bottles for solvents and water.
- Wash basins.
- Plastic sheets.
- Emergency eyewash bottle.
- Trash containers and paper towels.
- Aluminum foil and Plastic garbage bags.
- Storage containers (e.g. DOT approved 55 gallon drums and 5 gallon buckets with lids) for storage and disposal of contaminants and contaminated soils.

Steam cleaning and pressure washing equipment may be used for larger equipment and

vehicles.

Additional equipment necessary for decontaminating personnel vary depending upon the level of personnel protection clothing and equipment used onsite. These additional items are identified in relevant sections of this Standard Operating Procedure.

6.3 PERSONNEL DECONTAMINATION

Care must be taken to avoid any decontamination techniques which might be harmful to the individual (using solvents or acids on the skin). When serious or life threatening wounds are involved, First Aid ALWAYS takes precedence over decontamination and associated contamination control measures.

6.3.1 Decontamination of personnel will be performed under the supervision of a project safety & health representative (e.g. SSHO, RSO, RPT).

6.3.2 The following agents and techniques should be used when decontaminating personnel.

- **SOAP & WATER-** Wash area thoroughly for 2-3 minutes with tepid water and a mild low ph soap such as Phisoderm, Phisohex, Radcon, etc. Wash away from eyes, ears, nose, & mouth. The area should be resurveyed by a safety & health representative after each attempt to assess the effectiveness of the decontamination.
- **SOFT BRISTLE BRUSH-** Brushes may be used in conjunction with soap and water if soap & water alone do not adequately decontaminate the affected area. The pressure should not be great enough to bend the bristles out of shape. Avoid abrasing the skin in any way when using this technique. This technique should not be used on or in the vicinity of serious wounds.
- **SWEATING-** Wrap the contaminated area in plastic and place in warm water if possible for 20-30 minutes. Wash the area with soap & water after sweating. Use this technique if washing alone does not produce the satisfactory results. This technique shall not be used for the head, or serious wounds.
- **FLUSHING-** This is the only approved technique for decontaminating the eyes, ears, nose, mouth, and wounds.

6.4 EQUIPMENT DECONTAMINATION

6.4.1 General

Adequate supplies of all materials must be kept on hand. This includes all rinsing liquids and other required materials.

6.4.2 Engineering Controls to Minimize Equipment Contamination

Whenever practical, employ engineering controls to either prevent or minimize the exposure of equipment to site contamination. Steps such as placing monitoring equipment in plastic bags, exposing only sampling ports or sensors to the environment can reduce or eliminate the need for decontamination. Once equipment is decontaminated, covering equipment with an impermeable,

strippable coating (e.g. aluminum foil) will maintain cleanliness for the next use.

6.4.3 Material Compatibility

The substances chosen for equipment decontamination must be effective in removing the known or suspected site chemicals of concern.

The chemical and physical compatibility of the decontamination solutions or other decontamination materials to both each other and the chemicals of concern must be determined before they are used. Any decontamination method that: 1) poses a direct health hazard to workers (e.g., vapors from chemical decontamination solutions may be hazardous if inhaled, or they may be flammable); or 2) permeates, degrades, damages or otherwise impairs the safe functioning of the PPE is incompatible with such PPE and should not be used.

6.4.4 Decontamination Facility Design

At a hazardous waste site, decontamination facilities should be located in the Contamination Reduction Zone (CRZ), i.e., the area between the Exclusion Zone (the contaminated area) and the Support Zone (the clean area). Refer to SSHP for FMSS -specific requirements.

The extent of known contamination will determine to what extent equipment needs to be decontaminated. If the extent of contamination cannot be determined, cleansing should be done assuming that the equipment is highly contaminated until enough data are available to allow assessment of the actual level of contamination.

The following general decontamination principles should be considered when laying out the physical arrangement of the decontamination line:

- The decontamination method selected must be effective for the known or suspected chemicals of concern; and
- The decontamination process should consist of a series of steps performed in a specific sequence, each step performed at a separate station in order to prevent cross contamination with the stations preferably arranged in a straight line.
- All decontamination workers must be decontaminated before entering the clean Support Zone. Refer to Section 6.3 of this SOP and SSHP for safety issue considerations.

Site-specific factors that affect the decontamination facility design must be considered. The following are the typical factors for consideration:

- Proximity to work areas, water supplies, and contaminated material staging areas.
- The potential for exposure based on assigned worker locations, duties, activities and functions.
- The chemical, physical, and toxicological properties of the wastes.
- The movement of personnel and/or equipment among different zones.

- Contingency plans for emergencies.
- The methods available for protecting workers during condamination.

6.4.5 Standard Procedure for Small Equipment Decontamination

The 9-step decontamination procedure listed below is the generic standard procedure for small equipment (e.g. split spoons, hand augers, bailers, etc.) decontamination which combines both physical and chemical removal steps. This procedure may be modified to address site-specific chemicals of concern and media being sampled. Solvent rinses are not necessarily required when organics are not a contaminant of concern and may be eliminated from the sequence specified below. Similarly, an acid rinse is not required if analysis does not include inorganics.

- Remove any solid particles from the equipment or material by brushing and then rinsing with available tap water. This initial step is performed to remove gross contamination.
- Wash equipment with a non-phosphate detergent solution.
- Rinse with distilled/deionized water.
- If metals are among site chemicals of concern - Rinse with 10% nitric acid and then rinse with distilled/deionized water. If no samples are being collected for metals analysis, skip this step.
- Use the appropriate solvent rinse(s) if the sample will be analyzed for organics. Refer to Attachment 1 for the appropriate decontamination steps for the known or suspected chemicals of concern cross-referenced by EPA SW-846 analytical method numbers. The decontamination procedure for EPA Method 8270 shall be employed as the organic compound decontamination procedure if samples are being collected for more than one type of organic analysis.
- Air dry the equipment completely.
- Rinse again with distilled/deionized water.
- Dispose of all rinse and decontamination fluids in an appropriate manner in accordance with specifications in the Remedial Action Work Plan.

Sampling equipment that requires the use of plastic tubing should be disassembled and the tubing replaced with clean tubing, before commencement of sampling and between sampling locations.

6.4.6 Standard Procedure for Large Equipment Decontamination

Steam cleaning is the method of choice for large equipment decontamination. The pressurized fluid stream provides effective physical contaminant removal that can be rapidly applied to both large areas and small, hard to reach areas. Detergents and water soluble solvents such as isopropanol can be added to the steam cleaning water reservoir as required for the chemicals of concern. The use of this procedure does require the use and/or construction of containment devices

for the capture of the solids and rinsates generated during the process. Tubs such as plastic wading pools can be placed under smaller equipment to catch runoff.

The decontamination process for larger equipment such as drilling rigs require the construction of containment areas to capture the runoff. The design of this containment area can be as simple or as elaborate as frequency-of-use and chemicals of concern dictate. A simple containment area can be constructed from landscaping timbers and a waterproof pool tarp. A sloped, hard surface such as a paved portion of parking lot should be used to keep the tarp from tearing due to differential settling of the heavy equipment. The landscaping timbers should be arranged in a squared off “U” with the open side on the uphill side of the area. The “U” structure should be wide enough to allow decontamination workers to move freely around the equipment being decontaminated. The tarp is then draped over the timbers and pulled in tight against the inside side of the landscaping timbers to form a flat working area. heavy duty staples can be used to secure the tarp to the outer sides of the landscaping timbers. The heavy equipment or portion (such as the bucket of an excavator) that requires decontamination is placed in the area and steam cleaned as appropriate. Drill rigs are usually backed in since the rear of the truck normally requires the most decontamination. The solids and rinsate from the cleaning process will accumulate on the lower side of the tarp. Liquids can be bailed or pumped (using a sump pump) into the appropriate drum or tank. Solids can be shoveled into the appropriate drum or roll-off container. Plastic “walls” can be erected using wooden frames should more complete spray containment be required.

Should site conditions or traffic volume require, a more elaborate decontamination facility can be constructed by digging a sloped excavation, placing an impermeable liner and sump pump, and backfilling with gravel. The vehicles requiring decontamination can then be driven on from one end, cleaned, and driven out the other side.

It should be noted that steam cleaning can create exposure conditions for workers due to both splashing and inhalation. Refer to your health and safety plan for proper personal protection requirements.

6.4.7 Sanitizing Procedures

Reusable clothing and other personal articles must be decontaminated and sanitized before reuse. If practical, reusable protective clothing should be machine washed after a thorough decontamination. Otherwise, clean the clothing by hand.

6.5 QUALITY ASSURANCE

The effectiveness of any decontamination method used at a site should be assessed at the beginning of a project and periodically throughout the life of a project. Visual observation, equipment blanks, and wipe sampling are the typical methods that can be employed to determine the effectiveness of decontamination. Equipment blanks are collected by capturing analyte free water which is poured over sampling equipment after decontamination. These samples are normally included in the task-specific SAP as part

of the project Quality Control program. Refer to your FSP for equipment blank collection frequency.

The SSHO shall monitor project procedures to determine their effectiveness.

The Project Chemist shall monitor the effectiveness of decontamination procedures by evaluating the results of equipment rinsate blanks. If contaminants of concern are detected when equipment blanks are analyzed, insufficient equipment decontamination is indicated and procedures shall require modification.

If a decontamination method is not considered effective, the decontamination program must be revised.

Visual observation, wipe sampling, cleaning solution analysis, and permeation testing are the typical methods used to determine the effectiveness of decontamination.

6.6 DISPOSAL METHODS

All equipment used for decontamination must be decontaminated and/or disposed of properly. Buckets, brushes, PPE, tools, and other contaminated equipment should be collected, placed in containers, and labeled. All spent solutions and wash water should be collected and disposed of properly. PPE that is not completely decontaminated should be placed in plastic bags, pending further decontamination and/or disposal. Refer to SW-MWD-505-0, Cuttings and Fluids Management, for specific instructions regarding the handling and disposition of these materials.

7.0 ATTACHMENT

Decontamination for Organics by Analytical Method

DECONTAMINATION FOR ORGANICS BY ANALYTICAL METHOD

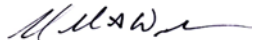
EPA ANALYTICAL METHOD NUMBER	DECONTAMINATION STEPS
8010 HALOGENATED VOLATILES	1. Rinse with mixture of 90% Hexane and 10% Ethyl Acetate 2. Rinse with solution of 90% Ethyl Acetate and 10% Isopropanol 3. Rinse with distilled/deionized water
8015 NON-HALOGENATED VOLATILES	1. Rinse with Isopropanol
8020 AROMATIC VOLATILES	1. Rinse with mixture of 90% Hexane and 10% MIBK 2. Rinse with Isopropanol 3. Rinse with distilled/deionized water
8080/8081 ORGANOCHLORINE PESTICIDES/PCB	1. Rinse with mixture of 90% Hexane and 10% Ethyl Acetate 2. Rinse with solution of 90% Ethyl Acetate and 10% Isopropanol 3. Rinse with distilled/deionized water
8100 TOTAL PETROLEUM HYDROCARBONS	1. Rinse with mixture of 90% Hexane and 10% Ethyl Acetate 2. Rinse with Isopropanol 3. Rinse with distilled/deionized water
8150 CHLORINATED HERBICIDES	1. Rinse with mixture of 90% Hexane and 10% Ethyl Acetate 2. Rinse with Isopropanol 3. Rinse with distilled/deionized water
8240/8260 VOLATILE ORGANICS	1. Rinse with mixture of 90% Hexane and 10% Ethyl Acetate 2. Rinse with Isopropanol 3. Rinse with distilled/deionized water
8250/8270 SEMIVOLATILE EXTRACTABLE ORGANICS	1. Rinse with mixture of 90% Hexane and 10% Ethyl Acetate 2. Rinse with solution of 90% Ethyl Acetate and 10% Isopropanol 3. Rinse with distilled/deionized water

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Field Notebook Content and Control

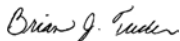
APPROVED:



09/30/2003

Mike Winters
Radiation Safety Officer

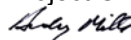
Date



09/30/2003

Brian Tucker
Project Chemist

Date



09/30/2003

Andrew Mills
Project Manager

Date

1.0 PURPOSE

The objective of this Standard Operating Procedure (SOP) is to set criteria for content entry and form of field notebooks for the FUSRAP Maywood Superfund Site.

2.0 SCOPE

This procedure presents the proper methods of using and maintaining field notebooks for site operations for the Maywood Project.

3.0 REFERENCES

Nielsen Environmental Field School, Field Notebook Guidelines, 1997.

4.0 DEFINITIONS

Biota - The flora and fauna of a region.

Decontamination - To remove contaminants from field sampling equipment that might bias analytical results.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform required work.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with the SSHP. The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on maintenance of the field notebook in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

5.5 SITE PERSONNEL

All employees who are engaging in any field activities that require documentation of observations or recording of the specifics of various field activities must be familiar with this Field Notebook Content and Control SOP.

6.0 PROCEDURES

6.1 GENERAL

Each site or operation, as applicable, will have one current site logbook, which will serve as an index of all activities performed at the site. It is initiated at the start of the first on-site activity (e.g., initial reconnaissance survey). Summary entries are made for every day that on-site activities take place. The details of all field activities shall be recorded in a separate field notebook. These field notebooks and the site logbook shall be made part of the project files.

Information recorded in field notebooks include observations, data, calculations, time, weather, description of the data collection activity, methods, instruments, and results. Additionally, the field notebook may contain descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

6.2 EQUIPMENT AND MATERIALS

- Site logbook

- Site-specific plans
- Hard-covered, waterproof field notebook(s)
- Indelible black ink pen
- Ruler or similar scale (in some circumstances)

6.3 PREPARATION

In addition to this SOP, site personnel responsible for maintaining field notebooks must be familiar with other SOPs pertinent to the task at hand. These should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation.

The field notebook is assigned to an individual responsible for its care and maintenance.

Field notebooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the field notebook. The following information shall be recorded inside the front cover of the field notebook:

Person and organization to whom the book is assigned, and phone number(s)

- Start date
- Project Name
- Stone & Webster Job Number
- Project Superintendent's Name
- Sequential Book Number (if applicable)

The first five pages of the field notebook shall be reserved for a table of contents. Mark the first page with the heading and enter the following:

TABLE OF CONTENTS	
Date/Description	Page
(Start Date/Reserved for TOC)	1-5

The remaining pages of the Table of Contents will be designated as such with "TOC" written on the top center of each page.

6.4 OPERATION

The following is a list of requirements that must be followed when using a field notebook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the field notebook. If data-collection forms are specified by an activity-specific work plan, this information need not be duplicated in the field notebook. However, any forms used to record site information must be referenced in the field notebook.
- Information should be factual and unbiased.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Write in black, indelible ink. Do not write in pencil unless working in wet conditions.

- Do not erase or blot out any entry at any time. Before an entry has been signed and dated, changes may be made but care must be taken not to obliterate what was written originally. Indicate any deletion by a single line through the material to be deleted. A change should be initiated and coded using one of the common data error codes shown in Attachment 1. All error codes should be circled.
- Do not remove any pages from the book.
- Do not use loose paper and copy into field notebook later.
- Record as much information as possible.
- All entries should be neat and legible.

Specific requirements for field notebook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the field notebook by inserting the following:

Above notes authored by:

_____	(Sign name)
_____	(Print name)
_____	(Date)

- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
 - a. Date and time.
 - b. Name of individual making entry.
 - c. Description of activity being conducted including station (i.e., well, boring, sampling, location number) if appropriate.
 - d. Unusual site conditions.
 - e. Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data.
 - f. People on site.
 - g. Level of personnel protection to be used.
 - h. Arrival / departure of site visitors.
 - i. Arrival / departure of equipment.
 - j. Sample pickup (chain-of-custody form numbers, carrier, time).
 - k. Sampling activities / sample logsheet numbers.

- l. Start or completion of borehole / trench / monitoring well installation or sampling activity.
- m. Health and Safety issues.
- n. Instrumentation calibration details.

Entries into the field notebook shall be preceded with the time of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the field notebook must reference the automatic data record or form.

While sampling, record observations such as color and odor. Indicate the locations from which samples are being taken, sample identification numbers, the order of filling bottles, sample volumes, and parameters to be analyzed.

A sketch of the station location may be warranted. All maps or sketches made in the field notebook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is towards the top of the page.

Other events and observations that should be recorded include (but are not limited to):

- Changes in weather that impact field activities.
- Subcontractor activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personnel protective equipment.

6.5 POST-OPERATION

To guard against loss of data due to damage or disappearance of field notebooks, copies of completed pages shall be periodically and securely stored by the project. Documents which are separate from the field notebook shall be copied and submitted regularly and as promptly as possible to the project files. This includes all automatic data recording media (print-outs, logs, disks or tapes) and activity-specific data collection forms required by other SOPs.

At the conclusion of each activity or phase of site work, the individual responsible for the field notebook will ensure that all entries have been appropriately signed and dated, and that corrections were made properly (single lines drawn through incorrect information, then initialed, coded, and dated). The completed field notebook shall be submitted to the project records file.

7.0 RESTRICTIONS / LIMITATIONS

Field notebooks constitute the official record of on-site technical work, investigations, and data collection activities. Their use, control, and ownership is restricted to activities pertaining to specific field operations carried out by Stone & Webster personnel and their subcontractors. They

are documents that may be used in court to indicate and defend dates, personnel, procedures, and techniques employed during site activities. Entries made in these notebooks should be factual, clear, precise, and as non-subjective as possible. Field notebooks, and entries within, are not to be utilized for personal use.

8.0 ATTACHMENT

Common Data Error Codes

COMMON DATA ERROR CODES

RE	Recording Error
CE	Calculation Error
TE	Transcription Error
SE	Spelling Error
CL	Changed for Clarity
DC	Original Sample Description Changed After Further Evaluation
WO	Write Over
NI	Not Initialed and Dated at Time of Entry
OB	Not Recorded at the Time of Initial Observation

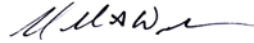
All Error Codes should be circled

STANDARD OPERATING PROCEDURE

FUSRAP Maywood Superfund Site

Subject: Procedure for Shipping Radiologically Contaminated Environmental Samples

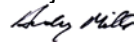
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This procedure presents the proper method for shipping low level radiologically contaminated environmental samples at the FUSRAP Maywood Superfund Site (FMSS).

2.0 SCOPE

This procedure applies to excepted packages for limited quantities of radioactive materials as defined in 49 CFR 173.421.

3.0 REFERENCES

49 CFR Parts 171 and 173 of the Transportation Regulations.

4.0 DEFINITIONS

None

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified to perform required work.

5.2 PROJECT ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for the task.

5.3 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with a site-specific SSHP. The Site Safety and Health Officer is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.4 PROJECT SUPERINTENDENT

The Project Superintendent is the individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed on shipping samples in accordance with the project requirements, this SOP, and related SOPs. He or she assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin, and that all necessary personnel are mobilized on time. The Project Superintendent maintains a daily log of activities each workday.

The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected encounters during field investigations and deviations from this SOP.

5.5 SITE PERSONNEL

Site personnel assigned to ship radiologically contaminated environmental samples will be trained in the proper techniques for conducting the work. They are required to read and sign the site specific SSHP and to follow the procedures in this SOP, unless superseded by other project specific requirements. All shipping activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

6.0 PROCEDURES

This section outlines the method for shipping limited quantities of radioactive materials as defined in 49 CFR 173.421.

6.1 DETERMINING IF THE PACKAGE IS AN EXCEPTED PACKAGE FOR LIMITED QUANTITIES OF RADIOACTIVE MATERIALS

A package can be shipped as an excepted package for limited quantities of radioactive materials if the following requirements are met:

1. The activity does not exceed the limits specified in 49 CFR 173.421.
2. The package meets the general design requirements specified in 49 CFR 173.410.
3. The exposure rate at any point on the external surface of the package does not exceed 0.5 mR/hour.

4. The removable radioactive surface contamination on the external surface of the package does not exceed 22 dpm/cm² for beta, gamma, and low toxicity alpha emitters, or 2.2 dpm/cm² for all other alpha emitting radionuclides.
5. The package does not contain more than 15 grams of ²³⁵U.

6.2 PACKAGE SHIPMENT

Package shipment consists of the following steps:

1. A cooler which conforms to the general design requirements in 49 CFR 173.410 will be used for shipment. Prior to shipment, the cooler must be prepared so that no leakage during shipment can occur. All valves on the cooler will be securely duct taped, both inside and outside the cooler and the cooler will be lined with either plastic or a large garbage bag.
2. All sample bottles will be placed in separate zip-lock bags before being placed in the cooler.
3. When placing sample bottles in the cooler, the less contaminated samples will be placed toward the outside of the cooler, and the more contaminated samples will be placed near the center of the cooler. Packing material will be placed above and below the samples.
4. When shipping more than one cooler, the more highly contaminated samples will be distributed among several coolers.
5. After the cooler is filled, the plastic or garbage bag will be closed and securely taped. A sticker which reads "Radioactive" will be placed on the outside of the garbage bag (or plastic).
6. A notice with the following information will be placed inside a zip-lock bag and taped to the inside of every cooler:

"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for excepted radioactive materials, limited quantity, N.O.S., UN 2910. If you have questions, call _____." (The cosigner's or consignee's name, address, and phone number will follow this statement).

If the activities of the samples being shipped are known, this data shall be used to determine the activity in the package and then compared to the Limited Quantity Table.

7. Once the cooler is completely packed, the outside of the cooler will be thoroughly wiped with damp paper towels. The cooler will be surveyed to ensure removable radioactive surface contamination on the external surface of the package does not exceed 22 dpm/cm² for beta, gamma, and low toxicity alpha emitters, or 2.2 dpm/cm² for all other alpha emitting radionuclides and; surveyed with a calibrated exposure rate instrument (e.g. Eberline RO2, Ludlum® Model 12S) to ensure that the exposure rate along the external surface of the package does not exceed 0.5 mR/hour @ contact. All external surfaces of the cooler will be scanned including the top, sides, and bottom.

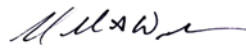
8. If the exposure rate at the surface of any cooler exceeds 0.5 mR/hour @ contact, the cooler will be repacked with additional packing material and/or the samples bottles will be further segregated so that more highly contaminated samples are placed into separate coolers. If the surface activity still exceeds 0.5 mR/hour @ contact, the cooler will not be shipped and the Radiation Safety Officer will be consulted for assistance.

STANDARD OPERATING PROCEDURE

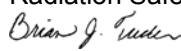
FUSRAP Maywood Superfund Site

Subject: Soil Probe Investigation

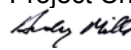
APPROVED:

 09/30/2003

Mike Winters
Radiation Safety Officer Date

 09/30/2003

Brian Tucker
Project Chemist Date

 09/30/2003

Andrew Mills
Project Manager Date

1.0 PURPOSE

This Stone & Webster Standard Operating Procedure (SOP), Soil Probe Investigation, is to be employed when collecting subsurface soil samples using the direct push soil probe method at Maywood Site properties with known or suspected soil and / or groundwater contamination at the FUSRAP Maywood Superfund Site (FMSS).

2.0 SCOPE

This procedure details the materials, equipment, and methods common to soil probe investigation activities. Consult the site-specific project plans and work plans for proposed soil probe locations. Always consult site-specific or program-specific requirements as well as manufacturer's instructions for equipment use to ensure compatibility of this SOP with project requirements. Field changes to this SOP shall be discussed with the Project Superintendent prior to implementation and shall be documented in project field logbooks.

3.0 REFERENCES

SOP SW-MWD-307-1 – Surface and Shallow Subsurface Soil Sampling.

SOP SW-MWD-308-1 – Soil Borings and Sampling.

SOP SW-MWD-402-1 – Operation of the TVA-1000 Photoionization / Flame Ionization Detector.

SOP SW-MWD-410-1 – Groundwater Level Measurement.

SOP SW-MWD-504-1 – Labeling, Packaging, and Shipping Environmental Samples.

SOP SW-MWD-505-1 – Cuttings and Fluids Management.

SOP SW-MWD-507-1 – Field Notebook Content and Control

U.S.E.P.A, A Compendium of Superfund Field Operation Methods, Document EPA/540/P-87/001, December, 1987.

4.0 DEFINITIONS

Direct Push – generic name for advancing media sampling piping/tubes with only direct mechanical force.

5.0 RESPONSIBILITIES

5.1 PROJECT MANAGER

Sets technical capability requirement criteria for personnel and ensures that personnel assigned to project tasks are properly qualified for the needed work.

5.2 PROJECT ENVIRONMENTAL ENGINEER

Translates client's requirements into technical direction of project. Reviews and approves technical progress, ensures that the Project Superintendent has been properly briefed and is prepared for overburden direct push probe activities.

5.3 PROJECT SUPERINTENDENT

The Project Superintendent is individual designated by the Project Manager to supervise investigative activities by Stone & Webster and related subcontracting personnel at a given site for the designated tasks. The Project Superintendent is responsible for ensuring that the field personnel have been briefed in monitoring soil probe investigation activities in accordance with the project requirements, this SOP and related SOPs. The Project Superintendent assures that all necessary equipment including safety equipment is available and functioning properly before project operations begin. The Project Superintendent assures that all necessary personnel are mobilized on time and maintains a daily log of activities each workday. The Project Superintendent coordinates and consults with the Project Manager on decisions relative to unexpected occurrences during soil probe investigation activities and deviations from this SOP.

5.4 SITE PERSONNEL

All employees, including the data logger, who are engaging in soil probe investigation activities are required to read and sign the Maywood Site Safety and Health Plan (SSHP), have current HAZWOPER and Radiation Worker training, and to follow the procedures in this SOP, unless superseded by project-specific requirements. All soil probe investigation activities, including deviations to this SOP, will be recorded in field logbooks during on-site activities.

5.5 SITE SAFETY AND HEALTH OFFICER

All field activities must be carried out in accordance with the SSHP. The Site Safety and Health Officer (SSHO), who may also serve as an observer of soil probe investigation activities, is responsible for ensuring that all site workers (Stone & Webster and subcontractors) have read, signed and are familiar with the requirements of the SSHP and that the requirements of the SSHP are met during site activities.

5.6 TASK MANAGER

Responsible to plan, implement, and closeout field work requiring direct push technology.

6.0 GENERAL EQUIPMENT & MATERIAL REQUIREMENTS FOR SOIL PROBE INVESTIGATION

The following is a list of equipment and material, which is commonly used on all projects when the direct push probe technique is performed in the overburden. Refer also to related SOP equipment and material requirements to ensure completeness.

Items required by subcontractor:

- Direct push probe machine - of appropriate size and direct push probe and sampling capabilities; mounted on four wheel drive vehicle (vehicle could be a Bobcat Loader); direct push probe sampling tools used to advance boring (i.e., direct push small diameter rods and augers) equipment, labor, and supplies to maintain optimal efficiency.
- Environmentally-safe lubricants
- Cement / bentonite supply for grouting
- Suitable grout mixers and grout pumps
- Soil sample collection and logging supplies - Stone & Webster Maywood SOP 308, Soil Borings and Sampling
- Decontamination supplies - See Stone & Webster Maywood SOP 506, Decontamination

Items carried by S&W on-site personnel:

- SSHP. To be read and signed by all site personnel prior to site activities.
- Personal Protective Equipment
- Field logbook(s)
- Clipboard
- Pencils
- Six-foot-ruler
- Pocket knife
- Camera (optional), check with Project Manager if required
- Volatile organic compound vapor meter
- Site boring logs
- Blank boring logs
- Weighted measuring tape
- Water level measuring device - See Stone & Webster Maywood SOP 410, Groundwater Level Measurement, Interface probe, if needed
- Paper towels

7.0 PRE-DIRECT PUSH PROBE ACTIVITIES AND OVERBURDEN DIRECT PUSH PROBE ACTIVITIES

7.1 GENERAL CONSIDERATIONS

Prior to selecting the direct push probe method for a specific property, the objectives of the field investigation must be established. The Maywood Pre-Design Investigation (PDI) program objectives include the following:

- Soil evaluation - representative samples are required, so the direct push probe technique must be able to accommodate the appropriate type of sample collection.
- Characterization of hydrogeologic conditions - the direct push probe technique shall allow for the characterization of each stratigraphic zone, and water level measurements.
- Evaluation of soil contamination - the direct push probe technique must provide the appropriate sample collection methods, must not introduce contaminants into the borehole or otherwise alter the existing soil or groundwater chemistry, and should not result in subsurface cross contamination during or after direct push probe.

7.2 PRE-DIRECT PUSH PROBE ACTIVITIES

Prior to constructing the direct push probe hole, several activities should be performed. These activities, which include both pre-mobilization office tasks and pre-direct push probe field tasks, are discussed below. Once the pre-direct push probe activities are completed, direct push probe installation may commence.

7.2.1 Pre-Mobilization Tasks

1. Acquire as much geologic and hydrogeologic information about the site as possible. This information may include possible soil and groundwater contamination present, groundwater table depths and fluctuations, surficial and bedrock geology, approximate thickness of overburden, depth to top of weathered rock, depth to competent rock, and site access.
2. Check and verify that the staked hole location corresponds to the location on the project plans. Check to see if visible structures will prevent a hole to be constructed at the proposed location.
3. Prior to direct push probe activities, inform the subcontractor of equipment requirements. For example, the length of casing, direct push soil probe method (i.e., macro, dual tube, etc.), and number and type of soil samplers required, should be indicated.
4. Ensure that all utilities in the vicinity of the proposed boring(s) have been cleared by the appropriate authorized parties (e.g., New Jersey One-Call System at 1-800-252-1133, owner, etc.) or, if utilities exist, are visibly marked on the ground surface in the area of the proposed boring. In addition, keep a safe working distance (pursuant to OSHA) from overhead utilities. NOTE: The direct push probe specification should identify the party responsible for having utilities cleared. If the responsible party is not

clearly identified then the Task Manager shall establish the responsible party. Ensure that utilities have been cleared prior to direct push probe.

7.2.2 Pre-Direct Push Probe Field Tasks

1. Sampling equipment shall be decontaminated prior to use using pressure or manual washing of the rig, direct push probe equipment, and tools, as required to prevent off-site contamination. The direct push probe related equipment shall be decontaminated on site prior to direct push probe activities.
2. Communicate with the subcontractor the requirements of the direct push probe program and what geologic and environmental information you require (This information should be a review for the subcontractor, but, in fact, he/she may not have knowledge of the soil probe investigation program details). Inform the subcontractor of the environmental sampling program that the project shall follow. This information includes sampling frequency, sampling depths, type of sample required (soil or groundwater), proposed depth to bottom of borehole, and special sampling techniques. Ensure that borehole grout mixes are selected in accordance with the project specifications.

7.3 GENERAL OVERBURDEN DIRECT PUSH PROBE METHOD PROCEDURES

The following sections outline general procedures used while constructing boreholes in overburden materials:

1. Assuming a vertical test boring, set the direct push rig over the proposed boring location. Level the direct push rig and ensure that the direct push rods used to advance the hole are in a vertical direct push probe position directly above the hole.
2. The inspecting geologist/engineer shall obtain and record measurements of tools to be used for direct push probe operations for depth and borehole diameter determination. Down-hole measurements taken by the subcontractors shall be to the nearest 0.1 foot.
3. Begin sampling or advancement of borehole to the desired depth utilizing the direct push method described below. Samples shall be taken using the steps described in Section 8.1.1.
4. When the borehole advancement tools are lowered into the borehole, the logger shall keep track of tool lengths to check subcontractor's stated depth of borehole.
5. The logger shall make certain that the subcontractor is performing depth measurements with a ruler and known tool lengths and not visually judging ("eyeballing") casing and tool projections above the ground. The logger shall maintain a mental note of depth to bottom of borehole by keeping track of the linear feet of tools in and above the ground. By mentally subtracting the "stick-up" above the ground, the logger can maintain a constant approximate check on the hole depth and subcontractor's indicated depths.
6. The breathing zone shall be screened by a designee of SSHO for volatile organic compounds (VOCs) using an organic vapor analyzer designated by the project. A

lower explosive limit meter (L.E.L.) shall be employed if required in SSHP. Record the measured readings at the depth and time of reading on the boring log.

7. During direct push probe activities, record direct push probe production, mechanical and / or direct push probe difficulties and sequences of direct push probe activities. Also record direct push rig mobilization time, direct push rig set-up time, and direct push probe commencement and completion times. This information should be recorded in a field log book. Pertinent details shall also be recorded on the borehole log (See Stone & Webster Maywood SOP 308, Soil Borings and Sampling). Refer to Attachment A for blank boring log.
8. Refusal of direct push probe advancement tools (i.e., casing refusal) is encountered when the borehole cannot be advanced using regular direct push probe advancement methods. Generally, refusal can be identified by the following characteristics:
 - Advancement of borehole is not noticeable or is very slow
 - A grinding noise is felt by the above ground gears or rods and sometimes the Direct push rig oscillates in a particular, repeatable fashion as the above ground gears are rotating. If on a wood obstruction, a grinding noise will not be heard, but the rig may have a spongy feel.
 - The direct push probe downpressure may be significantly higher than under "normal" direct push probe conditions. The direct push rig may be lifted off the ground surface.

If refusal is encountered in the boring, refer to Stone & Webster Maywood SOP 308, Soil Borings and Sampling for specific instructions. If the borehole cannot be advanced, relocate the borehole in a direction approximately five feet distant from the original location and start with the work in Section Paragraph 7.2.1. Measure the distance and direction and record this information on the boring log and in a field logbook.

NOTE: The actual distance of movement necessary may be greater depending on the site conditions. If the required movement is excessive, contact the Project Manager.

9. When the final depth is encountered and if an observation well is not to be installed, the probe hole shall be properly grouted using suitable cement/bentonite/water mix ratios.
10. When the hole is completed and the area is cleaned up, all contaminated equipment, including down-hole tools, hand tools, and direct push rig shall be decontaminated as specified above and directed by the Radiation Safety Officer (RSO).
11. Place a stake at the location of the hole and locate the as-built location on the project drawings. If the hole was relocated, note and record in which direction and the amount the hole was relocated.

8.0 METHOD-SPECIFIC SOIL SCREENING AND SAMPLING

In this section, the procedure for the direct push overburden direct push probe method at the FUSRAP Maywood Superfund Site properties is delineated.

8.1 DIRECT PUSH PROBE SERVICES

The direct push probe is a hydraulically powered percussion direct push probe machine used for small diameter subsurface investigations. It can obtain continuous soil cores, discreet soil samples, groundwater samples and vapor samples along with installation of permanent sparge points. It is ideally suited for initial subsurface screening purposes.

8.1.1 Procedures for Screening and Sampling Direct Push Probe Soil Samples

The following presents a procedure for screening and sampling direct push probe soil cores.

- Each four-foot soil core sample will remain in the acetate liner and marked with the appropriate field identification number, sealed with rubber end caps for liners, and placed into a designated (two inch ID) PVC container (including PVC end caps) supplied by the subcontractor for storage. Pertinent sample data will also be marked on the PVC container.
- Downhole gamma logging will be accomplished by suspending a Bicron[®] 3/8- inch x 3/8- inch sodium iodide gamma detector coupled to a Ludlum[®] Model 2221 ratemeter/scaler down the cased soil probe hole. During extraction of the outer casing, 30-second gamma counts will be collected at six-inch increments allowing for readings an uncased probe holes.
- Each soil probe hole will be grouted for the full length and location recorded by Global Positioning System (GPS) and survey.
- The sealed PVC containers will be transported to a dedicated location in Building 76 at the Maywood Interim Storage Site (MISS) for sample documentation, field screening, and sampling. Sample documentation will also include the preparation of a soil probe log including all pertinent field documentation including: soil probe identification number and location; soil column classification; and photo-documentation. Stone & Webster Maywood SOP 507, Field Notebook Content and Control, shall be followed.
- The field screening for radiological activity will be performed on the soil core contained in the acetate liner. A collimated Ludlum[®] 44-10, two-inch x two-inch sodium iodide detector will be used to screen the samples. The acetate liner shall be marked off at six inch intervals. The detector will be positioned approximately one half inch above the soil core, on a guide, to ensure that this distance is maintained over the entire length of each soil core. Readings shall consist of ten second integrations taken every six inches and recorded.
- The soil cores will then be screened for total organic vapors using a photoionization detector (PID) (see Stone & Webster Maywood SOP 401, Photoionization Detector (PID). A series of small perforations will be made through the acetate liner at six-inch increments. Prior to storage, these perforations will be sealed with tape.
- The soil samples will be described on a geologic log according to the Unified Soil Classification system.

- A minimum of three soil samples will be selected from each direct push location, for analysis of the radionuclides of concern (ROC), Thorium-232, Radium-226, and Uranium-238 based on field radiological screening and gamma logging values. Specifically, one soil sample will be taken at the highest reading location (suspected FUSRAP waste); a second soil sample shall be collected where the readings approach a constant value (suspected transition zone); and a third soil sample shall be collected within the zone of constant readings (below suspected transition zone). Additional samples may be taken based on the Task Manager's direction.
- Each extracted section of the soil core will be replaced with a spacer to preserve the integrity of the soil core. The spacer will be labeled with the sample identification number of the soil removed for testing.
- Each soil core will be placed into the PVC containers, labeled and stored in Building 76 for storage and future reference.
- Extracted samples shall be prepared consistent with the appropriate Safety and Ecology Corporation (SEC) on-site field laboratory soil preparation practice / SOP.
- Analysis for ROC on extracted sections of the soil core will be performed by the existing on-site field laboratory, using a Canberra high purity germanium detector, or equivalent. All testing in the on-site field laboratory will be completed in accordance with the procedures outlined in the CDQMP.
- Ten percent of the samples analyzed by the on-site field laboratory will be sent to a USACE-certified off-site laboratory, for confirmatory ROC analysis. Soil samples shall be placed in labeled containers provided by the laboratory, then placed in coolers maintained at 4°C. Sampling, labeling, and shipping will be completed in accordance with the procedures outlined in the CDQMP.
- Following analysis by the on-site and off-site laboratories, all soil samples will be returned to Building 76 for storage and future reference.
- Sampling tools will be decontaminated before each boring, after collecting each soil sample, and after each boring.
- All resultant data shall be entered into the project electronic database.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Quality control guidelines described in Section 1.0 of the Maywood Field Sampling Plan (part of the CDQMP) shall be followed. Field QC sample types include equipment rinsate blanks and duplicates. Equipment rinsate blanks must be collected each day that sampling occurs or each decontamination event, whichever is less, per matrix per parameter per field crew, per equipment type (assuming reusable sampling equipment is used). Field duplicate samples must be identified or numbered so that the laboratory does not know the samples are duplicates (thus the term "blind duplicates"), thus eliminating potential bias in the test measurement. Field duplicate samples must represent no less than 10 % of the total number of samples per matrix per parameter per area of study.

Matrix spike/matrix duplicate (MS/MD) for radionuclides are laboratory QC samples that will be collected in the field. The laboratory shall treat no less than 10% of all samples (per matrix) as MS/MD pairs, analyze at least one blank spike (or LCS) for a given method per matrix per sample batch (a sample batch contains a maximum of 20 environmental samples), and analyze method blanks every 12 hours of analysis time or every batch, whichever is more frequent.

10.0 ATTACHMENTS

PDI SOIL PROBE LOG SHEET

FUSRAP Maywood Superfund Site
Stone & Webster Environmental Technology &
Services
100 West Hunter Avenue
Maywood, New Jersey 07607

Tel: (201) 226-6600
FAX: (201) 226-6660

Task: Phase II PDI
Description: Implementation
Job Number: 085750316
Activity: Direct-Push Sampling

Site Designator		XXX		
Activity Designator		AAA	PDI	
Field Measurement/Sample Collection Designator		VV	SP	
Station Number		N N N		
Media		m m	SB	
Sample Type		n		
Sequential Sample Number		# # # # #	(see Below)	
		Northing (NAD 1927)	Easting (NAD 1927)	Elevation (NGVD 1929)
Location				
	Gamma Logging		Photoionization Detector (PID) Logging	
	Down Hole	Core		
Date			Date	
Time			Time	
Logger			Logger	
Detector Model #		SPA-3	PID Model #	Multi-RAE
Detector Serial #		CENAN 33401	PID Serial #	CENAN 21811
Scaler Model #		2224		
Scaler Serial #		132842		

Comments:

1. MPI No. _____.
2. Direct-push location grouted with BenSeal.

Signature (Down Hole Gamma Logging)

Date

Signature (Core Gamma Logging)

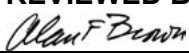
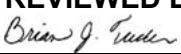
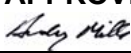
Date

Signature (PID Logging)

Date

Depth (Feet)	Down Hole Gamma Reading (c/10 sec)	Core Gamma Reading ¹	PID Reading (ppm)	Sample Description (per Field Operations Manual)	Laboratory Sample ID (Laboratory Designation)							
					X	Y	X	#	#	#	#	#
0.0												
0.5												
1.0												
1.5												
2.0												
2.5												
3.0												
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23.0												
23.5												
24.0												

¹ Location of Core Gamma Reading Based on Initial Continuous Scan

Procedure No. SOP 601 Revision No. 1 Date of Revision March 4, 2003 Last Review Date March 5, 2003 Page 1 of 18	
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Laboratory Internal Data Evaluation: Quality Assurance and Corrective Action	
PREPARED BY:  Radiochemistry Laboratory Mgr 02/13/03 REVIEWED BY:  CQCSM 02/13/03	REVIEWED BY:  Project Chemist 02/13/03 APPROVED:  Project Manager 02/13/03

1.0 PURPOSE

This document is intended to provide consistent guidelines for quality evaluation of radioanalytical data produced by the FMSS Radiological Laboratory (the Lab). In more subjective areas, only general guidance is offered due to the unique and complex nature of data relative to specific samples.

2.0 SCOPE

This document provides consistent methodology and guidelines for the evaluation of data and the basis for corrective actions to be taken when data fails to meet the criteria specified in this document. All appropriate procedures and protocols shall be followed throughout the analytical process to provide the best assurance that the requirements of this document are met.

This SOP applies only to Quality Controls in the analysis of samples in the Lab.

This SOP contains guidance for areas of analysis not currently performed in the Lab. Those areas are added to demonstrate the direction of quality control for those analyses and due to the impending date of the addition of these methods.

This procedure does NOT provide direction in the validation of the data. Validation of data requires information regarding the use of the data, which although is known by the site laboratory management, should not be applied when reviewing the data quality of analyses.

The final approval of any data falls to the Radiochemistry Laboratory Manager (RLM) and the Quality Assurance Officer (QA Officer). Data approval may be based on the professional judgment of either of these individuals with details of explanation provided within the Case Narrative of the Lab Reporting Batch (LRB).

3.0 REFERENCES

“Establishing a Quality Assurance Program for Analytical Chemistry Laboratories within the Nuclear Industry,” American Society for Testing and Materials, ASTM C1009-96e1.

USACE Kansas City and St. Louis District Radionuclide Data Quality Evaluation Guidance for Alpha and Gamma Spectroscopy, June 2001.

FUSRAP Maywood Superfund Site, Radiological Laboratory Quality Assurance Plan, Revision 0, May 2001.

FUSRAP Maywood Superfund Site, Standard Operating Procedure PP-8-1201-0, “Radiological Occurrence Reports,” June 2002.

“Instrumentation Quality Assurance for Radioassay Laboratories,” American National Standard Measurement and Associated, ANSI N42.23-1996

4.0 DISCUSSION

The goal of the Lab is to produce quality defensible data for release to the client. To produce this data specific actions are taken in the development of methods, operation of equipment, and training and performance of the Radiochemistry Lab Technicians to ensure consistent actions and processes occur. Upon completion of these actions, various steps in the process are examined against standards to determine whether the data produce meets these standards. The results of the examination and the data are reviewed by the Radiochemistry Lab Manager and/or the Quality Assurance Officer. Based on this review, the data is rejected, accepted with qualification, or fully accepted.

This document provides the guidelines for the primary examination of the data. It, however, falls, on the experience of the RLM and QA Officer to make the final acceptance determination.

5.0 DEFINITIONS

Case Narrative A document developed to describe and approve the results of analytical methods performed, the results and variances found of a sample, and the quality assurance measures taken and their results pertaining to a SDG of samples.

LCSF The analyzed value or “Found” value of a Laboratory Control Standard.

LCST The verified or certified value or “True” value of a Laboratory Control Standard.

MDA The Minimum Detectable Activity at the 95% confidence level.

Qualified Data - Sample information pertaining to the assay of an isotope and its concentration that has undergone a series of reviews for quality information and their acceptance.

SDG Sample Delivery Group - A group of samples identified by and peculiar to a given Chain-of-Custody (COC). The COC is assigned a number for tracking and reporting purposes.

Validated Data Sample information that has been independently reviewed by a qualified individual against prescribed acceptance criteria and independent testing results.

6.0 RESPONSIBILITIES

6.1 PROJECT CHEMIST

- 6.1.1 Periodic evaluation of data packages, and data quality, in general.
- 6.1.2 Documentation of findings/concerns regarding data quality during periodic surveillance and/or audits.
- 6.1.3 Ensuring corrective actions, performed in response to non-conformances, have been implemented.

6.2 RADIOCHEMISTRY LABORATORY MANAGER

- 6.2.1 Training laboratory personnel in the requirements of this procedure.
- 6.2.2 Ensuring the requirements of this procedure are followed.
- 6.2.3 Review of all data released to the client or used in the lab for the prescribed levels of quality designated by site policy, procedures, and methods.
- 6.2.4 Ensuring indications of, root cause analysis of, and corrective actions taken in relation to the prescribed areas of Quality Assurance required in the review of data is recorded as required.
- 6.2.5 Control and retention of laboratory quality assurance records.
- 6.2.6 Responding in a timely manner to audit and/or surveillance findings.
- 6.2.7 Initiation of corrective action, as necessary and performance of any follow-up, as required.

6.3 RADIOCHEMISTRY LABORATORY TECHNICIANS

- 6.3.1 Laboratory personnel shall be familiar, in conjunction with their assigned duties, with the quality control requirements of data developed in the analysis of samples in the lab
- 6.3.2 Identifying Quality Control and Assurance deficiencies in relation to the areas of sample analysis, sample isotope detection, and data development they work on.
- 6.3.2 Development and maintenance of laboratory quality assurance records.

7.0 PREREQUISITIES

- 7.1 None.

8.0 PRECAUTIONS, LIMITS, SAFETY

- 8.1 None.

9.0 RECORDS

- 9.1 Records developed in conjunction with associated SOPs for Instrument Operation or Analytical Method performance and documented in the respective Lab Notebook.

- 9.2 Case Narrative information as specified in this document.
- 9.3 Quality Control (QC) Chart for Calibration Check Isotope Activity and Peak Energy measured.
- 9.4 QC Chart for Background activity measured.
- 9.5 QC Chart for Method Blank activities measured
- 9.5 QC Chart for Laboratory Control Standard Check Isotope Activity and Peak Energy measured.
- 9.6 QC Chart for Matrix Spike Recovery measured.
- 9.7 QC Chart for Tracer Recovery maximum, mean, and minimum activity per SDG measured.

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10.0 PROCEDURE

10.1 ASSESSMENT OF LAB SAMPLE ANALYSIS QUALITY

- 10.1.1 Out-of-specification data shall NOT be presented to the client until the data has been reviewed, a root cause has been determined, and necessary or possible corrective actions are performed, unless the client waives this requirement.
- 10.1.2 Data must be rerun or resubmitted, depending on the nature of the corrective action even if the previously submitted data has been utilized due to program needs. The intent is to supply data that are technically valid and legally defensible.
- 10.1.3 Minimally, the following requirements are to be checked during the quality review of a batch of sample data.

NOTE

Contractual requirements for these items are not always the same as the data review criteria

- Holding times (laboratory holding times only)
 - Calibrations (for the period of analyses)
 - Daily calibration checks (control charts for the period of analyses)
 - Daily background checks (control charts for the period of analyses)
 - Daily blank checks (control charts for the period of analyses)
 - Method Blanks (the method blank ran with the batch)
 - Laboratory Control Standard (LCS)
 - Replicates
 - Tracer Recovery (as applicable)
 - Radionuclide quantitation and implied detection limits
- 10.1.4 Requirement specifics for each area of review are per the requirements detailed in Section 10.0.
- 10.1.5 In the review of sample data, the following timetable events should be indicated in the data package.
- Calibration Checks, Blank or Background Checks, and LCS checks are performed as required prior to analysis of any samples within a batch, a day, or a shift.
 - Matrix Spikes and Tracers are added prior to the digestion or chemical separation of a sample.
 - Samples are analyzed within 4 1/2 half-lives of their limiting decay scheme.

10.2 GUIDANCE ON QA INVESTIGATIONS AND CORRECTIVE ACTIONS RELATED TO RADIOASSAY WORK

- 10.2.1 To ensure that the Lab performs quality analyses, investigations and corrective actions are crucial elements when problems/incidents arise.
- 10.2.2 Elements of an investigation and corrective action plan that will be applicable at FMSS Radiological Laboratory:
- Notification and documentation of the problem/incident that resulted in adverse quality
 - Cause analysis (root cause analysis)
 - Investigation to determine if a problem/incident is prevalent in other radioassay processes
 - Correcting the problem/incident that resulted in adverse quality
 - Documentation of the cause analysis/investigation and corrective actions taken
 - RLM and QA officer review of the problem/incident and actions taken
 - Incorporation of changes to SOPs or methodology as required to prevent further occurrences
- 10.2.3 Items to examine when conducting a QA investigation related to the lab:
- Calibration results
 - Daily QC checks documented in log books
 - Frequency of liquid nitrogen filled in the dewars
 - P-10 gas pressure and flow rate
 - COCs available for all samples in which the lab has custody
 - Radioactive sources are in their storage box and away from instruments while acquiring data
 - Equipment usage and settings
 - Decontamination of equipment is adequate
 - Lab Personnel are up to date in their training
 - Preventive maintenance of instruments is performed consistently
 - Changes in type of LOT of lab materials being used

Note
The items mentioned above are only to be used as a guide to a QA investigation and problems could have different root causes.

- 10.2.4 When a problem is identified, initiate an investigation by Attachment 13.1, Corrective Action Form
- 10.2.5 Investigations should be expedited as problems impinge on lab performance
- 10.2.6 The RLM shall assign an individual to investigate the problem and determine corrective actions
- 10.2.7 Upon review and approval by the RLM and QA officer, the corrective action may be implemented
- 10.2.8 Proper implementation of a corrective action to a root cause results in:
 - A solution that prevents recurrence
 - A solution that is within the control of the lab

10.3 HOLDING TIMES

- 10.3.1 Ensuring a sample is analyzed within holding time for a sample analysis method can be used to ascertain the validity of results.
- 10.3.2 Holding time is based on the probable degradation of the sample analyte of interest from the time of sample collection through the time of sample preparation.
- 10.3.3 Samples analyzed for radioactive material content may also require a waiting period between sample preparation and the time of analysis to allow for in-growth of decay daughter products.
- 10.3.4 Deviations from required holding time shall be noted and discussed in the Case Narrative. This discussion shall include a professional judgment as to the effect on the data.

10.4 CALIBRATIONS AND CALIBRATION CHECKS

- 10.4.1 Calibrations shall be in place for, each applicable geometry, density, and matrix for each piece of analytical instrumentation employed.
- 10.4.2 Calibrations shall be performed upon initial setup, yearly, upon replacement of the calibration source, or as directed by the Radiological Laboratory Supervisor.
- 10.4.3 Re-calibrations may be performed, as required, to compensate for system drift.
- 10.4.4 Calibration Checks are to be performed daily and prior to the start of a batch of samples.
- 10.4.5 Calibration and calibration check results are to be logged into the Instrument Quality Control Chart Tracking Program.
- 10.4.6 Results of the calibration entry are to be reviewed as presented within the Instrument Quality Control Chart Tracking Program for acceptability and variance.
- 10.4.7 Calibration checks found to be outside the acceptance criteria are to be investigated and corrected prior to analyzing samples.

- 10.4.8 Completion of calibrations and the discovery of unacceptable calibration checks shall be noted in the Instrument Lab Notebook with notation of the corrective action taken.
- 10.4.9 Calibration checks are performed prior to the analysis of a batch of samples.
- 10.4.10 Samples are NOT to be analyzed if the calibration check does NOT return acceptable values, unless authorized by the Radiochemistry Laboratory Manager.
- 10.4.11 Samples analyzed prior to an unacceptable calibration shall have ALL data associated with those samples reviewed with the RLM and the samples re-analyzed as directed by the RLM.
- 10.4.12 Calibration status shall be identified in the Case Narrative of the Data Package. As requested printouts of instrument calibration results and Control Charts may also be added to the Data Package.

10.5 BACKGROUND AND BACKGROUND CHECKS

- 10.5.1 Backgrounds shall be determined at a minimum weekly and background checks should be performed a minimum of once per shift or at the start of a batch of samples.
- 10.5.2 Background checks for instruments presenting a spectrum of energy range shall be reviewed for changes within the energy ranges of the isotopes of interest.
- 10.5.3 Background and background check results are to be logged into the Instrument Quality Control Chart Tracking Program.
- 10.5.4 Results of the background entry are to be reviewed as presented within the Instrument Quality Control Chart Tracking Program for acceptability and variance.
- 10.5.5 Background or background checks found to be outside the acceptance criteria are to be identified to the Radiochemistry Lab Manager, investigated for cause, and corrected prior to analyzing samples.
- 10.5.6 Completion of backgrounds or background checks and the discovery of unacceptable backgrounds or background checks shall be noted in the Instrument Lab Notebook with notation of the corrective action taken.
- 10.5.7 Samples determined to have been analyzed prior to discovery of an unacceptable background shall have ALL data associated with those samples reviewed and as required by the RLM or QA Officer re-analyzed.
- 10.5.8 Background status shall be identified in the Case Narrative of the Data Package. As requested, printouts of instrument background results and Control Charts may also be added to the Data Package.

10.6 METHOD BLANKS AND BLANK CHECKS

- 10.6.1 Method Blank analyses determine the existence and magnitude of contamination problems during the sample preparation process.
- 10.6.2 Method Blanks (Blanks) may consist of processing a sample void of the isotopes of interest to be analyzed, such as Ottawa Sand, or may consist of using the virgin material used in obtaining a sample, such as an unused smear, air filter, or reagents used in a process.
- 10.6.3 Blanks are to be developed at the following times:
- At the beginning of an analysis batch
 - Upon the use of a new Manufactures Lot of sample material such as smears, filters or reagents
 - When contamination or recovery values questions sample results
- 10.6.4 Blanks are counted as part of a batch of samples (1/20) and are to be counted prior to the analysis of any samples and preferably prior to the counting of a calibration check.
- 10.6.5 Blank checks are counted when sample analyses continue past a given day.
- 10.6.6 Blank checks may reuse the blank developed at the beginning of the batch.
- 10.6.7 Blank checks shall be performed daily prior to the use of the instrument for the day and prior to the start of a batch.
- 10.6.8 Blank results are to be logged into the Sample Analysis Data Base as part of the batch analyses of samples.
- 10.6.9 Blank results are to be logged into the Instrument Quality Control Chart Tracking Program.

NOTE

Upon update of the Maywood Sample Data Base capabilities, blank checks are to be logged into the database.

- 10.6.10 Results of the blank or blank checks are to be reviewed as presented within the Instrument Quality Control Chart Tracking Program for acceptability and variance.
- 10.6.11 Blank checks are to be compared to the blank results variations shall be noted to the Radiochemistry Lab Supervision for possible corrective action.
- 10.6.12 Blank results indicating an activity greater than the determined associated uncertainty shall be qualified by determining the Normalized Absolute Difference (NAD) between the Blank and Sample and their respective uncertainties.

- 10.6.13 Using the following equation, determine the effect of possible contamination on each result.

$$NAD_{\text{Method Blank (PB)}} = \frac{|Sample - Blank|}{\sqrt{(2\sigma_{\text{Sample}})^2 + (2\sigma_{\text{Blank}})^2}}$$

Where:

Sample = is the sample result

Blank = is the blank result

$2\sigma_{\text{Sample}}$ = 2σ counting uncertainty of the sample

$2\sigma_{\text{Blank}}$ = 2σ counting uncertainty of the blank

- 10.6.14 Based on the results of the NAD test, qualify the data as follows:

NAD Result	Qualifier
>2.58	NONE
>1.96 and <2.58	J
<1.96	J or R ¹

¹ Minimally the result should be qualified as estimated, J; unless other quality indicators are deficient the evaluator may determine the result should be qualified as rejected, R.

- 10.6.15 Blank and blank checks found to be outside the acceptance criteria are to be identified to the Radiochemistry Lab Manager, investigated for cause, and corrected prior to analyzing samples.
- 10.6.16 Discovery of unacceptable blanks or blank checks shall be noted in the Instrument Lab Notebook with notation of the corrective action taken.
- 10.6.17 Samples determined to have been analyzed prior to discovery of an unacceptable blank or blank check shall have ALL data associated with those samples reviewed and as required by the RLM or QA Officer re-analyzed.
- 10.6.18 Blank results shall be identified in the Case Narrative of the Data Package. As requested, printouts of blank results may also be added to the Data Package.

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10.7 LABORATORY CONTROL STANDARD

- 10.7.1 The Laboratory Control Standard (LCS) serves as an indicator of instrument performance and stability. They are used primarily for sample analyses that do not involve complex chemistry and separation chemistry.
- 10.7.2 LCSs are QC samples that are previously analyzed Proficiency Evaluation Test Samples of known composition.
- 10.7.3 LCSs are to be of the same matrix, density, and geometry of the samples analyzed.
- 10.7.4 LCSs are counted as part of a batch of samples at least one per each batch of twenty samples analyzed.
- 10.7.4 LCS results are to be logged into the Instrument Quality Control Chart Tracking Program.
- 10.7.5 LCS checks are performed prior to the analysis of a batch of samples.
- 10.7.6 Results of the LCS entry are to be reviewed as presented within the Instrument Quality Control Chart Tracking Program for acceptability and variance.
- 10.7.7 Qualify the data results as follows:

Recovery Result Solid	Recovery Result Liquid	Qualifier
$70\% \geq R \leq 130\%$	$=75\% R = 125\%$	None
$=50 - <70\%$ $>130 - =150\%$	$=50 - <75\%$ $>125 - =150\%$	J
$<50\% \text{ or } > 150\%$	$<50\% \text{ or } > 150\%$	R

- 10.7.8 Discovery of unacceptable LCS analyses shall be noted in the Instrument Lab Notebook with notation of the corrective action taken.
- 10.7.9 LCSs found to be outside the acceptance criteria shall be identified to the Radiochemistry Lab Manager, investigated for cause, and corrected prior to analyzing samples.
- 10.7.10 Samples are NOT to be analyzed, if the LCS check does NOT return acceptable values, unless authorized by the Radiochemistry Laboratory Manager.
- 10.7.11 LCS status shall be identified in the Case Narrative of the Data Package.

10.8 REPLICATE ANALYSIS SAMPLES

- 10.8.1 Replicate analyses are an indicator of laboratory method precision.
- 10.8.2 Replicate analyses are performed as part of a batch of samples at least one per ten samples analyzed.
- 10.8.3 Using the following equation, calculate the NAD for each replicate pair of samples.

$$\text{Normalized Absolute Difference}_{\text{replicate}} = \frac{|Sample - R|}{\sqrt{(\sigma_{\text{Sample}})^2 + (\sigma_R)^2}}$$

Where:

Sample = first sample value (original)

R = second sample value (replicate)

σ_{Sample} = 2σ counting uncertainty of the sample

σ_R = 2σ counting uncertainty of the replicate

- 10.8.4 Based on the results of the NAD test, qualify the data as follows:

NAD Result	Qualifier
<1.96	NONE
>1.96 and <2.58	J
>2.58	J or R ¹

¹ Minimally the result should be qualified as estimated, J; unless other quality indicators are deficient the evaluator may determine the result should be qualified as rejected, R.

- 10.8.5 Replicate NADs found to be outside the acceptance criteria are to be identified to the Radiochemistry Lab Manager, investigated for cause, and corrected prior to analyzing samples.
- 10.8.6 If the sample and replicate activities are below 2 pCi, then the RLM shall review the data for acceptability.
- 10.8.7 Discovery of unacceptable NADs shall be noted in the Instrument Lab Notebook with notation of the corrective action taken.
- 10.8.8 Samples determined to have been analyzed with an unacceptable Replicate NAD shall have ALL data associated with those samples reviewed and as required by the RLM or QA Officer re-analyzed.
- 10.8.9 Replicate NAD results shall be identified in the Case Narrative of the Data Package.
- 10.8.10 Replicate NAD results are to be logged into the Sample Analysis Database as part of the batch analyses of samples.

10.9 RADIONUCLIDE QUANTITATION AND DETECTION LIMITS

- 10.9.1 Analytical uncertainties and MDAs are to be reported for all sample analysis results.

NOTE

The equations that produce the Uncertainty and Minimum Detectable Activity (MDA) values from a given sample vary between instrumentation programs. These programs should use equations that develop similar results for comparison of results as necessary. As practical, these should mirror current regulatory practices in theoretical computations.

- 10.9.2 Results and uncertainties (errors) are to be reported to 2 decimal places as calculated by the instrumentation report.
- 10.9.3 Report the result as given regardless of the size or sign of the result.
- 10.9.4 Review the results of the sample MDA against the following table of the Maywood Project Target Practical Quantitation Limits (PQLs) and MDAs.

PQLs and MDAs

PQLs		MDAs	
Ra-226	0.7 pCi/g	Ra-226	0.25 pCi/g
Th-232	0.7 pCi/g	Th-232	0.25 pCi/g
U-238	12.5 pCi/g	U-238	5.0 pCi/g

- 10.9.5 Verify that the appropriate detection limits have been met for low concentration or near background activity samples (counting uncertainty, and therefore MDAs, increase with increasing sample activity).
- 10.9.6 Note ANY uncertainties (errors) greater than the result or a result less than MDA.
- 10.9.7 Multiply the 2σ errors by 1.65.
- 10.9.8 Qualify results less than or equal to the specified detection limit as estimated, J.
- 10.9.9 Qualify results greater than the specified detection limit as non-detect estimated UJ.

NOTE

Sample results with uncertainties greater than the results indicate that the sample count was less than the critical level or less than the 95% confidence level of positive detection.

-
- 10.9.10 Qualify results less than the uncertainty as non-detect U.
 - 10.9.11 Qualify negative results with uncertainties greater than the absolute value of the result as non-detect, U.
 - 10.9.12 Qualify negative results that have uncertainties smaller than the absolute value of the result as rejected, R.
 - 10.9.13 Qualify results greater than the 2σ error and less than the MDA, and its 2σ uncertainty times 1.65 is less than its MDA, as estimated, J.
 - 10.9.14 Identification of flagged data shall be brought to the attention of the RLM or QA Officer.
 - 10.9.15 The RLM or QA Officer shall determine the corrective action to be taken.
 - 10.9.16 Flagged data and flagged data that has been changed shall be identified and

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10.10 TARGET RADIONUCLIDE LIST IDENTIFICATION

- 10.10.1 Instrumentation operating conditions and data outputs must be reviewed for completeness and accuracy.
- 10.10.2 Gamma Spectroscopy results shall have the following reviewed:
- Background counts in the relative channels for the isotopes of interest.
 - Counts received for the sample in the relative channels for the isotopes of interest.
 - Full Width Half-Maximum values determined by the peak search and quantification program as within 3.0 keV.
 - Peak Energy for the isotopes of interest, identified as within ± 2 keV of the library peak.
 - Key Energy (ies) identified and counted in determining relative quantification of the isotopes of interest.
 - Correction for decay, as appropriate.
- 10.10.3 Qualify Radionuclides that do NOT meet the criterion as rejected, R.
- 10.10.4 Qualify Radionuclides that do NOT meet the criterion as rejected, R.
- 10.10.5 Gas Proportional results shall have the following reviewed:
- Background Channel counts.
 - Alpha Cross talk %.
 - Correction for decay, as appropriate.
- 10.10.6 Qualify Radionuclides that do NOT meet the criterion as rejected, R.

10.11 MATRIX DENSITY VARIABILITY

- 10.11.1 Soil samples are dried and pulverized prior to analysis.
- 10.11.2 Gamma Spectroscopy sample containers, "Tuna Cans", should be fully loaded prior to sealing and analysis.
- 10.11.3 The volume and weight of the sample is determined in accordance with SOP 641, Receipt and Preparation of Soil Samples for Analysis by Gamma Spectrometry.
- 10.11.4 Calculate the density of the sample using the weights and volumes of each sample.

$$Density(\rho) = \frac{mass(g)}{volume(mL)}$$

- 10.11.5 Qualify a sample with a density greater than $\pm 30\%$ of the density of the calibration source used in the batch analysis as estimated, J.

10.12 QUALITY CONTROL CHARTS

- 10.12.1 Quality Control Charts may be developed by computer program or by hard copy on graph paper.
- 10.12.2 Axes of the Control Chart are dependent on the parameter being charted.
- 10.12.3 The Control and Warning limits shall be set respectively at the $\pm 2\sigma$ values and $\pm 3\sigma$ values of the mean of the summation of the observed values or at percent variation points determined by the RLM.
- 10.12.4 ALL data tracked shall be observed for trend patterns in the instrument operation or method performance.
- 10.12.5 Five points in succession that trend upward or downward from a point shall be examined for possible concern.
- 10.12.6 Five points on one side of the mean shall be examined for possible corrective action.
- 10.12.7 Any point that exceeds Control Limits shall be reviewed for data quality.
- 10.12.8 Any point that exceeds the Warning Limits shall have the data, the instrument operation, and method performance reviewed for quality.
- 10.12.9 Results of the investigation shall be reviewed for action by the RLM.
- 10.12.10 Actions taken shall be documented accordingly in the proper Lab Instrument, or Method Lab Notebook, and discussed in the Case Narrative as appropriate.

10.13 RADIOCHEMISTRY LAB MANAGER APPROVAL

- 10.13.1 The Radiochemistry Lab Manager shall review all data that is at or below 2 pCi/g that returns QC checks of concern.
- 10.13.2 Verify the returns of the data for items such as the following dependent on analysis performed:
- Channel counts
 - Peak Height
 - Peak shape (tailing)
 - Uncertainties
 - Examination of prepped sample for indications that the sample was attenuated, lost, or otherwise compromised
 - Examination of sample for indications of contaminants that could attenuate or interfere with separation
- 10.13.3 Define the final determined deposition of the sample.
- 10.13.4 Discuss any concerns with the QA Officer as warranted.
- 10.13.5 Contact the Task Manager to determine a course of action if needed.
- 10.13.6 Detail in the Case Narrative any decision that results in a change of qualification of the data.
- 10.13.7 Record ANY course of action that involves a change to an SOP or Instrument operation parameter in the appropriate Lab Notebook.

14.0 QUALITY CONTROL

- 11.1 None

15.0 DATA REVIEW

- 15.1 The QA Officer shall review ANY data, sample result, instrument operation, or method performance that is investigated, acted upon, and documented due to quality concerns as part of the Lab's periodic surveillance and audits.
- 15.2 The QA Officer shall randomly review data entries for accuracy and verify that data is entered unadulterated.

16.0 ATTACHMENTS

- 16.1 Corrective Action Form

Attachment 13.1
Corrective Actions Form

Instrument / Analysis: _____

Initiator: _____

Print Name

Initials

Date

Instructions: Complete this form with text, computer data, technical drawings or other pertinent data to demonstrate the problem, its cause, and the appropriate corrective action determined to be implemented; Use additional paper as needed to clearly state results.

Description of Problem / Incident

Problem

Material Examined or Researched or Technical Contacts Made

Technical Representative: Name - Time and Date contacted Material Title Date and Page/Section

Determined Root Cause and Immediate Corrective Actions Taken

Long Term Corrective Actions Taken

SOP # - proposed change

Corrective Actions Completed and Approved:

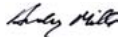
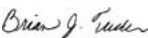
Comments

Radiochemistry Lab Manager

Date

Quality Assurance Officer

Date

Procedure No. SOP 602 Revision No. 0 Date of Revision February 20, 2003 Last Review Date February 20, 2003 Page 1 of 7	
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Analytical Data Management and Tracking	
PREPARED BY:  Radiochemistry Laboratory Mgr 02/20/03	APPROVED:  Project Manager 02/20/03
REVIEWED BY:  Project Chemist 02/20/03	

1.0 PURPOSE

The purpose of this procedure is to provide guidelines and requirements for managing sample data from the time of sample determination and collection to the time of final documentation.

2.0 SCOPE

This procedure covers the documentation of a sample from the time it is taken from the field through the analysis and data deliverable from the lab. The identification and sample actions taken by applicable personnel at Shaw Environmental & Infrastructure (Shaw E&I) and the FUSRAP Maywood Storage Site and its peripheral remediation sites, plus the onsite and offsite contract laboratories involved with the analysis of the samples.

3.0 REFERENCES

NUREG – 1575; *Multi-Agency Radiation Survey and Site Investigation Manual*; Chapter 7: Sampling and Preparation for Laboratory Measurements, Dec 1997

Shaw E&I, FUSRAP Maywood Superfund Site, Chemical Data Quality Management Plan (CDQMP), February 2000.

4.0 DISCUSSION

Data developed from sample analyses requires compilation and analysis to ensure that the FUSRAP Maywood Project Objectives are met. The Onsite Laboratory, the Offsite Laboratory, or the USACE Offsite Laboratory provides this data to Shaw E&I Task Managers and Quality Assurance personnel. The transfer of information is facilitated with an electronic copy of the data in a prescribed format. This format is usable by Shaw E&I to transfer sample information to the Maywood Superfund Site Database (MSSDB).

5.0 DEFINITIONS

Batch – A group of samples along with their respective quality control samples. The maximum number of samples in group is 20.

Electronic Data Deliverable (EDD) file – An electronic copy of data developed by the laboratory in an identified computer program containing the prescribed data fields and formats of the client.

pdf file – The resulting file extension found on documents scanned into Adobe Acrobat®. Scanned documents are found in the Documentum® program files for FUSRAP Maywood Site documents are often referred to as pdf files.

SDG – A group of samples identified by and peculiar to a given Chain-of-Custody (COC). The COC is assigned a number for tracking and reporting purposes. Work Order Number – The number, assigned by the laboratory, to a shipment of samples as they are received

6.0 RESPONSIBILITIES

6.1 SAMPLE COORDINATOR

- 6.1.1 Assigns the initial sample number in the Maywood database using a block of numbers specifically assigned to his/her work task.
- 6.1.5 Enters sampling field activity information into the database.
- 6.1.2 Coordinates the laboratory's responsibilities and maintains a high level of communication with the laboratories regarding the shipment and receipt of sample packages, analysis of samples, and transmittal of sample data reports.
- 6.1.3 Coordinates dispersal and completion of Final Data Analysis Reports.
- 6.1.4 Submits a weekly progress table on samples completed to the Task Manager.

6.2 FIELD OPERATIONS LEADER (FOL)

- 6.2.1 Ensures that the sample locations are identified and correspond with the sample number assignments.
- 6.2.2 Gives direction to the Sample Coordinator on the sample schedule and indicates what sample labels are needed.
- 6.2.3 Collects daily reports from Field Sampling Teams.

6.3 PROJECT CHEMIST (QA OFFICER)

- 6.3.1 Oversees the quality performance of the laboratories performing Maywood sample analyses.
- 6.3.2 Reviews the results of data package validations.
- 6.3.2 Provides technical support to the Task Managers and Field Operations Leaders.
- 6.3.3 Clarifies sampling procedure requirements or concerns.

6.4 TASK MANAGER

- 6.4.1 Translates client's requirements into technical direction for the Project and communicates to the Field Operation Leader changes in the sampling program per the client's request.
- 6.4.3 Ensures the Final Report of sampling efforts is submitted to the client in the appropriate format.

6.5 DATABASE MANAGER

- 6.5.1 Inputs the Electronic Data Deliverable (EDD) data files sent from both the onsite and offsite contract laboratories into the Maywood Superfund Site Database.

6.6 DOCUMENT COORDINATOR

- 6.6.1 Scans documents pertaining to the samples taken and analyzed for the Maywood Site as directed by the Sample Coordinator.

6.7 RADIOCHEMISTRY LABORATORY MANAGER (RLM) / OFFSITE PROJECT MANAGER

- 6.7.1 Maintains control of samples and sample data.
- 6.7.2 Ensures that the Maywood Site's quality control requirements for producing data and proper documentation of method protocol are met.
- 6.7.2 Delivers the Electronic Data Deliverable (EDD) associated with a given data package to the Sample Coordinator, Database Manager, and Project Chemist.

7.0 PREREQUISITIES

- 7.1 None

8.0 PRECAUTIONS, LIMITS, SAFETY

- 8.1 NONE

9.0 RECORDS

- 9.1 NONE

10.0 PROCEDURE

NOTE

All actions or tasks performed in coordination of the completion of the Standard Operating Procedure (SOP) shall be done in accordance with the task specific SOP and Maywood Chemical Data Quality Management Plan (CDQMP).

10.1 Field Operations Leader (FOL), performs the following steps.

- 10.1.1 Requests Sample Identification numbers by completing a Sample Request Form, Attachment 2.
- 10.1.2 Gives the Sample Request Form to the Sample Coordinator.
- 10.1.3 Responds to the questions of the Sample Coordinator pertaining to the Form.

10.2 Sample Coordinator, perform the following steps.

- 10.2.1 Reviews the Sample Request Form and discusses concerns with the FOL.
- 10.2.2 Signs into the Maywood Superfund Site Database (MSSDB).
- 10.2.3 Assigns Sample Identification numbers for the samples requested.
- 10.2.4 Prints the labels for the sample containers.

10.3 FOL prepares the bottle sets or sample cans.

NOTE

The Offsite Laboratory sends Bottle Sets for specific analyses to the Site. These Bottle Sets are to be maintained by the Sample Coordinator.

10.4 FOL performs the following steps.

- 10.4.1 Ensures sample containers are properly labeled at the time of sample collection.
- 10.4.2 Collects samples and identify each on the Chain of Custody.
- 10.4.3 Provides the Chain-of-Custody to the Sample Coordinator to review.
- 10.4.4 Upon acceptance of the COC by the Sample Coordinator, packages and ships the samples to the designated Lab.

10.5 Sample Coordinator performs the following steps.

- 10.5.1 Reviews the Chain-of-Custody with the FOL.
- 10.5.2 Notifies the Offsite or USACE Lab of Sample shipment via e-mail to the laboratory.
- 10.5.3 Enters into the MSSDB field information for each sample collected

- 10.6 Upon receiving the samples, the laboratory (Onsite, Offsite, or USACE) is required to perform the following steps:

NOTE

These steps are overviews of a process. Specifics with the Offsite Laboratories are dictated by Contract Agreement and by SOPs developed by the Offsite Labs. Onsite Laboratory requirements are specified in Maywood SOPs.

- 10.6.1 Logs the receipt of the samples.
- 10.6.2 Enters the sample into the Lab's Laboratory Information Management System (LIMS).
- 10.6.3 Ensures the samples are tracked and analyzed by a number or identification that is directly referenced to the Sample Identification number provided by the Maywood Site.
- 10.6.4 Maintains an internal Chain-of-Custody on the sample as appropriate.
- 10.6.5 Analyzes the samples as required in the appropriate timeframe dictated.
- 10.6.6 Reviews the data for quality assurance based on blank checks, calibration checks, and control sample results.

NOTE

Onsite the Radiochemistry Laboratory Manager, or designee, reviews all data and qualifies certain parameters in accordance with SOP 601, Laboratory Internal Data Evaluation.

- 10.6.7 Notifies the Sample Coordinator of concerns with the sample results.

NOTE

Sample analysis concerns should be relayed by the Sample Coordinator to the Project Chemist, Task Manager, Radiation Safety Officer, or Project Manager as appropriate for comment or resolution.

- 10.6.8 Provides data analysis results per the requirements of the Electronic Deliverable Package or by download to the MSSDB to the Sample Coordinator, the Database Manager, and the Sample Analysis Data Validator.
- 10.6.9 Provides an electronic copy of the Final Report of the Sample Analysis with a Case Narrative of sample and quality control results determined during the analysis to the Sample Coordinator.

NOTE

Specifics regarding Electronic Data Deliverables can be found in the *Chemical Data Quality Control Program Manual*.

- 10.6.10 Prepares backup files of lab data to reduce the possibility of lost data.

- 10.7 Sample Coordinator and Project Chemist shall review the data presented by the lab for completeness and accuracy.
- 10.7.1 Review each data point related to its quality controls.
 - 10.7.2 The Project Chemist shall review approximately 10% of the data.
 - 10.7.3 Data results that fall outside the determined quality assurance parameters (2σ or 3σ values or percent recoveries) are to be investigated and corrective action taken, if necessary.
- 10.8 Sample Coordinator performs the following steps after the data has been reviewed.
- 10.8.1 Presents electronic copy of the Final Report after review to the Document Coordinator.
 - 10.8.2 Transmits electronic copies of the Final Report and MSSDB material to the Sample Analysis Data Validator as necessary depending on the volume of reports they have received.
 - 10.8.3 Transmits data results to the Task Mangers for review and resolves conflicts or concerns raised from the review.
- 10.9 Task Manager reviews the data results relating the Project Objectives to the samples results.
- 10.9.1 Reports problems immediately to the Sample Coordinator.
 - 10.9.2 Relays concerns that involve Project Objectives to the Project Manager.
- 10.10 Document Coordinator performs the following steps.
- 10.10.1 Records the Electronic Data Deliverable Final Report received date, LRB number, and Task Identifier.
 - 10.10.2 Scans the report to create a pdf file of the data package.
 - 10.10.3 Copies the pdf files onto a compact disc and deliver it to the Sample Coordinator.
 - 10.10.4 Stores the scanned documents in the share drive Documentum® folders.
- 10.11 Sample Coordinator mails the copy of the pdf files of the Final Report to the Sample Analysis Data Validator, if the data is designated for validation.
- 10.12 Validator performs the following steps.
- 10.12.1 Reviews the data for validation.
 - 10.12.2 Adds a data qualifier column to the EDD file and populates it with qualifiers as appropriate.
 - 10.12.3 Develops a Data Validation Report.
 - 10.12.4 Transmits the Data Validation Report to the Project Chemist and the Validated Database to the Database Manager.

10.13 Database Manager performs the following steps.

10.13.1 Reviews ALL EDD's prior to importing them into the MSSDB to ensure consistency in nomenclature/spelling, sample number format, and content.

10.13.2 Periodically reviews database data tables for consistency in nomenclature and for completeness and makes appropriate edits, as necessary.

10.13.3 Alerts the Project Chemist and Sample Coordinator of any noted errors or inconsistencies for corrective action by the laboratories as appropriate.

10.14 Sample Coordinator transmits data and data reports to the clients (USACE and NJDEP) as appropriate.

10.15 The Project Chemist shall make the final decision in conjunction with the Sample Coordinator, Task Managers, Project Manager, and client regarding the archiving of sample data.

11.0 QUALITY CONTROL

11.1 The database records and allows tracking of ALL assigned sample numbers; allows assignment of numbers only within designated blocks of numbers assigned to each project task; and does not allow duplication of sample numbers.

11.2 The database only allows the addition of laboratory sample results for sample numbers that have been previously defined and described in the database with respect to several key parameters such as sample point location, short sample number, and complete (long) sample number identifier.

11.3 Inconsistencies are resolved with the Sample Coordinator and Project Chemist and appropriate changes are made to ensure compatibility and completeness.

12.0 DATA REVIEW

12.1 Data Coordinator compares a hardcopy of scanned laboratory data packages to the scanned version to ensure completeness and correspondence of both the scanned and hardcopy documents.

12.2 Project Chemist reviews 10% of the non-quality sample results and 100% of the quality control sample results for completeness and accuracy.

12.3 Submittals to the NJDEP require additional review and checking for consistency and completeness. Data to be submitted must pass a NJDEP computerized check for compatibility and consistency.

13.0 ATTACHMENTS

13.1 NONE

Procedure No. SOP 603 Revision No 0 Date of Revision February 20, 2003 Last Review Date February 20, 2003 Page 1 of 15	
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Radiochemistry Laboratory Document Development and Control	
PREPARED BY:  Radiochemistry Laboratory Mgr 02/20/03	APPROVED:  Project Manager 02/20/03
REVIEWED BY:  Project Chemist 02/20/03	

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the process for the development and control of documents used to perform laboratory tasks, including SOPs, Quality Assurance Manual, Lab Notebooks, equipment operation manuals, Forms, and Data Records.

2.0 SCOPE

These methods apply to FUSRAP Maywood Superfund Site (FMSS) Onsite Laboratory (the Radiochemistry Lab or the Lab). It applies to the Lab's existing SOPs, new SOPs, and laboratory documentation, such as notebooks and log sheets and forms.

3.0 REFERENCES

Chemical Data Quality Management Plan (CDQMP) FUSRAP Maywood Superfund Site (FMSS); Field Sampling Plan (FSP) Section; Stone & Webster Inc.

U.S. Nuclear Regulatory Commission (NRC) Inspection Manual; Chapter 0040, Preparing and Revising Documents, Exhibit 4- Preparation of an Inspection Procedure.

Engineering Manual (EM) 200-1-3; 1 February 2001, Appendix I – Shell for Analytical Chemistry Requirements; USACE.

4.0 DISCUSSION

SOPs and other documents generated and prepared for the Radiochemistry Lab play an integral part of the laboratory sample handling, preparation, and testing process.

SOPs for the Radiochemistry Lab are designed and organized to be a useful tool for the staff performing analyses or operating and maintaining the Lab and its materials and equipment. To do so the format for the various SOPs and the Rules of Construction are set in this SOP.

All SOPs require a foundation in development and a valid review prior to being implemented. Procedures, protocols, and methods will be developed, reviewed, and implemented in accordance with current industry practices, policy and procedures. Prior to implementation, SOPs will be performance tested and measured against quality assurance / quality control (QA/QC) requirements. ALL procedures shall be produced with the goals of obtaining results with the highest integrity and quality and in the safest and most environmentally sound manner practical.

Lab operations and sample analyses undertaken are tracked to allow for future review and consideration, if a problem or question arises or if other related information is needed. Lab Notebooks are maintained to track steps taken in calibrating, maintaining, or operating instrumentation and equipment. Lab Notebooks are also used to write down steps taken in various analyses. These notebooks will be used to track primarily chemical manipulations; however, they may be used for other purposes involving analytical methods as determined by the Radiochemistry Lab Manager (RLM).

Several items within the performance of a method or analysis are tracked on forms or data sheets. These forms and data sheets are developed within the respective SOP that calls for the development and tracking of the data.

In conjunction with these documents, the manufacturers and vendors of the Lab's instrumentation and equipment provide extensive documentation specifically designed for the use and maintenance of that material. This SOP dictates how those materials are to be maintained and controlled.

5.0 DEFINITIONS

5.1 NONE

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6.0 RESPONSIBILITIES

6.1 RADIOCHEMISTRY LABORATORY MANAGER (RLM)

- 6.1.1 Ensuring compliance with this SOP in the development, processing and handling of all Lab Documents, SOPs, Forms, and Records
- 6.1.2 Training laboratory personnel in the requirements of this procedure.
- 6.1.3 Controlling and retaining of laboratory QA records
- 6.1.4 Initiating corrective action as necessary, and performing of any follow-up, as required if problems are encountered in the area of laboratory documentation.
- 6.1.5 Annually ensuring all SOPs are reviewed and revised as required by the review.

6.2 QA OFFICER

- 6.2.1 Ensuring all SOPs are reviewed annually and revised as required by the review.
- 6.2.2 Coordinating with the RLM and USACE to resolve problems related to operation of the laboratory that could prevent proper documentation of sample receipt and custody, reagents/standards receipt and preparation, sample preparation and testing, instrument calibration and maintenance, non-conformances and corrective actions, and sample and laboratory waste disposal.
- 6.2.3 Following up any corrective actions that may have been taken.

6.3 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLTs)

- 6.3.1 Performing the requirements of this procedure.
- 6.3.2 Ensuring that adequate notebooks, log sheets, file dividers, etc. are available for daily operation.
- 6.3.3 Maintaining laboratory QA records

6.4 DOCUMENT CONTROL ADMINISTRATOR (DCA)

- 6.4.1 Ensuring the requirements of this SOP are in concert and compliance with the operating methods employed for documents at the FMSS.

7.0 PREREQUISITES

- 7.1 NONE

8.0 PRECAUTIONS, LIMITS, SAFETY

- 8.1 NONE

9.0 RECORDS

- 9.1 NONE

10.0 PROCEDURE

10.1 STANDARD OPERATING PROCEDURE RULES OF CONSTRUCTION

- 10.1.1 Formatting of SOPs including Titles, Section numbering and Step structure is in accordance with this SOP and with guidelines set by Stone & Webster. The formatting of the document shall follow the requirements of this SOP, unless the formatting change is done to facilitate ease of use or the document is outside the boundaries of normal SOPs.

The Layout of a SOP is to be consistent for ALL SOPs. The positions of indents and the font type used have been specified and are under the control of the DCA.

SOP number assignments are as follows:

601 – 610	Administrative
611 – 620	Lab Rad Protection
621 – 640	Instrumentation
641 – 699	Analytical Methods

Section requirements can be found in Attachment 1; Radiochemistry Lab Administrative SOP Sections, and Attachment 2; Radiochemistry Lab Instrumentation and Analytical Method SOP Sections.

- 10.1.2 Standard writing rules of construction shall apply as follows, unless the context describes otherwise.
- 1) Words imparting the plural include the singular.
 - 2) Words imparting the masculine include the feminine.
 - 3) The word “shall” is to be used as an imperative action.
 - 4) The word “must” is to be used as an imperative sense.
 - 5) The word “should” is to be used as a recommended action.
 - 6) The word “may” is to be used to imply user permission or authority.
 - 7) The word “includes” is to be used to infer inclusion not limitation.
 - 8) Acronyms or abbreviations are to be identified in full at first use in the body of the document, in a detachable or “reproduced for use” Attachment, Form, or other portion of the document.

- 10.1.3 SOPs are developed primarily for a singular task. Several tasks in an SOP can cause confusion and inadvertent missed steps. Tasks that are like tasks may be combined in one SOP provided there is clear definition to separate the tasks.

By example,

The preparations of all samples for isotopic analysis require digestion. However, the initial steps to get a soil sample to digestion are different from those for a water sample. Here an SOP is written for sample prep and the Procedure Section is subdivided into each particular matrix with all samples ending in a condition for isotopic analysis.

By doing this, a change does not have to be tracked through several SOPs but only through one. Missing a change in another SOP could result in the data not being acceptable or qualified or could cause harm.

- 10.1.4 Analytical or Instrument SOPs contain Steps that are identified in single action sentences, and not as a written paragraph containing several actions. This ensures steps are not lost within a paragraph and the user accidentally reading over them.

By example,

Click on the Tab labeled **EXIT**.

- 10.1.5 Administrative SOPs often contain explanations or positions rather than action Steps. These SOPs are therefore allowed to contain paragraphs. Care should be exercised that these paragraphs are not overly wordy or long. Paragraphs should be limited to a single thought process involved.

By example,

This SOP as written is the way Administrative Steps are formatted.

- 10.1.6 If/Then, Once, Upon, When/Then or other judgment/logic steps use a separate line from the action step to clearly identify the decision requirements.

By example,

If this had been a logic decision,
Write the Step in this manner.

- 10.1.7 NOT, NEITHER, NOR or other negative step requirements use capital letters to clearly identify the decision requirement.

- 10.1.8 ALL is to be capitalized when used as an imperative action.

- 10.1.9 **NOTE**, **CAUTION**, and **WARNING** statements are isolated within a table box centered in the document with the condition highlighted to ensure they stand out for the user as information essential to performing the method effectively and safely.

These statements can be sentences strung together in a paragraph format or contain an illustration to effectively relay information to the user.

By Example,

CAUTION

Two Technicians are required to fill the Transfer Dewar. The Technician working directly with or near cryogenic gases shall wear appropriate Personal Protective Equipment (PPE).

- 10.1.10 **WARNING** statements shall include the control measure(s) to be implemented to prevent an occurrence of the hazard or incident identified in the Warning.

By Example,

WARNING

Ovens operated in drying samples are at extremely high temperatures (greater than 100° C). DO NOT touch any material in the oven without thermal resistant gloves.

- 10.1.11 Examples are called out “By Example” in Administrative documents as illustrated throughout this SOP or as part of a **NOTE** in instrumentation or method SOPs.

NOTE

In this procedure, computer commands are stated in **BOLD** type. Programs are referred to in *Italicized* type. Commands to be typed in by the Technician are in quotation marks; “command”.

- 10.1.12 Parameters identified and controlled by another document are called out as “refer to the controlling document” versus adding the parameter, which may not be changed in concurrence with an update to the controlling document. This will prevent two separate approved values working in conflict with each other.
- 10.1.13 "In accordance with" is a statement requiring the user to incorporate the performance of a cited document into the performance of the SOP.
- 10.1.14 "Per the requirements of" is a statement requiring the user to incorporate the specific applicable requirement of a cited document into the performance of the SOP.

- 10.1.15 Referenced documents are to be referred to by their controlling title, number, and revision.

Referenced SOPs are referred to without their appropriate revision inferring the use of the current revision.

By example,

SOP 600 Rev. No. 01, SOP DOCUMENT is referred to as SOP 600, SOP DOCUMENT.

- 10.1.16 Editing of SOPs should consider the continuation of Steps across pages. An action Step from an SOP shall NOT be broken between two pages. Bullet or numbered lists may be carried over. Administrative paragraphs should not be broken.

To this end, an SOP controlling an instrument or equipment operation or analytical method may routinely have dead space left at the bottom of a page. When that space exceed 2 or more inches the space shall be placed in the center of the blank space and noted as:

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10.2 STANDARD OPERATING PROCEDURE AND LAB NOTEBOOK NUMBERING

- 10.2.1 Lab SOPs are assigned a number group within the procedure structure of the CDQMP. This number group is the 600 series.
- 10.2.2 600 series SOPs are further divided into four subgroups.
- 1) 600 to 610 is applied to the Lab Administrative SOPs
 - 2) 611 to 620 is applied to the Lab Radiation Protection SOPs
 - 3) 621 to 640 is applied to the Lab Instrumentation and Equipment SOPs
 - 4) 641 to 699 is applied to the Lab Analytical Method SOPs
- 10.2.3 Lab Notebooks are to be provided for each piece of analytical counting instrumentation, major equipment or grouping of equipment that is considered a major system, and for each analytical method.
- 10.2.4 Lab Notebooks should be legal bound pages with sequential numbered pages.
- 10.2.5 Lab Notebooks are to be assigned a sequential number as given out. This number is assigned by the RLM and will be maintained by a Lab Notebook Identification File.
- 10.2.6 The Lab Notebook Identification File should indicate the LB No.; the Title (instrument name or method); Date of Issuance; and Date of Completion.

10.3 STANDARD OPERATING PROCEDURE REVIEW AND APPROVAL PROCESS

10.3.1 SOPs shall be developed to support all identified tasks within the Lab. Preferably the SOP is initially developed by a subject matter expert. However, administrative personnel can develop SOPs by copying published documents into the Lab SOP format, with the Technical Review adding required changes to add specificity reflective of the Lab.

10.3.2 The Technical Review of the document is required to be performed by a qualified individual as identified by either the RLM or QA Officer. SOPs requiring performance of a task should be tried by the individual(s) designated to perform the task for feedback.

The RLM shall ensure ALL performance steps in a SOP mimic the actual steps performed in Lab operations. Variances in performance capabilities are to be noted for review. The reviews shall take into account variables such as material handling, equipment restrictions, manpower, ergonomics, and scheduling.

The RLM shall ensure that NO SOP is written that violates a Safety or Radiation Protection requirement. The RLM shall forward SOPs that have radiation safety hazard potential to the Radiation Safety Officer and SOPs that have chemical or physical safety hazard potential to the Site Safety & Health Officer for review, as appropriate. SOPs will NOT be approved that can result in a potential loss of life or extremely hazardous situation.

10.3.3 Approval of an SOP is the prerogative of the RLM. The RLM shall not approve a procedure, which does not meet the goals of the Lab or cannot be performed as written.

Each procedure is reviewed by the QA Officer to ensure that QA/QC objectives are clearly defined, met, and reported in the course of performance of the procedure.

The final approval for implementation of the procedure comes from the Project Manager. The Project Manager is required to ensure that the Maywood Project and the incorporate Maywood Project tasks shall support the requirements of the SOP as detailed.

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10.4 CHANGES AND REVISIONS

10.4.1 SOPs are not written in concrete. It is expected that as an SOP is used and applied that changes will be required to reflect changes in operation, technical position, new purchases, modifications to equipment, and innovation.

10.4.2 Temporary changes can be made using pen and ink changes. Pen and ink changes should be limited to typos or minor revisions such as changing an addition from 0.5 to 1.0 mL.

Pen and ink changes are to be authorized by the RLM prior to entry into a Rad Lab SOP. Pen and ink SOP changes must be communicated to the QA Officer for inclusion into the QA Office copy of laboratory SOP's. These types of changes must include the date and initials of the person making the changes.

Temporary changes should be incorporation into the existing SOP at the time of annual review of the SOP.

Pen and ink changes shall be minimized. At any point when the changes look to confuse the technician or cause an error to happen, the document shall be revised. Extensive changes shall require a new SOP be researched properly and developed, unless dictated as such by the RLM or QA Officer with justification.

10.4.3 Revisions to SOPs should be performed when dictated. Yearly SOP reviews DO NOT dictate a requirement to revise an SOP. They do however provide a point where pen and ink changes are to be incorporated.

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10.5 TEMPORARY PROTOCOL FOR RESEARCH AND DEVELOPMENT

- 10.5.1 A Temporary Protocol for Research and Development is prepared to control a precisely stated process, while a permanent SOP is being researched and needs to be tested. Temporary protocols are generally written due to the lack of a published or recognized method available. They are essentially written for experiments.
- 10.5.2 Data developed or achieved shall NOT be considered acceptable for reporting purposes. The Temporary Protocol mimics a SOP in design and content, and primarily is provided as guidance in an operation that is currently uncontrolled. At a minimum the Temporary Protocol will have the following sections:
- 1) Overview and Scope - A brief discussion of the purpose of the Temporary Protocol and how it is to be applied in the Rad Lab.
 - 2) Proposed Test - An outline of the major steps in the protocol.
 - 3) Apparatus - Materials needed for the protocol.
 - 4) Reagents - Chemicals and solutions needed for the protocol including the solution calculations.
 - 5) Procedure - Step by step how the protocol is to be performed.
 - 6) Result Tabulation and Reporting - Detail how the data from the protocol is to be handled and used to make an informed decision on the outcome of the protocol.
- 10.5.3 The document is reviewed and approved by the RLM. While this document is in effect, it is open for comment and revision. Comments and revisions are expected, as the document is a research tool. The protocol may be in effect but altered due to noted results in the performance of the protocol.
- Pen and ink changes may be made to the steps of the Protocol as approved by the RLM.
- 10.5.4 Temporary Protocols are time sensitive documents. By definition a Temporary Protocol shall be in force for a period of not greater than 90 days. If the protocol is necessary for normal operations after the lifetime, it should be written and approved as a SOP or as an amendment to an existing SOP. Attachment 2, Temporary Protocol for Research and Development, provides the template for this document.

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10.6 DOCUMENT CONTROL

- 10.6.1 Documents developed by the Lab are under the control of the RLM, QA Officer, and the DCA for the FMSS Project.
- 10.6.2 Upon completion of the development, review, and approval process, a SOP will be placed onto the network server and saved in a designated folder located on the Shared Drive.
- 10.6.3 The document will be transposed to the Documentum program by the DCA.
- 10.6.4 The DCA will produce the necessary hard and electronic copies and distribute them as designated.

Copies of SOPs provided to designated individuals are to be numbered and identified by the DCA.
- 10.6.5 The SOPs will be maintained in the Lab in those locations deemed appropriate by the RLM to provide ready availability in the performance of the SOP.
- 10.6.6 Manufacturer and Vendor manuals, pamphlets, instructions, or procedures are to be maintained by the Lab. These documents are to be filed in a clearly marked and easily identifiable manner. A list is to be maintained that identifies what documents are on-hand in the Lab. The list should include at a minimum; the Vendor/Manufacturer Name/Address/Phone Number, Document Title or Description, and Date Received.
- 10.6.7 Documents that include specific preventive maintenance are to be identified for inclusion in the equipment or instrument SOP.

11.0 QUALITY CONTROL

- 11.1 The QA Officer shall ensure that each SOP written meets the data quality requirements of the Maywood Project as directed by the CDQMP and any other authorizing document.
- 11.2 The QA Officer shall ensure that Lab Notebooks are created and maintained as prescribed.

12.0 DATA REVIEW

- 12.1 The RLM shall review each Lab Notebook on a minimum of a monthly basis or whenever a major event occurs to ensure proper documentation and to examine any findings for possible root causes.

13.0 ATTACHMENTS

- 13.1 Radiochemistry Lab Administrative SOP Sections
- 13.2 Radiochemistry Lab Instrumentation and Analytical Method SOP Sections
- 13.3 Radiochemistry Lab Temporary Protocol for Research and Development Format

ATTACHMENT 13.1 Radiochemistry Lab Administrative SOP Sections

ADMINISTRATIVE SOPs

1.0 PURPOSE

No sub structure

2.0 SCOPE

No sub structure

3.0 REFERENCES

No sub structure

4.0 DISCUSSION

No sub structure

5.0 DEFINITIONS

Indented Alphabetical List

6.0 RESPONSIBILITIES

6.1 Title as Stated

6.1.1 End

7.0 PREREQUISITES

7.1

7.1.1 End

8.0 PRECAUTIONS, LIMITS, SAFETY

8.1

8.1.1 End

9.0 RECORDS

10.1

10.1.1 End

10.0 PROCEDURE

10.1 Task

10.1.1 Step

10.11.1 Step

• List

11.0 QUALITY CONTROL

11.1

11.1.1 End

12.0 DATA REVIEW

12.1

12.1.1 End

13.0 ATTACHMENTS

13.1 End

ATTACHMENT 13.2 Radiochemistry Lab Instrumentation and Analytical Method SOP Sections

1.0 PURPOSE

Text

2.0 METHOD SUMMARY AND VALIDATION

Text

3.0 RESPONSIBILITIES

3.1 Title as Stated

3.1.1 Item

4.0 SAFETY PRECAUTIONS

4.1 Item

5.0 INTERFERENCES

5.1 Item

6.0 APPARATUS AND MATERIALS

6.1 Item

7.0 REAGENTS AND STANDARDS

7.1 Item

8.0 SAMPLE PRESERVATION AND STORAGE

8.1 Item

9.0 HOLDING TIMES

9.1 Item

10.0 OPERATING CONDITIONS

10.1 Task

10.1.1 Step

- List

11.0 PROCEDURE

11.1 Task

11.1.1 Step

- List

12.0 QUALITY CONTROL

12.1 Item

13.0 REPORTING LIMITS

13.1 Item

14.0 QUALITATIVE IDENTIFICATION INFORMATION

14.1 Item

15.0 DATA REVIEW

15.1 Item

ATTACHMENT 13.2 Radiochemistry Lab Instrumentation and
Analytical Method SOP Sections (con't)

16.0 RECORDS

16.1 Item

17.0 PREVENTATIVE MAINTENANCE

17.1 Item

18.0 POLLUTION PREVENTION

18.1 Item

19.0 WASTE MANAGEMENT

19.1 Item

20.0 METHOD FLOW CHART

20.1 Item

21.0 REFERENCES

21.1 Item

22.0 ATTACHMENTS

22.1 Item

ATTACHMENT 13.3 Radiochemistry Lab Temporary Protocol for Research and Development Format

TITLE

Proposed By Initials/Date

Reviewed and Approved By RLM Initials/Date

1.0 OVERVIEW

1.1 Text

2.0 PROPOSED TEST

2.1 Major Steps

3.0 DETERMINED PROTOCOL OUTCOME REQUIREMENTS

3.1 Text

4.0 EQUIPMENT and REAGENTS

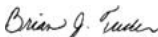
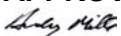
4.1 Text

5.0 PROCEDURE

5.1 Step

6.0 RESULT TABULATIONS

6.1 Descriptive Text or Steps

Procedure No. SOP 604 Revision No. 0 Date of Revision February 20, 2003 Last Issue Date February 20, 2003 Page 1 of 4	
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Sample Identification and Storage	
PREPARED BY:  Radiochemistry Laboratory Mgr 02/20/03 REVIEWED BY:  Project Chemist 02/20/03	APPROVED:  Project Manager 02/20/03

1.0 PURPOSE

This procedure details the method for applying a lab control identification number to a sample and the proper method and location for storage of the sample while either undergoing analysis or being held for future determination or disposal.

2.0 SCOPE

This procedure applies to Samples submitted to the Maywood Onsite Laboratory (the Radiochemistry Lab or the Lab) and placed under the control of the Lab Staff.

3.0 REFERENCES

Chemical Data Quality Management Plan – FUSRAP Maywood Superfund Site

SOP-MWD-504; Labeling, Packaging, and Shipping Environmental Sample

SOP-MWD-602; Analytical Data Management and Tracking

SOP-MWD-641; Receipt and Preparation of Soil Samples for Analysis by Gamma Spectrometry

4.0 DISCUSSION

Soil samples taken for analysis by the prime contractor for the FUSRAP Maywood Project are identified and tracked by a unique number identifying the sample. For tracking purposes internal to the Lab's operations these samples are require an identifier. For simplicity these numbers are derived from the sample identification number.

Air samples are taken by the Radiation Protection Group and provided to the Lab for analysis and data tracking. These samples are provided a unique identifier assigned by the Lab.

Samples are stored in one of three locations onsite. These include the Maywood Onsite Laboratory (the Radiochemistry Lab or the Lab), the Prep Lab and local area storage racks, and the Sample Storage Facility (SeaLand Container). Air samples are stored at the Lab and soils samples are stored in one of the three locations dependent on analysis or use status.

5.0 DEFINITIONS

NONE

6.0 RESPONSIBILITIES

6.1 RADIOCHEMISTRY LABORATORY MANAGER (RLM)

- 6.1.1 Ensuring that samples are clearly identified using the proper identification number.
- 6.1.2 Ensuring that the sample identification number is used to track analysis data.
- 6.1.3 Ensuring Radiochemistry Laboratory Technicians are aware of the requirements of this SOP.
- 6.1.4 Ensuring samples are properly stored and maintained.
- 6.1.5 Coordinating with the Project Manager and his staff to resolve problems related to the identification and storage of samples.

6.2 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLT)

- 6.2.1 Performing this procedure as written.
- 6.2.2 Reporting any problems in the performance of the SOP, the identification of a sample, or the storage of a sample to the RLM.
- 6.2.3 Initiating and recording the sample identification number for air samples.
- 6.2.4 Placing samples into storage upon the completion of analysis.
- 6.2.5 Coordinating the storage of samples to ensure ease of identification and retrieval.

6.3 QA OFFICER / PROJECT CHEMIST

- 6.3.1 Verifying sample data is identified by the sample identification number.
- 6.3.2 Periodically reviewing sample documentation and sample storage locations for compliance to requirements.

6.4 SAMPLE CUSTODY OFFICER (SCO)

- 6.4.1 Initiating the development of soil sample identification numbers in accordance with SW-MWD-504 and SW-MWD-602.

7.0 PREREQUISITES

7.1 NONE

8.0 PRECAUTIONS, LIMITS, AND SAFETY

- 8.1 All Site Health and Safety requirements shall be followed when performing a task.
- 8.2 All samples are to be considered radiation hazards and possibly contaminated until determined otherwise by radiation and contamination survey.
- 8.3 All samples are to be stored in such manner that external forces such as water, or excessive heat or airflow do not compromise the sample.
- 8.4 All samples are to be maintained in such a manner, as their contents cannot be loss from normal handling, transportation, or storage.

9.0 RECORDS

- 9.1 NONE

10.0 PROCEDURE

10.1 SOIL SAMPLE IDENTIFICATION

NOTE

Samples arriving to the Lab are either Grab Samples or Core Samples. Grab Samples should arrive at the Lab with a Label applied and a completed Chain of Custody. Core Samples arrive to the Lab with a Chain of Custody and sheet(s) of printed labels to be applied to the samples extracted from the Cores

- 10.1.1 Proceed with the requirements of SOP 641, Receipt and Preparation of Soil Samples for Analysis by Gamma Spectroscopy.

10.2 AIR SAMPLE IDENTIFICATION

- 10.2.1. Upon the Lab receipt of air samples, log the samples into the Air Sample Tracking Spreadsheet and assign the next sequential number to the sample.
- 10.2.2 Record the sample identification number onto the Air Sample Envelope.

10.3 SAMPLE STORAGE

- 10.3.1 Store Core Samples in the Prep Lab, if awaiting sample prep, or in the designated Sample Storage racks outside of the Prep Lab, if awaiting direction from the SCO.
- 10.3.2 Store samples prepped for analysis in either the Lab for analysis or the Sample Storage Facility, if awaiting further disposition (shipment to offsite lab, retention, or disposal).
- 10.3.3 Contact the RLM and SCO if problems arise in the storage of soil samples.
- 10.3.4 Store Air Samples in designated sample container storage areas in the Lab.

11.0 QUALITY CONTROL

- 11.1 Database numbers are to be reviewed by the Project Chemist and SCO to ensure that duplication of numbers does not exist.
- 11.2 Only the Project Chemist, SCO, and RLM shall have the ability, with justification, to reassign or change a sample number
- 11.3 Verify that all sample analysis data is developed and documented by a unique identification number.

12.0 DATA REVIEW REQUIREMENTS

- 12.1 The Project Chemist, RLM, and SCO shall review the status of the database and spreadsheet numbering routinely to ensure compliance.
- 12.2 The review shall consist of the examining any printouts or reports developed and examination of the database numbering system.

13.0 ATTACHMENTS

- 13.1 NONE

Procedure No.		SOP 605
Revision No.		1
Date of Revision		February 20, 2003
Last Issue Date		February 20, 2003
Page		1 of 3
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Sample Container Control		
PREPARED BY: <i>Timothy Mackay</i> Radiochemistry Laboratory Mgr 02/20/03		APPROVED: <i>Shirley Miller</i> Project Manager 02/20/03
REVIEWED BY: <i>Brian J. Tucker</i> Project Chemist 02/20/03		

1.0 PURPOSE

This procedure provides guidelines for the control of sample containers utilized by the FUSRAP Maywood Superfund Site Radiological Laboratory (the Laboratory).

2.0 SCOPE

This procedure provides guidelines for the control of sample containers used by the Laboratory. This procedure applies to all laboratory personnel and all users of sample containers that may be utilized for analysis by the laboratory.

3.0 REFERENCES

3.1 N/A

4.0 DISCUSSION

4.1 N/A

5.0 DEFINITIONS

- 5.1 Sample container - "Tuna Can" and lid, a soil sample canister of approximately 230 mL of volume constructed of stamped steel and coated internally; manufactured by Embarcadero Can Corporation.

6.0 RESPONSIBILITIES

6.1 RADIOCHEMISTRY LABORATORY MANAGER (RLM)

- 6.1.3 Training laboratory personnel in the requirements of this procedure.
- 6.1.2 Resolving issues involving sample containers and (potential) laboratory quality
- 6.1.3 Reviewing documentation regarding sample container problems for trends, root causes, and corrective actions

6.2 QA OFFICER

- 6.2.1 Coordination with the RLM and Project personnel to resolve problems related to the control of sample containers.

6.3 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLTs)

- 6.3.1 Responsible for proper storage of sample containers.
- 6.3.2 Documentation of incidences of sample container damage and/or contamination
- 6.3.3 Ensuring that adequate sample containers are available for daily operation.

7.0 PREREQUISITES

- 7.1 NONE

8.0 PRECAUTIONS, LIMITS, AND SAFETY

- 8.1 Improper use of sample containers can result in undesired radioactive material being present in a sample which will result in erroneous results.

9.0 RECORDS

- 9.1 NONE

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10.0 PROCEDURE

10.1 SAMPLE CONTAINER

- 10.1.1 All sample containers to be utilized by the Lab shall be controlled by the laboratory.
- 10.1.2 Inventory shall be maintained sufficient to meet project requirements.
 - 10.1.2.1 When the inventory falls to 200 sample containers (2 boxes), place an order for 10 boxes.
- 10.1.3 All sample containers shall be stored in an area, which will minimize the potential of contamination and/or damage.
 - 10.1.3.1 Storage areas include the Warehouse Building for the pallet of unopened boxes, the Lab Prep Room, and the Lab.
- 10.1.4 Sample containers suspected of having become contaminated shall not be utilized unless proven to be free of contamination through Project-approved radiological survey methods in accordance with Maywood RPP Procedures PP 8-805, “Radiological Surveys”, and PP 8-902, “Unrestricted Release Requirements”.
- 10.1.5 Damaged containers shall not be used for analysis.
- 10.1.6 Damaged containers shall be properly disposed.
 - 10.1.6.1 Dispose of clean containers as trash.
 - 10.1.6.2 Dispose of contaminated containers in accordance with SOP 612, Sample Disposal.

11.0 QUALITY CONTROL

- 11.1 [Section in process]

12.0 DATA REVIEW

- 12.1 [Section in process]

13.0 ATTACHMENTS

- 13.1 [Section in process]

Procedure No. SOP 610 Revision No. 0 Date of Revision February 20, 2003 Last Issue Date February 20, 2003 Page 1 of 5	
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Preventive Maintenance Program	
PREPARED BY: <i>Samuel J. McKinney</i> Radiochemistry Laboratory Mgr 02/20/03 REVIEWED BY: <i>Brian J. Tucker</i> Project Chemist 02/20/03	APPROVED: <i>Shirley M. Holt</i> Project Manager 02/20/03

1.0 PURPOSE

This procedure details the requirements for implementing and maintaining a Preventive Maintenance Program for equipment and instrumentation used in the Maywood Onsite Laboratory to develop analytical data.

2.0 SCOPE

This procedure applies to all laboratory equipment used to generate data for analysis results. This procedure applies to, but is not limited to, the following equipment or instrumentation:

- Analytical balances,
- Gamma spectrometers,
- Scintillation counting instruments

This SOP does NOT describe the requirements or determinations of steps to correct problems associated with the operation of a nuclear counting system.

3.0 REFERENCE

ANSI N42.23-1996; Measurement and Associated Instrument Quality Assurance for Radioassay Laboratories

Chemical Data Quality Management Plan – FUSRAP Maywood Superfund Site

Operating Manuals of Associated Analytical Equipment

4.0 DISCUSSION

To ensure that the highest level of quality is obtained during sample analysis, instrumentation and associated analytical equipment shall be operated and maintained in accordance with industry standards and manufacturer recommendations. Preventive maintenance is that practice that routinely requires certain prescribed actions to be taken to ensure that the instrument or equipment continues to operate within accepted parameters. Instrument performance is tracked through the use of quality control charts coupled with technicians' notes and observations. Manufacturers' service bulletins may also require further actions be taken in order to ensure proper instrument or equipment operation.

5.0 DEFINITIONS

Preventive Maintenance - regularly scheduled inspection, test, and maintenance operations designed to keep instruments or equipment in proper working order and capable of meeting manufacturers' standards for accuracy and precision.

6.0 RESPONSIBILITIES

6.1 RADIOCHEMISTRY LABORATORY MANAGER (RLM)

- 6.1.1 Ensuring the Preventive Maintenance (PM) required for each instrument or equipment used in the Maywood Onsite Laboratory (the Lab) is properly identified and recorded.
- 6.1.2 Ensuring that a schedule of required PMs is developed and used to implement PM action plan.
- 6.1.3 Ensuring the PM Action Plan is utilized and maintained to the best ability of the Lab operations schedule and requirements.
- 6.1.4 Communicating the requirements for the PM of instrumentation and equipment to the RLTs.
- 6.1.5 Including the requirements of associated PMs in the training of RLTs on designated instruments and equipment.
- 6.1.6 Coordinating Lab operations with the scheduling of Manufacturer or Vendor Technicians in the performance of PMs.
- 6.1.7 Coordinating with the Project Manager, Project Chemist, and Vendors or Manufacturers to resolve problems related to the performance of PMs that could prevent the completion of required analyses.
- 6.1.8 Ensuring Vendor or Manufacturer Technicians complete the required Preventive Maintenance as required to meet Radiochemistry Laboratory Quality Objectives.

6.2 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLT)

- 6.2.1 Perform PMs as trained and as required.
- 6.2.2 Report any problems associated with the performance of a PM or the result of a PM that causes the instrument or equipment to be inoperable or operate outside of normal parameters.
- 6.2.3 Ensure that adequate supplies are available for the performance of assigned PMs.
- 6.2.4 Notify the RLM immediately of any problem noted with an instrument or analytical equipment.

6.3 PROJECT CHEMIST

- 6.3.1 Verifies preventive maintenance agreements and contracts have been executed with associated manufacturers of Lab instrumentation or equipment.
- 6.3.2 Reviews quality data associated with instrument and equipment operation to determine the effectiveness of PMs and the need for any other corrective actions necessary to ensure quality data.

6.4 PROJECT MANAGER

- 6.4.1 Appoints an individual to oversee contracts and contract service agreements pertaining to the Lab instrumentation and equipment.
- 6.4.2 Reviews and revises the work schedules of site activities to allow for the coordination of Lab operations related to the completion of required Preventive Maintenance.

7.0 PREREQUISITES

- 7.1 NONE

8.0 PRECAUTIONS, LIMITS, AND SAFETY

- 8.1 All equipment and instrumentation that operate with electrical power, compressed gases, cryogenic gases, or radioactive materials shall NOT be worked on internally without the removal of the present danger or proper safety controls implemented.
- 8.2 All Site Health and Safety requirements shall be followed when performing a task.
- 8.3 Vendors shall be notified of hazards in the areas adjacent to the area where they performing a PM.
- 8.4 PMs should not be postponed for more than 30 days.

9.0 EQUIPMENT

- 9.1 NONE

10.0 RECORDS DEVELOPED

- 10.1 Preventive Maintenance Action Plan
- 10.2 Lab Instrumentation Run Log
- 10.3 Lab Instrumentation Maintenance Log

11.0 PROCEDURE

- 11.1 New Instrumentation or Equipment Purchase
 - 11.1.1 Upon purchase of a piece of analytical instrumentation or equipment, determine the required Preventive Maintenance required for the article.
 - 11.1.2 Identify and record the required materials needed to perform the PM.
 - 11.1.3 Determine and record the frequency of the PM.
 - 11.1.4 Present the determined information to the RLM for incorporation into the associated SOP(s).
 - 11.1.5 Place the PM into the Preventive Maintenance Action Plan.
 - 11.1.6 Determine the next required date for the PM and record it for future reference.
- 11.2 Performance of PMs by RLTs
 - 11.2.1 Read and review the requirements of the PM to determine steps to be taken, expected outcome, required testing, and records needed to be developed.
 - 11.2.2 Assemble all materials required to perform the PM prior to the performance date.
 - 11.2.3 Perform the PM as directed.
 - 11.2.4 Notify Lab supervision immediately of a problem or associated error noted during the performance of a PM.
 - 11.2.5 Notify Lab supervision immediately if a PM cannot be completed within its assigned time frame.
 - 11.2.6 Record the performance of the PM, any associated information describing additive information on performing the PM, and the next schedule date of the PM in the associated Lab Instrumentation Notebook.
- 11.3. Performance of PMs by Vendors or Manufacturers
 - 11.3.1 Identify the PM within two months of required performance.
 - 11.3.2 Determine if any other work, required or needed, can be performed in conjunction with the PM.
 - 11.3.3 Contact the Vendor or Manufacturer to arrange for performance of the PM and detail the requirements of any other work.
 - 11.3.4 Schedule the Vendor or Manufacturer representative to arrive within +30/-14 days of the required PM scheduled date.
 - 11.3.5 Notify the RLM of the scheduled date and time.

- 11.3.6 Escort, observe, and aid the representative, as appropriate, while at the Lab.
- 11.3.7 Review the progress and results of the PM with the representative.
- 11.3.8 Record the performance of the PM as well as any additional information gathered while performing the PM.,
- 11.3.9 As appropriate, schedule the next date of the PM with the representative and record it in the associated Lab Instrumentation Notebook.

12.0 QUALITY CONTROL REQUIREMENTS

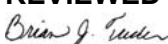
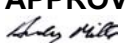
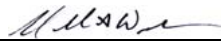
- 12.1 ONLY Vendor or Manufacturer specified replacement parts are to be used in performing a required Preventive Maintenance action.
- 12.2 Critical points in the performance of a PM should be double checked by another qualified RLT.
- 12.3 Verify that the instrument or equipment performs to required specifications or Radiochemistry Lab Quality Control requirements prior to placing the article back in service.
- 12.4 Upon purchase of a piece of analytical instrumentation or equipment, determine what functions if performed by the staff at Maywood Onsite Lab will void any Service Agreement or Contract.

13.0 DATA REVIEW REQUIREMENTS

- 13.1 The Lead RLT or RLM shall review the results of the performance of a PM.
- 132 The review shall consist of the examining any printouts developed, details recorded in the Lab Instrumentation Run Log, Instrumentation Maintenance Log, or comments written by the Vendor or Manufacturer.

14.0 ATTACHMENTS

- 14.1 NONE

Procedure No. Revision No. Date of Revision Last Issue Date Page	SOP 611 0 February 20, 2003 February 20, 2003 1 of 7
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Laboratory Contamination Control	
PREPARED BY:  _____ Radiochemistry Laboratory Manager Date REVIEWED BY:  _____ Project Chemist Date APPROVED:  _____ Project Manager Date	REVIEWED BY:  _____ Radiation Safety Officer Date REVIEWED BY:  _____ Project Certified Health Physicist Date

1.0 PURPOSE

This procedure provides consistent methodology, guidelines, and protocols to be followed to control and mitigate contamination within the laboratory environment.

2.0 SCOPE

This procedure provides consistent methodology, guidelines, and protocols to be followed to control contamination within the laboratory environment. This procedure applies to all laboratory and associated operations and will be implemented whenever the laboratory is actively engaged in analytical activities. This procedure shall be strictly followed to ensure that radiological contamination is quickly identified so that the potential for cross-contamination of samples and personnel is maintained As Low As Reasonably Achievable (ALARA). (If the laboratory will be inactive for a period of 3 months, the Project Manager may direct that an abbreviated version of this procedure be prepared and implemented).

The scope of this procedure does NOT cover non-radiological de minimus spills or releases. Non-radiological spills or releases are performed in accordance with SOP 613, Hazardous Waste Management.

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3.0 REFERENCES

- Site Safety and Health Plan, FUSRAP Maywood Superfund Site
- PP-8-200, Radiation Protection Plan
- PP-8-805, Radiological Surveys
- PP-8-807, Survey Documentation and Review
- PP-8-815, Personnel Survey and Decontamination
- PP-8-701, Access Control
- PP-8-702, Radiological Posting Requirements
- PP-8-704, Hazardous Work Permits Preparation and Use

4.0 DISCUSSION

The Lab in its course of operation handles samples in raw form. This means that the material is open to the environment and all the physical and chemical motive forces that can spread material from its original location. These forces include but are not limited to such mechanisms as physical contact with the technician, mechanical pulverizing and spinning, intense heat, and physical movement from container to container. All these actions can result in the spread of radioactive material throughout the Lab work environment and onto objects or personnel.

This SOP prescribes methodologies and practices common in the nuclear/radiochemistry industry and often described as “Good Practices” that eliminate or reduce the spread of radioactive material.

5.0 DEFINITIONS

Contamination - the presence of unwanted radioactivity above background in the laboratory or on laboratory surfaces.

Decontamination - removal of radioactive contamination.

Removable Contamination - surface radioactive contamination that can be removed by moderate physical action.

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6.0 RESPONSIBILITIES

6.1 RADIOCHEMISTRY LABORATORY MANAGER (RLM)

- 6.1.1 Supervises operations of the FMSS Radiological Laboratory.
- 6.1.2 Ensures all laboratory procedures are developed and performed in such a manner as to maintain control of radioactive material and reduce the possibility of contamination.
- 6.1.3 Ensures that staff and resources are available to carry out laboratory functions in such a manner as to minimize or reduce contamination.
- 6.1.4 Trains laboratory personnel in the requirements of this procedure.
- 6.1.5 Ensures the requirements of this procedure are followed.
- 6.1.6 Initiates corrective action, as necessary and performs any follow-up, as required.
- 6.1.7 Responds in a timely manner to concerns or problems involving contamination control related to Lab operations and sample control.
- 6.1.8 Coordinates with the Project Manager, Project Certified Health Physicist, Radiation Safety Officer and USACE to resolve laboratory related problems related to radiological contamination within the laboratory.

6.2 RADIATION SAFETY OFFICER (RSO)

- 6.2.1 Has primary responsibility for Radiological Controls in the Lab as well as all areas onsite where samples are drawn, maintained, transferred, or manipulated.
- 6.2.2 Provides assistance to Lab personnel in controlling or cleanup of radioactive contamination.

6.3 PROJECT CHEMIST (QA OFFICER)

- 6.3.1 Reviews Lab operations periodically to ensure compliance with this SOP and related QC documentation.
- 6.3.2 Performs and documents periodic surveillance and/or audits, in conjunction with the CQCSM and in accordance with FMSS procedures.
- 6.3.3 Performs follow-up of corrective actions, as performed in response to non-conformances.

6.3 RADIOCHEMISTRY LAB TECHNICIANS (RLTs)

- 11.4.1 Maintain documentation relating to contamination control.
- 11.4.2 Perform the requirements of this procedure.

7.0 PREREQUISITES

- 7.1 All personnel working the radiochemistry Lab have completed Radiation Worker Training in conjunction with General Employee Training.

8.0 PRECAUTIONS, LIMITS, AND SAFETY

- 8.1 Radioactive materials may pose an internal and/or external exposure hazard. Individuals performing setup or operations of the system shall be trained in the proper handling of radioactive materials and the methods of maintaining personal exposures As Low As Reasonably Achievable (ALARA).

9.0 EQUIPMENT

- 9.1 Masslinn® Cloths
- 9.2 Smears
- 9.3 Portable Radiation Survey Instruments – capable of detecting alpha particle emissions. The Ludlum 43-5 alpha scintillation probe coupled with a scaler-ratemeter such as the Ludlum 2221 or 2241 are utilized by RLT's.

10.0 RECORDS

- 10.1 Radiation Survey Maps and Contamination Record

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11.0 PROCEDURE

11.1 SAMPLE CONTAMINATION CONTROL

- 11.1.1 Segregate sample containers from the sample preparation area by storing them in a unique location where radioactive material is not normally present or where samples analysis or preparation is performed.
- 11.1.2 Handle samples one at a time to prevent cross-contamination.
- 11.1.3 If the sample prep or analysis area exhibits signs of contamination (visually or by radiological survey), stop all sample operations and clean the area.

11.2 LABORATORY CONTAMINATION CONTROL

- 11.4.1 Ensure all laboratory areas are appropriately posted for radiological conditions.
- 11.4.2 Perform all work per the requirements of the appropriate HWP.
- 11.4.3 Ensure all radioactive sources are appropriately labeled.
- 11.4.4 Handle all samples received by the laboratory as potentially contaminated and radioactive until analysis has provide sufficient information to understand the proper handling concerns.
- 11.4.5 Store all samples and radioactive source material in their respective designated areas.
- 11.4.6 Survey all areas of the Laboratory for loose contamination at a minimum of once per week.
- 11.4.7 Survey areas where samples have been manipulated for loose surface contamination upon the completion of the manipulation or whenever deemed appropriate.
- 11.4.8 Survey the areas where samples are stored for general radiation levels at least once a month, or at a greater frequency as prescribed by the Radiation Safety Officer.
- 11.4.9 Perform a leak test of sealed radioactive sources upon receipt and every January and July.
- 11.4.10 Take corrective actions immediately upon discovery of any contamination problem defined as detection above the upper 95% confidence limit of the established background level. Document in the Lab Operation Notebook all contamination events or improperly operating equipment, which may have caused contamination of samples, personnel, or areas and the corrective action(s) taken.

11.3 RESPONSE TO POTENTIAL CONTAMINATION EVENT

- 11.3.1 Upon discovery of a potential contamination event, the concept of SWIMS should be used.
- STOP the event, if this can be performed without causing undue personal risk.
 - WARN others of the event. Notify effected personnel, laboratory management, site safety and site management. The RSO shall be notified in the event that the loss of contamination control has occurred.
 - ISOLATE the potentially effected area(s).
 - MINIMIZE exposure to personnel and the spread of contamination.
 - SECURE ventilation, ONLY IF THIS DOES NOT DEGRADE THE SAFETY OF THE FACILITY.
- 11.4.1 Perform decontamination as necessary in accordance with the Site Safety Health Plan and the Radiation Protection Program procedures, and under the direction of the RSO.

NOTE

Depending on the magnitude of the event, an Activity Hazards Analysis review and a Hazardous Work Permit may be required to complete decontamination activities.

- 11.4.1 Document the event in accordance with PP-8-807, Survey Documentation and Review, and shall at a minimum include:
- Description of the event
 - Cause of the event.
 - Actions taken to minimize exposures and spread of contamination at the inception of the event.
 - Area(s) affected by the event.
 - Materials and equipment involved, as applicable.
 - ALARA review, if applicable.
 - HWP(s), if applicable.
 - Decontamination method(s) employed.
 - All procedural documents required for the procedures employed in mitigating the event, i.e. survey forms, exposure rate log, survey instrument daily check log, etc
- 11.4.2 Perform a root cause analysis for all major events.

11.4 ROUTINE DECONTAMINATION

NOTE

Routine decontamination may be required based on the routine surveys specified in Laboratory Contamination Control of this procedure.

- 11.4.1 RLM reviews the results of routine laboratory contamination surveys.
- 11.4.2 Decontaminate and re-survey affected areas of the laboratory as required by survey indications and results.
- 11.4.3 Document in the Lab Operations Notebook, as a corrective action, major decontamination of the Lab, or part of the Lab as determined by the RLM.

12.0 QUALITY CONTROL

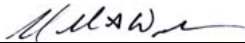
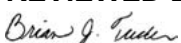
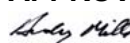
- 12.1 Any actions that increase the spread of contamination ultimately will reduce the quality of lab operations and results.

13.0 DATA REVIEW

- 13.1 All surveys and Lab Operation Notebook entries pertaining to contamination problems are to be reviewed by the RSO, RLM, and QA Officer to ensure cause analysis has determined the root cause and to initiate a plan of action to prevent, reduce, or eliminate sources or error or points of concern that result in the spread of contamination

14.0 ATTACHMENTS

NONE

	Procedure No. SOP 612 Revision No. 0 Date of Revision February 20, 2003 Last Issue Date February 20, 2003 Page 1 of 4
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site	
Subject: Sample Disposal	
PREPARED BY: Dan Mackney, Radiological Laboratory Manager	
REVIEWED BY:  Radiation Safety Officer 02/20/03 REVIEWED BY:  Site Safety & Health Officer 02/20/03 REVIEWED BY:  Project Chemist 02/20/03	REVIEWED BY:  Transportation & Disposal Coordinator 2/20/ REVIEWED BY:  Project Certified Health Physicist 02/20/03 APPROVED:  Project Manager 02/20/03

1.0 PURPOSE

This procedure describes the sample disposal process. Certain soil samples, such as Final Status Survey (FSS), may be retained until completion of site remediation unless directed otherwise by the Project Manager. Other samples will be discarded after generation of acceptable analytical results, i.e., following internal quality assurance/quality control (QA/QC) review.

2.0 SCOPE

This procedure applies to all samples processed by the Maywood On-site laboratory.

3.0 REFERENCES

SW-MWD-601, Laboratory Internal Data Evaluation; Quality Assurance and Corrective Action

4.0 DISCUSSION

None

5.0 DEFINITIONS

None

6.0 RESPONSIBILITIES

6.1 SAMPLE COORDINATOR

- 6.1.1 Identifies samples ready for disposal to the Radiochemistry Laboratory Manager.
- 6.1.2 Records the date of disposal for each sample within the Maywood Sample Database.

6.2 RADIOCHEMISTRY LAB MANAGER (RLM)

- 6.2.1 Ensures all samples provided to the Maywood Onsite Laboratory (the Lab) are stored in a safe and secure manner.
- 6.2.2 Verifies prior to disposal that the correct samples are sent.
- 6.2.3 Provides the Sample Coordinator with documentation of samples sent for disposal.

6.3 PROJECT CHEMIST (QA OFFICER)

- 6.3.1 Conducts periodic reviews of the sample storage practices used in the laboratory to ensure that samples are retained as prescribed.
- 6.3.2 Reviews sample disposal records to determine that samples are disposed of in a timely manner or retained as required.

6.4 RADIOCHEMISTRY LAB TECHNICIANS

- 6.4.1 Store samples in the designated locations and for disposing of samples as directed by the RLM.

7.0 PREREQUISITES

- 7.1 None

8.0 PRECAUTIONS, LIMITS, SAFETY

- 8.1 All Site Health and Safety requirements shall be followed when performing a task.
- 8.2 All samples are to be considered radiation hazards and potentially contaminated until determined otherwise by radiation and contamination survey, or process knowledge.
- 8.3 All samples are to be stored in such manner that external forces such as water, or excessive heat or airflow do not compromise the container or waste resulting in the dispersal of the waste.
- 8.4 All samples are to be maintained such that their contents cannot be lost from normal handling, transportation, or storage.

9.0 RECORDS

- 9.1 Chain-of-Custody identifying samples for disposal.

10.0 PROCEDURE

- 10.1 Samples are NOT immediately disposed of without consideration of their status.
 - 10.1.1 Soil samples and some water samples analyzed for excavation control or other purposes that do not require reporting results to outside agencies or the public may be discarded upon generation of analytical results.
 - 10.1.2 Samples derived from 'in-process' materials, whose results are used solely for guiding project activities while they are in progress may be discarded upon generation of analytical results.
 - 10.1.3 The Project Chemist or Radiochemistry Lab Manager may choose to wait until testing of other task-related samples (such as Final Status Survey samples) has been completed.
 - 10.1.4 RLM will determine which prepared samples may be discarded immediately after analysis.
 - 10.1.5 ALL air filter samples will be retained as directed by the Radiation Safety Officer.
 - 10.1.6 The Task Manager or Project Manager may request that certain samples be retained.
 - 10.1.7 Soil samples collected for FSS purposes within portions of properties will be retained in a designated storage area until the entire property has been released.
- 10.2 Storage areas for samples are established onsite for samples have been analyzed and are awaiting QA/QC review of analytical results, disposal, or transport.
 - 10.2.1 Samples designated for long-term storage shall have been dried to reduce the possibility of container corrosion, unless otherwise directed by the Project Chemist, Task Manager, or RLM.
 - 10.2.2 Samples placed in long-term storage will be clearly identified by sample number using indelible markings.
 - 10.2.3 Identification should include an inventory of samples in storage and their location in the storage area.
 - 10.2.4 The Radiochemistry Lab will generate and retain a log of all samples placed in long-term storage.
 - 10.2.5 The Sample Coordinator will review sample disposal storage records and compare with disposal records.

- 10.4 The Sample Coordinator, after a review of sample status, shall identify those samples that can be disposed of by notification to the RLM.
- 10.4.1 Document the samples allowed to be disposed of and provide a copy to the RLM.
- 10.4.2 Identify the samples to be returned by completing a Chain of Custody with the Sample ID numbers and other pertinent information.
- 10.4.3 Submit the completed COC's to the QA Department for scanning into Documentum.
- 10.5 Soil samples will be discarded as contaminated soil with normal site soil load-outs.
- 10.5.1 Soil sample material will be placed in a stockpile of soil awaiting offsite disposal.
- 10.5.2 Sample cores will be broken apart prior to disposal in railcars, or per direction of the Transportation and Disposal (T&D) Coordinator.
- 10.6 Water samples and liquid sample preparations will be discarded as liquid laboratory waste.
- 10.7 Used or contaminated sample containers should be disposed of as contaminated soil with normal soil load-outs.
- 10.8 Other sample types will be discarded as directed by the RLM.

11.0 QUALITY CONTROL

- 11.1 None

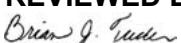
12.0 DATA REVIEW

- 12.1 QA Officer reviews sample custody record, disposal records, and disposal COC's as part of the Lab's surveillance and audit process.

13.0 ATTACHMENTS

- 13.1 None

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Procedure No. SOP 613 Revision No. 0 Date of Revision February 20, 2003 Last Review Date February 20, 2003 Page 1 of 4	
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Hazardous Waste Management	
PREPARED BY:  Radiochemistry Laboratory Mgr 02/20/03	REVIEWED BY:  Project Chemist 02/20/03
REVIEWED BY:  CQCSM 02/20/03	APPROVED:  Project Manager 02/20/03

1.0 PURPOSE

This procedure details the method for control and storage of sample and sample preparation wastes developed in the operation of the Radiochemistry Laboratory (the Lab) and classified as either radioactive material or hazardous waste while being held for disposal.

2.0 SCOPE

This procedure applies to ALL wastes designated as radioactive, or potentially radioactive developed in the processing of samples by and the operation of the Radiochemistry Laboratory.

3.0 REFERENCES

Chemical Data Quality Management Plan – FUSRAP Maywood Superfund Site

ASTM D 5928-96; Standard Test Method for Screening of Waste for Radioactivity

EM –385-1-80; USACE Radiation Protection Manual; Chapter 9 Waste Management

PP-8-900, Radioactive Material Control Program; Maywood Superfund Site, Site Safety and Health Plan, Volume 2, Appendix C

PP-8-902, Unrestricted Release Requirements; Maywood Superfund Site, Site Safety and Health Plan, Volume 2, Appendix C

4.0 DISCUSSION

Sample preparation and handling operations result in the development of waste products. At this time, the Lab does NOT process sample materials chemically. Therefore, all sample wastes produced are potentially radioactive. When hazardous chemicals are introduced into the process, this SOP will be revised to accommodate their incorporation.

The ONLY liquid wastes produced are from decontamination operations. This liquid waste is in the form of water containing a decontamination agent (soap). The nominal process is to allow the water to evaporate and then dispose of the dry material.

Dry material is retained in accordance with the SOPs developed by Radiation Protection and the Radiation Safety Officer.

5.0 DEFINITIONS

5.1 NONE

6.0 RESPONSIBILITIES

6.1 RADIOCHEMISTRY LABORATORY MANAGER (RLM)

- 6.1.1 Training the Radiochemistry Laboratory Technicians in methods to minimize waste products during the performance of sample preparation and analysis.
- 6.1.2 Reviewing ALL SOPs and methods employed in the Lab for means to reduce or eliminate waste.
- 6.1.3 Ensuring that wastes generated during lab operations are segregated properly, stored in approved and labeled containers, and transferred to waste accumulation/disposal points in accordance with this procedure and as directed by the Radiation Safety Officer.
- 6.1.4 Reporting immediately any loss of control of radioactive material in the laboratory to the Radiation Safety Officer.

6.2 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLT)

- 6.2.1 Performing this procedure as written.
- 6.2.2 Reporting any problems in the performance of the SOP to the RLM.
- 6.2.3 Ensuring that waste products are segregated properly prior to disposal.
- 6.2.4 Minimizing the amount of waste produced to the best of their ability and training.
- 6.2.5 Storing or transferring hazardous wastes properly.

6.3 PROJECT CHEMIST (QA OFFICER)

- 6.3.1 Ensuring this SOP meets the regulatory requirements and national standards for waste disposal.
- 6.3.2 Reviewing ALL logs, notebooks, and records detailing waste disposal for compliance to site and regulatory requirements.

6.4 RADIATION SAFETY OFFICER (RSO)

- 6.4.1 Ensuring that lab personnel manage radioactive wastes in a manner consistent with this procedure and sound radiation protection practices.
- 6.4.2 Providing the necessary training and guidance to Laboratory staff in the methods of surveying articles and materials for radioactive contamination.

7.0 PREREQUISITES

- 7.1 NONE

8.0 PRECAUTIONS, LIMITS, AND SAFETY

- 8.1 All Site Health and Safety requirements shall be followed when performing a task.
- 8.2 All wastes are to be considered radiation hazards and possibly contaminated until determined otherwise by radiation and contamination survey, or process knowledge.
- 8.3 All wastes are to be stored in such manner that external forces such as water, or excessive heat or airflow do not compromise the container or waste resulting in the dispersal of the waste.

All wastes are to be maintained in such a manner, as their contents cannot be loss from normal handling, transportation, or storage.

9.0 RECORDS

- 9.1 NONE

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10.0 PROCEDURE

10.1 DRY WASTES

- 10.1.1. Control ALL Radioactive or potentially Radioactive Material in accordance with site Radiation Protection Program Policies, PP-8-900 – Radioactive Materials Control Program and PP-8-902- Unrestricted Release Requirements.
- 10.1.2 Place contaminated and non-contaminated materials in designated storage containers.

NOTE

DO NOT overfill a storage bag as this may result in a rip or tear in the bag and a loss of material control.

- 10.1.3 Replace waste containers or liners as necessary to avoid loss of radioactive materials control.
- 10.1.4 Notify Radiation Protection for survey and transfer of filled container/liner.

NOTE

The survey and transfer of radioactive material in the form of a filled container/liner may be performed by trained and qualified lab personnel, at the discretion of the Radiation Safety Officer

10.2 WET WASTES

- 10.2.1. Allow wet wastes to dry by evaporation, by storing them in the fume hood with the fan operating at least overnight
- 10.2.2 When the material has dried, dispose of the material as dry waste, per Section 10.1.

11.0 QUALITY CONTROL

- 11.1 NONE

12.0 DATA REVIEW

- 12.1 NONE

13.0 ATTACHMENTS

- 13.1 NONE

Procedure No. Revision No. Date of Revision Last Issue Date Page	SOP 621 0 November 27, 2002 November 27, 2002 1 of 66				
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Canberra Gamma Spectroscopy System Operation					
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> PREPARED BY: <i>Timothy Mackay</i> Radiation Laboratory Manager Date </td> <td style="width: 50%; vertical-align: top;"> APPROVED: <i>Shirley Hill</i> Project Manager Date </td> </tr> <tr> <td style="vertical-align: top; margin-top: 10px;"> REVIEWED BY: <i>Brian J. Tucker</i> Project Chemist Date </td> <td></td> </tr> </table>		PREPARED BY: <i>Timothy Mackay</i> Radiation Laboratory Manager Date	APPROVED: <i>Shirley Hill</i> Project Manager Date	REVIEWED BY: <i>Brian J. Tucker</i> Project Chemist Date	
PREPARED BY: <i>Timothy Mackay</i> Radiation Laboratory Manager Date	APPROVED: <i>Shirley Hill</i> Project Manager Date				
REVIEWED BY: <i>Brian J. Tucker</i> Project Chemist Date					

1.0 PURPOSE

The purpose of this procedure is to detail the operation of the Canberra Gamma Spectrometry System to identify and quantify gamma-emitting radionuclides of interest to the FUSRAP Maywood Superfund Site.

2.0 METHOD SUMMARY AND VALIDATION

- 2.1 The system is first calibrated for energy and efficiency with a NIST traceable standard of known activity contained in a geometry that is typical of those used in the analysis of the sample.
- 2.2 A homogenous, weighed aliquot of the sample is placed into a container with an identical geometry. The sample matrix, the shape and size of the container, and the distance from the detector must all exactly match those of the calibration standard.
- 2.3 The sample is counted for a sufficient period to meet the detection limit that is required.
- 2.4 After counting, the spectrum is analyzed for the presence, identification, and quantification of any gamma-emitting radionuclide.
- 2.5 After the analysis is printed, the printout is reviewed for completeness and quality requirements acceptability.
- 2.6 The method used is in accordance with the procedures specified in EPA Method 901.1 DOE Ga-01-R, and Manufacturer's recommendations (refer to Section 22.0 References). EPA Method 901.1 and DOE Ga-01-R were designed for the determination of gamma emitting radionuclides in drinking water, without separating them from the sample matrix. It has been expanded to include other matrices including groundwater, soil, sludge, non-aqueous liquid, air filter, vegetation, biota and solid materials. The major principals in gamma spectrometry remain the same and are equally applicable to both the original and this modified method. Therefore, method validation will not be addressed.

3.0 RESPONSIBILITIES

3.1 RADIOCHEMISTRY LABORATORY MANAGER (RLM)

- 3.1.1 Ensuring this procedure reflects actual operation parameters in the Laboratory.
- 3.1.2 Annually reviewing and revising as required this procedure.
- 3.1.3 Coordination with the Project Manager, Project Chemist, and USACE to resolve problems related to receipt and preparation of samples into the Laboratory that could prevent completion of required analysis.
- 3.1.4 Initiation of corrective action, as necessary and performance of any follow-up as required ensuring the quality of operation of the instrument and data produced is maintained.
- 3.1.5 Training Laboratory personnel in the use and performance of this procedure to assure that suitable proficiency is achieved and maintained.
- 3.1.6 Instructing Laboratory personnel in associated laboratory safety (including radiation safety), hazard communications, and hazardous waste management, and ensuring the
- 3.1.7 Control and periodic transmittal of the Laboratory's associated Quality Assurance records.
- 3.1.8 Responding to and documenting of associated periodic surveillance and/or audits, in conjunction with the CQCSM and in accordance with FMSS procedures.
- 3.1.9 Responding in a timely manner to associated audit and/or surveillance findings.
- 3.1.10 Overseeing operation, maintenance, and calibration of the Gamma Spectrometry system and associated lab instrumentation.
- 3.1.11 Reviewing and ensuring submittal of completed data packages and electronic data to the data users and data validation group.

3.2 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLTs)

- 3.2.1 Performing this procedure as written.
- 3.2.2 Reporting any problems in the performance of this procedure to the Laboratory Manager for immediate resolution.
- 3.2.3 Ensuring that adequate Laboratory supplies are available for daily operation in accordance with this procedure.
- 3.2.4 Developing and maintaining the associated Laboratory Quality Assurance records developed by this procedure.
- 3.2.5 Maintaining the laboratory sample database.

3.3 QA OFFICER:

- 3.3.1 Ensuring the Quality Control requirements set for the analysis of samples and operation of the gamma spectroscopy system at FMSS is maintained.
- 3.3.2 Performing routine scheduled and unscheduled audits of the Lab in the performance of this procedure and the maintenance of the required Quality Control Records.
- 3.3.3 Documenting periodic surveillances and/or audits associated with this procedure in conjunction with the CQCSM and in accordance with FMSS procedures.
- 3.3.4 Providing technical assistance to the staff of the Radiochemistry Laboratory.

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4.0 SAFETY PRECAUTIONS

WARNING

This procedure employs the use of Liquid Nitrogen (LN₂) a cryogenic gas. Cryogenic gases are at extremely cold temperatures (LN₂ = -195.8°C). Human tissue will freeze immediately upon contact with the liquid. DO NOT open LN dispensing valves, touch hoses, or work near the area of LN dispensing without the proper Personal Protective Equipment (PPE).

- 4.1 Nitrogen is a colorless, odorless, tasteless gas, which acts as a simple asphyxiant, and can cause severe frost burn damage to tissues. Use extreme caution when handling Liquid Nitrogen (LN₂) or contacting surfaces cooled by LN₂.
- 4.2 Avoid skin contact with Liquid Nitrogen (LN₂) or surfaces cooled by LN₂ to avoid frostbite.
- 4.3 Always use proper eye and skin protection when handling LN₂ or surfaces cooled by LN₂.
- 4.4 Ensure adequate ventilation is maintained when handling LN₂.
- 4.5 HPGe detector crystals may be warmed to room temperature and subsequently re-cooled. These cycles shall be minimized to extend the life of the crystals.
- 4.6 If allowed to warm, crystals must be allowed to warm all the way to room temperature before beginning a re-cooling cycle.
- 4.7 If allowing a detector to warm, ensure the bias voltage is turned off.
- 4.8 Ensure the detector is cooled at least 12 hours before applying bias voltage to the crystal.
- 4.9 Never exceed the manufacturer's recommended operating voltage for the detector.
- 4.10 Ensure the high voltage power supply is set to zero before energizing the unit.
- 4.11 Germanium detectors operate at bias voltages to 3000 V DC or higher. Ensure the detector(s) are grounded through the supplied High Voltage coaxial cable to a properly grounded Power Supply or NIMBIN.
- 4.12 Use extreme caution when adjusting internal preamplifier controls to avoid contact with the high voltage circuit.
- 4.13 When a cryostat exhibits signs of catastrophic vacuum failure, such as heavy moisture or ice formation on the surface or extremely high LN₂ loss rate, stop using the unit immediately. Secure the HVPS applied to the detector. If the unit (detector) is in a shield, close the shield door.
- 4.14 Radioactive materials may pose an internal and/or external exposure hazard. Individuals performing setup or operations of the system shall be trained in the proper handling of radioactive materials and the methods of maintaining personal exposures as low as reasonably achievable (ALARA).

5.0 INTERFERENCES

- 5.1 The counting dead time must remain below 15%. This may not be the case for samples with high levels of activity and steps must be taken to lower their dead time. These steps may include reducing the size of the sample aliquot and/or by increasing the distance and/or by changing the geometry and/or by addition of shielding between the detector and the sample container. These changes must be reflected by corresponding changes in the calibration standards or by applying a correction factor.
- 5.2 Metals, such as lead, strongly attenuate gamma rays, even when present in solution, leading to inaccurate results. Attenuation corrections must be applied to those samples such as soils where the characterization of the soil has been determined. Solid samples that have been digested may require dilution.

6.0 APPARATUS AND MATERIALS

- 6.1 NIMBIN - Consisting of an ADC Model 9633, AIM Model 556, H.V.P.S. Model 9645, Amplifier Model 9615, and Power Control Module Model 2100; Canberra Industries
- 6.2 Desktop InSpector - Model INSP-14; Canberra Industries
- 6.3 Uninterruptible Power Supply – 15 min load protection, 570 W, 120V
- 6.4 Mixed Gamma calibration standard - 60 to 1800 keV, NIST traceable; Analytics, Inc. or equivalent
- 6.5 Cryostat; 30L, Model D-30; Canberra Industries
- 6.6 HPGe detector; Closed-end Coaxial, P- type 55-62 mm x 55-59 mm, 2.0 keV resolution @ 1332 keV, Model 3020,4020; Canberra Industries
- 6.7 Preamplifier –low noise, high speed FET, with LN₂ level detection and shutoff, Model 2001 or 2002; Canberra Industries
- 6.8 30 Liter LN₂ Dewar, one per detector and one for LN₂ transfer, Model D-30; Canberra Industries
- 6.9 Latex transfer hose, 0.5 in. ID, 3 foot long, Lab Safety Supplies
- 6.10 Low Background Virgin Lead Shield, Approximately 24” x 18” cylindrical with 4” thick lead shield and Aluminum and Copper liner; Canberra Industries
- 6.11 Low-pressure LN₂ tank w/insulated supply line; SOP Gas Supply Company
- 6.12 Personal Computer, Pentium II, 330 MHz, 256 MB RAM; IBM or equivalent
- 6.13 Computer Monitor, 15”, 0.28 dpi; IBM or equivalent
- 6.14 Laser Printer, Model HP LaserJet, Hewlett Packard Industries or equivalent
- 6.15 Software: May be updated to the most current version as required by manufacturer for support purposes
 - Windows 95® or Windows/98®
 - Genie 2000®, Gamma Analysis V1.2A

- Genie 2000®, ProCount-2000® V1.1
- Genie 2000®, Basic Spectroscopy V1.2A
- Microsoft Excel® 97
- Microsoft Word® 97
- Microsoft Access® 97

7.0 REAGENTS AND STANDARDS

- 7.1 Liquid Nitrogen, commercial grade.
- 7.2 Calibration Standard, NIST traceable, Mixed gamma 60-1836 keV, approximately 40 kBq contained in a replicate geometry and developed at a density compatible with sample analysis.
- 7.3 Lab Control Standard; Mixed gamma, with IOCs in relative ratio to sample activities measured contained in a replicate geometry and developed at a density compatible with sample analysis.

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8.0 SAMPLE PRESERVATION AND STORAGE

- 8.1 Samples must be stored and handled in such a manner that they will not become contaminated by, nor will they contaminate other samples or standards. The samples may be hazardous and the radioactive activity levels should have been pre-screened prior to sample prep. Treat samples with higher levels of activity (>200 cpm) with special precaution.
- 8.2 Soil samples to be analyzed gamma spectroscopy require NO preservation.
- 8.3 Homogeneity of the sample is crucial to accurate results. If this step is inadequate, the sample aliquot will not be representative of the bulk sample and ALL subsequent work will be unreliable.
 - 8.3.1 ALL samples must be thoroughly mixed.
 - 8.3.2 Solid samples must be completely crushed, pulverized, homogenized, and evenly split to an appropriate aliquot.
 - 8.3.3 Review any applicable SOP for the particular details of the sample preparation procedure for each of these matrices, OR refer to Rad Lab supervision.
- 8.4 Dust is a perennial problem when dealing with pulverized samples and it may be particularly hazardous with samples that are highly siliceous and/or contain anomalous levels of radiogenic materials.
 - 8.4.1 Nominally samples that are analyzed by Gamma Spectroscopy are in sealed cans.
 - 8.4.2 Considerations are to be made as to whether to place a sample container in a plastic bag prior to analysis on the detector.
- 8.5 A visual inspection of the sample or calibration standard or check source shall be performed prior to use.
 - 8.5.1 Samples or Lab Control Standards that have containers that exhibit problems may be transferred to another container.
 - 8.5.2 Calibration standards are to be placed into a plastic bag and transferred to the Company of Origin for reconfiguration and Certification.

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9.0 HOLDING TIMES

- 9.1 Aqueous samples should be preserved within 5 days of collection for all determinative methods.
- 9.2 Analysis can be performed anytime within a year. However, concern must be weighed for samples containing short-lived isotopes. All isotopes of concern (IOCs) should be counted prior to 4 half-lives ($t_{1/2}$) of the most limiting isotope.
 - 9.2.1 Decay correction of the sample is performed up to 12 $t_{1/2}$ by the Gamma Spectrometry analysis program.
 - 9.2.2 For quality purposes 4 $t_{1/2}$ is at least 6.25% of the original activity and can be recounted for accurate results.

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10.0 OPERATING CONDITIONS

NOTE

In this procedure, computer commands are stated in **BOLD** type. Programs are referred to in *Italicized* type. Commands to be typed in by the Technician are in quotation marks: "command".

10.1 Set-Up the System

NOTE

Initial setup shall be performed by a qualified individual as indicated by the Radiochemistry Laboratory Manager or a person under the direct supervision of that individual. The steps described in this Section are generalized and not intended to be a detailed account of operating the system.

- 10.1.1 Ensure the Dewar and cave are installed on secure footing and level in allocation that minimizes electromagnetic (EM) and radio frequency (RF) interferences.
- 10.1.2 Ensure the detector and cold finger are placed securely in the Dewar housing and the sealing ring is tight.
- 10.1.3 Verify the wiring has been correctly installed.
- 10.1.4 Proceed with filling the Dewar with Liquid Nitrogen, and allow the System to equilibrate.
- 10.1.5 Verify the fill after 24 hours by adding Liquid Nitrogen.
- 10.1.6 Proceed with Starting *Genie 2000/ProCount*.
- 10.1.7 Install the Prescribed Set Points, Attachment 14.1, for normal operation.

NOTE

The Prescribed Set Points for Normal Operation are to be developed by the Radiochemistry Laboratory Manager and recorded in the Gamma Spectroscopy System Lab Notebook as well as Attachment 14.1.

- 10.1.8 Proceed with Powering the NIMBIN/Desktop Inspector.
- 10.1.9 Proceed with Energy Calibration and Efficiency Calibration of the System.
- 10.1.10 Radiochemistry Laboratory Manager, review the Set-up and Calibration notes and data results for completeness accuracy and acceptability.
- 10.1.11 If the RLM accepts the Set-up of the system based on the prescribed parameters, operate the system as directed.

NOTE

Upon completion of the Set-up of the Gamma Spectroscopy system, several functions and parameters will have been preset. This is done to simplify operations and to ensure consistency in counting of samples and quality control parameters. Any changes to Prescribed Set Points shall be approved by the Radiochemistry Lab Manager prior to installation and use.

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CAUTION

Two Technicians are required to fill the Transfer Dewar. The Technician working directly with or near cryogenic gases shall wear appropriate Personal Protective Equipment.

WARNING

The Transfer Dewar is always considered to contain Liquid Nitrogen.
DO NOT TOUCH the Transfer Rig suction tube without proper gloves.

10.2 Filling the Transfer Dewar with Liquid Nitrogen (LN or LN₂).

- 10.2.1 Notify other personnel in the Lab and area of the Dewars that Liquid Nitrogen transfer is to be performed.
- 10.2.2 Remove the Transfer Dewar Dispensing Rig Assembly from the Transfer Dewar and place in a secured area.
- 10.2.3 Place the Liquid Nitrogen dispensing hose into the Transfer Dewar and secure it in place.

CAUTION

The opening of the Liquid Nitrogen cylinder discharge valve can result in the immediate freezing of water vapor from the atmosphere present at the valve. This freezing of the water vapor can result in the valve retaining an ice plug. The ice plug can prevent the valve from reseating when being closed. This is minimized by immediately opening the valve greater than one-quarter turn full open.

- 10.2.4 Open the LN discharge valve greater than one-quarter of full turn, but no more than one-half of full turn.

NOTE

The initial release from the cylinder will be a mixture of liquid and saturated vapor. A distinct, audible change will occur in the discharge as the mixture turns to primarily liquid. There is also an audible change noted as the Dewar fills with liquid. Experience will guide the technician in preventing overfill of the Dewar.

- 10.2.5 Throttle the discharge valve as necessary to reduce violent sputtering of the LN.
- 10.2.6 Slowly open the discharge valve as liquid is added to the Dewar.
- 10.2.7 Observe and listen to the discharge into the Transfer Dewar.
- 10.2.8 When the Transfer Dewar is near full close the LN discharge valve.
- 10.2.9 Remove the dispensing hose from the Transfer Dewar slowly allowing LN to drain from the hose as it is removed.
- 10.2.10 Place the discharge line down in a secured area.
- 10.2.11 Secure the Transfer Dewar Dispensing Rig Assembly onto the Transfer Dewar and lock it down.

10.3 Filling the Gamma System (GS) Dewar with Liquid Nitrogen from the Transfer Dewar.

CAUTION

Appropriate Personal Protective Equipment shall be worn when working with or near cryogenic gases.

- 10.3.1 Fill the Transfer Dewar prior to filling a GS Dewar
- 10.3.2 Place the Transfer Dewar next to the GS Dewar.
- 10.3.3 Connect the Transfer Hose to the GS Dewar in a secure manner.
- 10.3.4 Open the Transfer Assembly Rig Discharge Valve one-half of full turn.

NOTE

The initial release from the cylinder will be a mixture of liquid and saturated vapor. A distinct, audible change will occur in the discharge as the mixture turns to primarily liquid. There is also an audible change noted as the Dewar fills with liquid. Experience will guide the technician in preventing overfill of the Dewar.

- 10.3.5 Observe the discharge from the GS Dewar vent.
- 10.3.6 Open the Transfer Dewar Dispensing Rig Assembly in such a manner as to not cause excessive discharge and sputtering from the GS Dewar vent.
- 10.3.7 Observe the GS Dewar vent.
- 10.3.8 When liquid is observed being discharged from the vent OR when the discharge velocity obtains a steady state, close the Transfer Dewar Dispensing Rig Assembly discharge valve.

NOTE

The lack of liquid discharge or a steady state of vapor venting indicates the equilibrium state of the two Dewars: i.e., there is insufficient volume in the Transfer Dewar to push additional LN into the GWS Dewar.

- 10.3.9 If no liquid was discharged from the GS Dewar, remove the Transfer Hose from the GS Dewar, repeat the Section for Filling the Transfer Dewar, and then repeat this Section.
- 10.3.10 If liquid is observed being discharge, remove the Transfer Hose from the GS Dewar and place the Transfer Dewar in a secure location for storage.

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10.4 Starting the Gamma Spectroscopy Operating Program

- 10.4.1 From the **Start** button on the Windows Desktop, select “**Start**”, and “**ProCount 2000**”.
- 10.4.2 At the prompt, Type in *User name*: as “manager”.
- 10.4.3 Click **Ok**.

NOTE

When working with a Windows based program, various Windows will open up after executing a command. The following procedural Sections and Steps assume that the appropriate Window is open after performing a command function.

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10.5 Calibration of Detection System 1) Acquisition of a Spectrum

NOTE

Energy and Shape calibrations are performed after initial setup, annually, after hardware replacement, replacement of a calibration source, or as directed by the Radiochemistry Laboratory Supervisor.

NOTE

The calibration of the system is a three-stage process requiring the 1) Acquisition of a Spectrum, 2) Full Energy and Shape Calibration, and 3) Efficiency Calibration.

- 10.5.1 Place the Certified Multi-Gamma Calibration Source in the detector and close the cave.
- 10.5.2 Select **D. Calibration**.
- 10.5.3 Select a detector from the list by clicking to highlight, and Click **Select**.
- 10.5.4 Select **A. Count Calibration Spectrum**.
- 10.5.5 Enter *Preset Live (secs)*: 3600.

NOTE

The detector will begin acquiring data at this point. If data has been entered in error, Clicking **Abort** in the next window will stop acquisition with no processing of data.

- 10.5.6 Select the *Certificate File*: from the dropdown menu.
- 10.5.7 Enter the *Sample ID*: as follows:
- 10.5.8 Enter the *Description*: as follows:
- 10.5.9 Click **Ok**.

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10.6. Calibration of Detection System 2) Full Energy and Shape Calibration

10.6.1 Select **D. Calibration**.

10.6.2 Select a detector from the list by clicking to highlight, and Click **Select**.

10.6.3 Select **B. Full Energy & Shape Calibration**.

NOTE

A Dialog Box will open showing the information pertaining to the most recently acquired spectrum.

10.6.4 If necessary, correct the *Certificate File* from the dropdown menu.

10.6.5 If Spectrum information is correct, Click **Ok**.

10.6.6 Move the Cursor anywhere onto the *Acquisition and Analysis* window, and Click the mouse to focus on it.

NOTE

It may be necessary to reduce the magnification of the spectrum to clearly view and isolate peaks during Energy Calibration.

10.6.7 Move the Cursor to the lower peak in the spectrum corresponding to Y-88 @ 1836.06 keV, and Click the Mouse to focus on it.

10.6.8 Using the arrow buttons, Move the Cursor back and forth until the maximum count point is obtained.

NOTE

A good starting point for identifying the Peak Region-of-Interest (ROI) is approximately 5 channels either side of the peak.

10.6.9 Click the Mouse on the Left Marker and Drag it to the point, below the Cursor, where the peak appears to rise from the continuum.

10.6.10 Click the Mouse on the Right Marker and Drag it to the point, above the Cursor, where the peak appears to return into the continuum.

10.6.11 Click on **Marker** in the *Full Energy & Shape Calibration* window to copy the marker locations (*ROI Start* and *ROI End*) into the window.

10.6.12 Observe the *Channel* and *Energy, keV*.

10.6.13 If the channel and keV readouts DO NOT correspond to the Calibration Certificate and Prescribed Set Points settings, Enter **Cancel** to and Repeat Steps 11.8.6 through 11.8.12 to obtain correct values.

10.6.14 If the channel and keV readouts correspond to the Calibration Certificate settings and Prescribed Set Points settings, Click **Update**.

10.6.15 Repeat Steps 11.8.7 through 11.8.14 for the following peaks: Cs-137 @ 661.66 keV and Co-60 @ 1332.50.

NOTE

Upon completion of this Step, the *Energy Calibration Curve* window opens. This window displays graphically the results of the Energy and Shape Calibration.

- 10.6.15 Review the graph data points for each peak for acceptability compared against the Prescribed Data Setpoints.
- 10.6.16 Use the Energy and Shape buttons to switch between graphs for review of the Energy and Peak Shape Calibration Curves.
- 10.6.17 Consult with the RLM to change the order of the polynomial equation.
- 10.6.18 Consult with the RLM to delete outliers (bad data points).
- 10.6.19 When an acceptable Calibration Curve is obtained, Print a copy of the curves, and Click “**OK**.”
- 10.6.20 Initial each page of the Report and Chart.
- 10.6.21 Present the Report and Charts to the RLM for review and approval.
- 10.6.22 RLM review all calibration reports and charts, when approved direct the performance of an Efficiency Calibration.

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10.7 Calibration of Detection System 3) Efficiency Calibration

10.7.1 Select **D. Calibration**.

10.7.2 Select **D. Efficiency Calibration**.

10.7.3 Select a geometry from the list by clicking to highlight, and Click **Select**.

10.7.4 At the response prompt, "*Do you want to replace the old calibration?*", Click **Yes**.

NOTE

A Dialog Box will open showing the information pertaining to the most recently acquired spectrum.

10.7.5 If necessary, correct the *Certificate File* from the dropdown menu.

10.7.6 If Spectrum information is correct, Click **Ok**.

10.7.7 Review the Efficiency Calibration Screen data, switching between the curves (dual, linear, and empirical) and between the scales (linear and log), as necessary.

10.7.8 Review the graph data points for each peak for acceptability compared against the Prescribed Data Setpoints.

10.7.9 Consult with the RLM to change the order of the polynomial equation.

10.7.10 Consult with the RLM to delete outliers.

10.7.11 When an acceptable Calibration Curve is obtained, Print a copy of the curves, and Click "**OK**."

10.7.12 Initial each page of the Report and Chart.

10.7.13 Present the Report and Charts to the RLM for review and approval.

10.7.14 RLM review all calibration reports and charts.

10.7.15 After completion of the Efficiency Calibration, a Background count must be performed, see Section 11.7.

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10.8 Energy Recalibration

10.8.1 Select D. Calibration.

10.8.2 Select a detector from the list by clicking to highlight, and Click Select.

10.8.3 Select C. Energy Re-Calibrate.

NOTE

A Dialog Box will open showing the information pertaining to the most recently acquired spectrum.

10.8.4 If necessary, correct the *Certificate File* from the dropdown menu.

10.8.5 If Spectrum information is correct, Click **Ok**.

NOTE

After selecting **Ok**, the computer system automatically performs the recalibration. When the recalibration is done, the *Energy Calibration Curves* window will appear to allow for review and acceptance of the results.

10.8.6 Review the graph data points for each peak for acceptability compared against the Prescribed Data Setpoints.

10.8.7 Use the Energy and Shape buttons to switch between graphs for review of the Energy and Peak Shape Calibration Curves.

10.8.8 Consult with the RLM to change the order of the polynomial equation.

10.8.9 Consult with the RLM to delete outliers (bad data points).

10.8.10 When an acceptable Calibration Curve is obtained, Print a copy of the curves, and Click **Ok**.

10.8.11 Initial each page of the Report and Chart.

10.8.12 Present the Report and Charts to the RLM for review and approval.

10.8.13 RLM review all calibration reports and charts.

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11.0 PROCEDURE

11.1 Counting a Sample

- 11.1.1 Place a sample in the cave atop the detector in the correct orientation for the sample geometry.
- 11.1.2 Select **A. Sample Counting**.
- 11.1.3 Select a Sample Type from the list by Clicking on the listing to highlight, and Click **Select**.
- 11.1.4 Select the Detector to be used from the list by Clicking on the listing to highlight, and Click **Ok**.
- 11.1.5 Observe the indicated *Live Time*.

NOTE

The counting times for the various samples and geometries are part of the Prescribed Set Points. Refer to the corresponding Attachment 14.1.10 for these values.

- 11.1.6 If the *Live Time* is incorrect, contact Lab Supervision prior to proceeding.
- 11.1.7 If the *Live Time* is correct, Click **Ok**.

NOTE

The detector will begin acquiring data at this point. If data has been entered in error, Clicking **Cancel** in the next window will stop acquisition with no processing of data. Data information can be altered at a point after acquisition as needed by Lab Supervision.

- 11.1.8 Type in the *Sample ID* # indicated on the sample label as follows: Site Designator – Lab ID number.

By Example: 01A-011225

- 11.1.9 Type in the *Sample Quantity* as the recorded weight of the sample.
 - 11.1.10 Type in the *Units* as “gram”.
 - 11.1.11 Type in the *Sample Date and Time* as the recorded sample collection date and time, using the 24-hour clock plus seconds.
- By Example: “4/10/02 12:00:00 AM” (or PM)
- 11.1.12 If required, Type in the *Description*.
 - 11.1.13 As required, enter the sample data into the Detector Run Log.
 - 11.1.14 Upon completion of acquisition, observe a hard copy printout of the data is printed.
 - 11.1.15 Review the data as appropriate.
 - 11.1.16 Clear the cave of the sample and return the sample to its designated storage location.

11.2 Counting a Quality Control Sample (Daily QC Check or Background)

- 11.2.1 Place a Calibration Check Sample or Blank Sample in the cave atop the detector in the correct orientation for the sample geometry.
- 11.2.2 Select **F. Quality Control**.
- 11.2.3 Select either **A. Calibration QC Count** or **B. Background QC Count**.
- 11.2.4 Select the Detector to be used from the list by Clicking on the listing to highlight, and Click **Ok**.
- 11.2.5 Select the Geometry to be used from the list by Clicking on the listing to highlight, and Click **Ok**.
- 11.2.6 Enter the required *QC Count Preset Live Time*.

NOTE

The counting times for the various samples and geometries are part of the Prescribed Set Points. Refer to the corresponding Attachment 14.1.10 for these values.

NOTE

The detector will begin acquiring data at this point. If data has been entered in error, Clicking **Cancel** in the next window will stop acquisition with no processing of data.

- 11.2.7 Enter the *Sample ID* as follows: “(Geometry) QC”, “Blank”, or “Background”.
By Example: “TUNACAN QC”
- 11.2.8 Enter the sample data into the Detector Run Log.
- 11.2.9 Upon completion of acquisition, observe a hard copy printout of the data is printed.
- 11.2.10 Review the data as appropriate.
- 11.2.11 Clear the cave of the sample and return the sample to its designated storage location.

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11.3 Counting a Weekly Background

- 11.3.1 Empty the cave of any samples or blanks, or sources, and close the cave.
- 11.3.2 Select **E. Background Count**.
- 11.3.3 Select the Detector to be used from the list by Clicking on the listing to highlight, and Click **Ok**.
- 11.3.4 Click **Sample Blank**.
- 11.3.5 Select the Geometry to be used from the list by Clicking on the listing to highlight, and Click **Ok**.
- 11.3.6 Enter the required *Background Count Preset Live (secs)*.

NOTE

The counting times for the various samples and geometries are part of the Prescribed Set Points. Refer to the corresponding Attachment 14.1.10 for these values.

NOTE

The detector will begin acquiring data at this point. If data has been entered in error, the user must use the **Detector Management** functions to abort the acquisition.

- 11.3.7 As required, enter the sample data into the Detector Run Log.
- 11.3.8 Upon completion of acquisition, observe a hard copy printout of the data is printed.
- 11.3.9 Review the data as appropriate.
- 11.3.10 Clear the cave of the sample blank and return the blank to its designated storage location.

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11.4 Counting a Quality Control Sample (Daily QC Check or Background)

- 11.4.1 Place a Calibration Check Sample or Blank Sample in the cave atop the detector in the correct orientation for the sample geometry.
- 11.4.2 Select **F. Quality Control**.
- 11.4.3 Select either **A. Calibration QC Count** or **B. Background QC Count**.
- 11.4.4 Select the Detector to be used from the list by Clicking on the listing to highlight, and Click **Ok**.
- 11.4.5 Select the Geometry to be used from the list by Clicking on the listing to highlight, and Click **Ok**.
- 11.4.6 Enter the required *QC Count Preset Live Time*.

NOTE

The counting times for the various samples and geometries are part of the Prescribed Set Points. Refer to the corresponding Attachment 14.1.10 for these values.

NOTE

The detector will begin acquiring data at this point. If data has been entered in error, Clicking **Cancel** in the next window will stop acquisition with no processing of data.

- 11.4.7 Enter the *Sample ID* as follows: Geometry QC or Daily BKG Date.
- 11.4.8 As required, enter the sample data into the Detector Run Log.
- 11.4.9 Upon completion of acquisition, observe a hard copy printout of the data is printed.
- 11.4.10 Review the data as appropriate.
- 11.4.11 Clear the cave of the sample and return the sample to its designated storage location.

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11.13 Electronic Data Package Generation

- 11.13.1 Open Windows® Explorer.
- 11.13.2 Go to the Gamma directory and expand.
- 11.13.3 Go to the ProCount directory and expand.
- 11.13.4 Go to the Repfile subdirectory.
- 11.13.5 Highlight the repfiles associated with the analyzed batch and move/copy them to the XL_General subdirectory of the Gamma Folder.
- 11.13.6 Open Gamma Converter.
- 11.13.7 Click on **General Reporting**.
- 11.13.8 Answer **Yes** to the dialog box, if the files have been placed in the General_Inst (XL_General) file.
- 11.13.9 Enter the Batch ID number (e.g., 01G001) in to the dialog box.
- 11.13.10 Click **Ok**.
- 11.13.11 Highlight one sample at a time.
- 11.13.12 Click **Ok**.
- 11.13.13 If all nuclides from the library file are desired for reporting, Click **Transfer Data (As Shown)**.
- 11.13.14 If only certain nuclides are desired, select the nuclides then Click **Keep Selected Items** then **Transfer Data (As Shown)**.
- 11.13.15 Using the screen provided, edit the parameters then click **Ok**.
- 11.13.16 Repeat this sequence for each sample.

NOTE

When the last sample has been accepted the program will auto-generate and save a Microsoft Access® file corresponding to the batch ID given. The program will also auto-generate a Microsoft Excel® file and print a copy of the Excel® spreadsheet. The Access® file will be saved under the Gamma file folder. The Excel® sheet will be saved in the “XL_General” subfolder of the Gamma file folder.

- 11.13.17 Radiochemistry Lab Manager, or designee, shall review and qualify the data.
- 11.13.18 Entered the qualifiers into the Excel® spreadsheet.
- 11.13.19 Save both the Access® and Excel® files on the lab archive disk containing the repfiles.
- 11.13.20 Label a blank formatted 1.44 MB floppy disk with the Batch ID (e.g., 01G001), and place it in Drive A.
- 11.13.21 Copy the files from the *Repfile* and the *Gamma Converter* file to the floppy disk, and provide the disk for Sample Group Record transmittal.

11.14 Control Chart Printing

- 11.14.1 From the Main menu, select **F. Quality Control**.
- 11.14.2 Select “QC Plot/Report.”
- 11.14.3 Select parameter of interest, Background or Calibration QC count.
- 11.14.4 Select geometry of interest.
- 11.14.5 Select **Results - Show Chart**.
- 11.14.6 Enter date (00/00/00) and time (00:00:00) values for the period of interest.
- 11.14.7 Print copies of each peak energy, FWHM and decay corrected chart.
- 11.14.8 Highlight each category individually.
- 11.14.9 Click on **Show**, then **Print**.

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11.15 Analyzing a Previously Analyzed Spectrum with a Different Library

NOTE

Analysis of Spectrums with different libraries is performed solely as directed by the Radiochemistry Lab Manager. The Library used in each of the Analysis Sequence Files is found in the Prescribed Set Points. Data analyzed by different libraries IS NOT to be used for reporting purposes unless clearly directed by the Radiochemistry Lab Manager.

- 11.15.1 From the Main menu, select **G. System Maintenance**.
- 11.15.2 Select **A. Analyze Sample Data File**.
- 11.15.3 Select a sample type from the list by Clicking to highlight, and Click **Choose by Sample Type**.
- 11.15.4 Select a sample from the list, as identified by Sample ID or Sample Analysis Date, by Clicking to highlight, and Click **Select**.
- 11.15.5 Select **C. Select Alternate Analysis Sequence File**.
- 11.15.6 Select the *Analysis Sequence File* containing the required library from the 5pull down menu, and Click **Ok**.
- 11.15.7 Select **F. Analysis, Show Report**.
- 11.15.8 Review the printout and provide the printout to the Radiochemistry Lab Manager.

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11.16 Changing the Sample Information of a Previously Analyzed Spectrum

NOTE

Analysis of Spectrums with different sample information is performed solely as directed by the Radiochemistry Lab Manager. Data analyzed by using different sample information IS NOT to be used for reporting purposes unless clearly directed by the Radiochemistry Lab Manager. Corrections made due to Quality Control and Assurance requirements shall be properly documented.

- 11.16.1 From the Main menu, select G. System Maintenance.
- 11.16.2 Select A. Analyze Sample Data File.
- 11.16.3 Select a sample type from the list by Clicking to highlight, and Click Choose by Sample Type.
- 11.16.4 Select a sample from the list, as identified by Sample ID or Sample Analysis Date, by Clicking to highlight, and Click Select.
- 11.16.5 Select E. Modify Sample Information.
- 11.16.6 Select the *Analysis Sequence File* from the pull down menu, and Click Ok.
- 11.16.7 Enter in the required change to the *Sample ID*, *Sample Qty.*, *Sample Unit*, *Sample Date*, or *Description*, and Click Ok.
- 11.16.8 Select F. Analysis, Show Report.
- 11.16.9 Review the printout and provide the printout to the Radiochemistry Lab Manager.

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11.17 Sample Data Calculations

- 11.17.1 Sample data calculations are prescribed by the Canberra GENIE2000[®] software program.
- 11.17.2 Any changes to the methods used in calculating peak area, activity, error, MDA, or certainties shall be approved by review of the Project Chemist, Project Certified Health Physicist, and Radiochemistry Lab Manager.
- 11.17.3 As acquired, revisions to the Canberra GENIE 2000[®] software program shall be installed in a timely fashion as prescribed by the Radiochemistry Lab Manager.
- 11.17.4 Changes to methods or program upgrades are to be logged in the Detector Maintenance Log and the Laboratory Operations Log.

11.18 Preventative Maintenance

- 11.18.1 Fill Dewars at least once a week to maintain cooling.
- 11.18.2 Clean inside of shielded counting chamber by wiping with a damp cloth followed by a wipe down with a dry cloth at least once a month.
- 11.18.3 Inspect visually the detector end-cap for damage.
- 11.18.4 Maintain clean and safe electrical wiring and connections.
- 11.18.5 Track the detector's operation (FWHM, normalization of energy fit, background, etc.) to detect problems such as gain shift or resolution or efficiency fluctuations are observed.

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12.0 QUALITY CONTROL

- 12.1 Verify results are within quality control limits for operation in accordance with Radiochemistry Lab Quality Assurance requirements.
- 12.2 IF data fails quality control requirements, OR data appears to be suspect, Notify Rad Lab supervision.
- 12.3 Calibrate the system with an NIST traceable multi-line calibration standard yearly ± 30 days.

NOTE

The secondary standard may be freshly prepared, but is generally a previously spiked sample from an external performance evaluation where sample results are recorded and known.

- 12.4 Perform a multi-line primary OR secondary standard analysis monthly, or before each use for each geometry to be analyzed.
 - 12.4.1 Include the sample type and geometry typically analyzed.
 - 12.4.2 Count the standard for that time period where the smallest activity of the standard meets a MDA of 0.1 pCi/unit (liter/air filter/etc.).
- 12.5 Analyze a spiked sample at intervals of every 20 samples of a given matrix.

NOTE

The spiked sample may be freshly prepared, but is generally a previously spiked sample from an external performance evaluation where sample results are recorded and known.

NOTE

A Given Matrix is defined as follows. Any sample of a given matrix includes ALL samples of a like type (e.g. Water, Soil, Air Filter) taken from one site (e.g. Cluster 5) AND sent as a collective quantity, which may include several Chain of Custodies (COCs), to be analyzed.

- 12.6 Analyze a Duplicate sample or a Lab Replicate at intervals of every 10 samples.

NOTE

The duplicate sample need NOT be a split of the original sample and need NOT be removed from the sampling container and placed in a new container. It is best to use the same sample ensuring that the sample is shaken or mixed and then placed back for counting.

- 12.7 Analyze background weekly, AND whenever radiation levels change significantly.

NOTE

Background should be counted for the same time period of the longest sample time currently employed for a given sample matrix and geometry.

- 12.8 Analyze a calibration standard and a blank prior to the start of any batch (20 samples).

- 12.9 Verify counting times are identical for ALL samples within a given geometry and method, including QC samples.
- 12.10 The Radiochemistry Lab manager is to review analysis data for the results of Energy calibration normalized difference, noted data outside FWHM but within FW25M, bad peak shape, points beyond 12 half-lives, peak centroids outside of library centroids, and unresolved multiplets.
- 12.11 Use Control Charts as a tool for trend analysis of system performance and background tracking.
 - 12.11.1 Control Charts that will accompany data packages (decay corrected activity) shall have points that bracket the analysis period for the data package of interest.
 - 12.11.2 For system trending analysis the period used to establish the 2- and 3- sigma ranges should use data points taken over a period of time sufficient to represent the normal operating environment of the laboratory. The sample n sigma function continuously updates the 2 and 3 sigma ranges.
 - 12.11.3 The Radiochemistry Laboratory Supervisor periodically reviews the control charts for trending analysis. Patterns in the data points may indicate a problem in the system. Should an abnormal trend be recognized, the Radiochemistry Laboratory Supervisor shall perform an investigation of possible causes.
- 12.12 Record problems encountered and actions taken in the Detector Maintenance Log and the Laboratory Operations Log.

13.0 REPORTING LIMITS

- 13.1 Minimum Detectable Activity is based on the requirements of the client, site, and/or regulatory requirements and should be at the maximum 10% of the nominal sample value.
- 13.2 Report values of an MDA that exceed stated requirements to Rad Lab supervision.

14.0 QUALITATIVE IDENTIFICATION INFORMATION

- 14.1 Tracking the results of the data from the Calibration Standard and Lab Control Sample provide instant feedback as to the operation of the instrument.
- 14.2 Key energy lines of the Isotopes of Concern should be established within ± 0.2 keV.
- 14.3 Activities of the Isotopes of Concern should be within 95% to 100% of determined values.

15.0 DATA REVIEW

15.1 Minimum Detectable Activity (MDA)

- 15.1.1 MDA is based on the requirements of the client, site, and/or regulatory requirements and should be at the maximum 10% of the nominal sample value.
- 15.1.2 Report values of an MDA that exceed stated requirements to Rad Lab supervision.

15.2 Recovery Limits

- 15.2.1 Recovery limits are set in accordance with the requirements set forth by the Lab Data Quality Assurance Program.
- 15.2.2 ALL samples analyzed that are not governed by a QAPP should follow recovery recommendations set forth by controlling regulatory agencies.

15.3 Sample Tracking

- 15.3.1 Sample analysis will be logged in on Sample Tracking Form for Gamma Spectroscopy (STF-GS), Attachment 22.2.
- 15.3.2 The STF-GS will identify samples analyzed in any given batch.
- 15.3.3 The STF-GS will be used to ensure the batch is analyzed in such a manner to meet QC data requirements for a batch.
- 15.3.4 Any samples analyzed without the use of an STF-GS will not be considered qualified samples results.

16.0 RECORDS

- 16.1 Gamma Spectrometry Run Log
- 16.2 Energy and Shape Calibration – electronic file and hardcopy
- 16.3 Efficiency Calibration – electronic file and hardcopy
- 16.4 Daily Background Check – electronic file and hardcopy
- 16.5 Weekly Background – electronic file and hardcopy
- 16.5 Daily Calibration Check QC Report – electronic file and hardcopy
- 16.6 Detector Maintenance Log
- 16.7 Laboratory Operation Log
- 16.8 Sample Tracking Form

17.0 PREVENTIVE MAINTENANCE

- 17.1 Fill Dewars at least once a week to maintain cooling.
- 17.2 Clean inside of shielded counting chamber by wiping with a damp cloth followed by a wipe down with a dry cloth at least once a month.
- 17.3 Ensure that the detector end-cap is undamaged.
- 17.4 Maintain clean and safe electrical wiring and connections.
- 17.5 Track the detector's operation (FWHM, normalization of energy fit, background, etc.) to detect problems such as gain shift or resolution or efficiency fluctuations are observed.

18.0 POLLUTION PREVENTION

- 18.1 ALL steps possible and practical shall be taken to ensure the requirements of local, state, and federal regulatory agencies are met when disposing of wastes to the local environment.
- 18.2 ALL waste products should be characterized to identify the chemical(s) inherent in the waste, volume produced during analysis, and disposal pathway.
- 18.3 Liquid wastes, disposed of by way of the lab drainage system, shall NEVER be disposed of in quantities OR contain material(s) that cannot be handled by the local sewage treatment system.
- 18.4 Waste disposed should be pretreated as necessary prior to disposal to a condition that can be handled by the local sewage treatment system (e.g. neutralization of acids or bases).
- 18.5 ALL wastes that CANNOT be handled by the local sewage system shall be contained and disposed of through proper waste disposal techniques and with waste brokers licensed to handle such wastes.

19.0 WASTE MINIMINAZATION

- 19.1 ALL wastes are to be handled in the proper manner.
- 19.2 Exercise care during the performance of the method to ensure the production of waste is minimized.
- 19.3 ALL waste is to be disposed of in the proper designated container.
- 19.4 Wastes may be collected and stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient, for treatment prior to disposal, or for disposal.
- 19.5 ALL waste is to be deemed to contain radioactive material, AND is to be handled accordingly, UNTIL tested and released as prescribed by the lab release limits.
- 19.6 ALL waste is to be tested AND treated prior to disposal, OR properly packaged and stored for return to the originator.
- 19.7 Waste may be stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient.

- 19.7.1 Unused sample volumes should be retained AND returned to the client when possible for disposal.
- 19.7.2 Unused samples that are not returned SHALL be treated and/or disposed of properly.
- 19.8 Empty containers are to be rinsed AND/OR treated to ensure they are acceptable for disposal.
 - 19.8.1 Containers that CANNOT be treated are to be retained for disposal.
- 19.9 Used PPE is to be checked for contamination prior to normal lab disposal.
- 19.10 PPE used in the preparation or handling of known source material is to be disposed of as radioactive waste.

21.0 REFERENCES

ASTM C1402-98; Standard for High-Resolution Gamma-Ray Spectrometry of Soil Samples

ANSI N42.14-99; Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides

ANSI N42.23-96; Measurement and Associated Instrumentation Quality Assurance for Radioassay Laboratories

EPA 600 4-80-032; Prescribed Procedures for Measurement of Radioactivity in Drinking Water; Method 901.1, Gamma Emitting Radionuclides

DOE Environmental Measurements Laboratory HASL-300, 28th Edition, February 1997, Method Ga-01-R, Gamma Radioassay

Canberra Germanium Detectors User's Manual – Current Version

Canberra Genie-2000 Application Manual – Current Version

Canberra Genie-2000 Operations Manual – Current Version

Canberra Genie-2000 Customization Tools Manual – Current Version

USACE Kansas City and St. Louis Radiological Data Evaluation Guidance – 2000

Maywood FUSRAP Superfund Site Laboratory Quality Assurance Manual

22.0 ATTACHMENTS

- 22.1 Prescribed Set Points for Normal Operation
 - 22.1.1 MCA Runtime Input Definitions
 - 22.1.2 Geometry Names
 - 22.1.3 Analysis Sequence File - TUNA CAN
 - 22.1.4 Analysis Sequence File – QC Spike
 - 22.1.5 Analysis Sequence File – BACKGROUND – Empty Cave
 - 22.1.6 Analysis Sequence File – Proficiency Sample Evaluation

- 22.1.7 Analysis Library - List 2 (Greater Than 1.5 Days)
- 22.1.8 Analysis Library - Calibration Source Mixed Gamma
- 22.1.9 Acquisition Setup Values
- 22.1.10 MCA Adjust Dialog Values
- 22.1.11 Prescribed Counting Times
- 22.2 Sample Tracking Form –Gamma Spectroscopy
- 22.3 GLOSSARY OF TERMS

ATTACHMENT 22.1 Prescribed Set Points for Normal Operation

ATTACHMENT 22.1.1 MCA Runtime Input Definitions

MCA	INPUT	SIZE	ADC	MKR	STAB	AMP	HV	GAIN
AIM	DET01	4096	1P			1P	1P	
InSpector	DET02	4096	1P			1P	1P	

ATTACHMENT 22.1.2 Geometry Names

Number	Identification
1	500 mL MARINELLI
2	PETRI DISH
3	WET COUNT
4	TUNA CAN
5	PE SAMPLES
6	TUNA CAN

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ATTACHMENT 22.1.3 Analysis Sequence File - TUNA CAN

The following Sequence Steps are established for the analysis sequence called –TUNA CAN.
This sequence is use for the normal analysis of soil samples.

Analysis Sequence Editor – TUNACAN

ANALYSIS SEQUENCE EDITOR – TUNACAN.ASF		X
Sequence Title		
TUNA CAN		
Current Steps		
Peak Locate – Library Simple		
Peak Area – Sum / Non-linear		
Area Correction – Std. Bkg. Subtract		
Efficiency Correction - Standard		
Nuclide Identification – NID w/ Interference Corrr.		
Detection Limits – Curie MDA		
Reporting Standard		
Reporting Standard		
Reporting Standard		
Reporting Standard		
Reporting Standard		

The following are the setpoints and conditions in each of the Analysis Sequence Steps associated with this file.

Peak Locate – Library Simple

Simple Library Peak Locate Setup		X
Search Region		
Start Channel	1	Stop Channel 4096
Nuclide Library: C:\Genie2K\CAMFILES>List2\routine		Select..
Tolerance	2.0 keV	☒ Add to existing results
☒ Energy	☐ FWHM	
☐ Auto-generate ROIs	ROI Width +/- 1.00	☐ Generate Report
☐ Check for adjacent peaks		
OK	Cancel	Help
		Execute

ATTACHMENT 22.1.3 Analysis Sequence File - TUNA CAN (cont.)

Peak Area- Sum/Non-linear LSQ fit

Sum / Non-linear LSQ FIT Setup				X
Peak Area Region				☐ 95% Critical level test
Start Channel	1			☐ Use fixed FWHM
Stop Channel	4096			☒ Use fixed tail parameters
Continuum	4	Channels		☐ Fit singlets
☐ Channels			FWHM	☐ Display ROIs
				☐ Reject zero area peaks
Contiuum function:	Step			
Residual Search				
☐ Perform Search	Threshold	4.00		
	Minimum Separation [FWHM]	1.00		
ROI Limits Determination				
Max. num. FWHMs between peaks		5.00		
Max. num. FWHMs for left limits		2.00		
Max. num. FWHMs for right limits		2.00		☐ Generate Report
OK	Cancel	Help	Execute	

Area Correction- Std. Bkg Subtract

Setup for Standard Bkg. Subtract				X
Bkg. File:	C:\Genie2K\CAMFILES\BKG.CNF	Select..		
Tolerance:		keV		☐ 95% Critical level test
☐ Energy	☐ FWHM			☐ Generate Report
OK	Cancel	Help	Execute	

Efficiency Correction - Standard

Efficiency Correction Setup		X
Efficiency Calib. Type:	Dual	
		☐ Generate Report
OK	Cancel	Help
		Execute

ATTACHMENT 22.1.3 Analysis Sequence File - TUNA CAN (cont.)

NID w/Interference Correction

NID plus Interference Correction Setup				X
NID range				
Start Channel	1	Stop Channel	4096	
NID Library:		C:\Genie2K\CAMFILES>List2\routine	Select..	
☒	Perform MDA Test	☐	Inhibit Acquisition Time Decay Correction	
Tolerance	2.00 keV	NID Confidence threshold:	0.30	
☒ Energy	☐ FWHM	MDA Confidence factor:	5.00 %	
Cascade Correction				
Coincidence library	C:\GENIE2K\CAMFILE\cai_lib.clb	Select		
Geometry composer file		Select		
☐	Perform cascade correction	☐	Generate Report	
OK	Cancel	Help	Execute	

Minimum Detectable Activity (MDA) Setup				X
Confidence Factor		5.00 %		
☒	Perform variable ROI widths:	ROI width + / -	3.00 FWHM	
☐	Inhibit Acquisition Time Decay Correction	Add Constant	2.71	
		Multiplier:	3.29	
Cascade Correction				
Coincidence library	C:\GENIE2K\CAMFILE\cai_lib.clb	Select		
Geometry composer file		Select		
☐	Perform cascade correction	☐	Generate Report	
OK	Cancel	Help	Execute	

ATTACHMENT 22.1.3 Analysis Sequence File - TUNA CAN (cont.)

Standard Report

Standard Report Setup		X
Template Name:	NUTECH.TPL	▼
Directory:	C:\GENIE2K\CTLFILES\	
Section Name:	Header	▼
Error Multiplier:	2.000000	
Start on:		Output to:
☒	Page One	☐ Screen
☒	New Page	☐ Printer
☒	New File	
Activity Units:	pCi	Multiplier: 1E+006
OK	Cancel	Help Execute

Standard Report

Standard Report Setup		X
Template Name:	NUTECH.TPL	▼
Directory:	C:\GENIE2K\CTLFILES\	
Section Name:	Peak Analysis	▼
Error Multiplier:	2.000000	
Start on:		Output to:
☐	Page One	☒ Screen
☒	New Page	☐ Printer
☐	New File	
Activity Units:	pCi	Multiplier: 1E+006
OK	Cancel	Help Execute

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ATTACHMENT 22.1.3 Analysis Sequence File - TUNA CAN (cont.)

Standard Report

Standard Report Setup X

Template Name: NUTECH.TPL ▼
Directory: C:\GENIE2K\CTLFILES\
Section Name: NID_inf ▼
Error Multiplier: 2.000000

Start on:
☐ Page One
☒ New Page
☐ New File

Output to:
☒ Screen
☒ Printer

Activity Units: pCi Multiplier: 1E+006

OK Cancel Help Execute

Standard Report

Standard Report Setup X

Template Name: NUTECH.TPL ▼
Directory: C:\GENIE2K\CTLFILES\
Section Name: MDA ▼
Error Multiplier: 2.000000

Start on:
☐ Page One
☒ New Page
☐ New File

Output to:
☒ Screen
☒ Printer

Activity Units: pCi Multiplier: 1E+006

OK Cancel Help Execute

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ATTACHMENT 22.1.3 Analysis Sequence File - TUNA CAN (end)

Standard Report

Standard Report Setup		X	
Template Name:	DELIMIT.TPL	▼	
Directory:	C:\GENIE2K\CTLFILES\		
Section Name:	<All>	▼	
Error Multiplier:	2.000000		
Start on:		Output to:	
☐	Page One	☐	Screen
☒	New Page	☒	Printer
☐	New File	☐	
Activity Units:	pCi	Multiplier:	1E+006
OK	Cancel	Help	Execute

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ATTACHMENT 22.1.4 Analysis Sequence File – QC Spike

The following Sequence Steps are established for the analysis sequence called –TUNA CAN.
This sequence is use for the normal analysis of soil samples.

ANALYSIS SEQUENCE EDITOR – QCSPIKE.ASF		X
Sequence Title		
Qcspike		
Current Steps		
Peak Locate – Unidentified 2 nd Diff.		
Peak Area – Sum / Non-linear		
Area Correction – Std. Bkg. Subtract		
Efficiency Correction - Standard		
Nuclide Identification – NID w/ Interference Corr.		
Detection Limits – Curie MDA		
Reporting Standard		
Reporting Standard		
Reporting Standard		
Reporting Standard		
Reporting Standard		

The following are the setpoints and conditions in each of the Analysis Sequence Steps associated with this file.

Peak Locate – Unidentified 2nd Diff.

Peak Locate Unidentified 2 nd Diff. Setup				X
Search Region				
Start Channel	1	Stop Channel	4096	
Significance Threshold	3.00	Select..		
Tolerance:	1.50	keV	☐	Add to existing results
☐ Energy		FWHM	☐	Generate Report
OK	Cancel	Help	Execute	

ATTACHMENT 22.1.4 Analysis Sequence File – QC Spike (cont)

Peak Area- Sum/Non-linear LSQ fit

Sum / Non-linear LSQ FIT Setup				X
Peak Area Region			☐ 95% Critical level test	
Start Channel	1		☐ Use fixed FWHM	
Stop Channel	4096		☒ Use fixed tail parameters	
Continuum	4	Channels	☐ Fit singlets	
☐ Channels		FWHM	☒ Display ROIs	
			☐ Reject zero area peaks	
Contiuum function:		Step ▼		
Residual Search				
☐ Perform Search	Threshold	4.00		
	Minimum Separation [FWHM]	1.00		
ROI Limits Determination				
Max. num. FWHMs between peaks	5.00			
Max. num. FWHMs for left limits	2.00			
Max. num. FWHMs for right limits	2.00		☐ Generate Report	
OK		Cancel	Help	Execute

Area Correction- Std. Bkg Subtract

Setup for Standard Bkg. Subtract				X
Bkg. File:	C:\Genie2K\CAMFILES\G00D01B.cnf	Select..		
Tolerance:	1.50	keV	☐ 95% Critical level test	
☒ Energy	☐ FWHM		☐ Generate Report	
OK		Cancel	Help	Execute

Efficiency Correction - Standard

Efficiency Correction Setup		X
Efficiency Calib. Type:	Dual ▼	
	☐ Generate Report	
OK	Cancel	Help
	Execute	

ATTACHMENT 22.1.4 Analysis Sequence File – QC Spike (cont)

NID w/Interference Correction

NID plus Interference Correction Setup [X]

NID range
Start Channel Stop Channel

NID Library:

☐ Perform MDA Test ☐ Inhibit Acquisition Time Decay Correction

Tolerance keV NID Confidence threshold:

☒ Energy ☐ FWHM MDA Confidence factor: %

Cascade Correction
Coincidence library
Geometry composer file
☐ Perform cascade correction

Minimum Detectable Activity (MDA) Setup [X]

Confidence Factor %

☒ Perform variable ROI widths: ROI width +/- FWHM
☐ Inhibit Acquisition Time Decay Correction

Add Constant Multiplier:

Cascade Correction
Coincidence library
Geometry composer file
☐ Perform cascade correction

ATTACHMENT 22.1.4 Analysis Sequence File – QC Spike (cont)

Standard Report

Standard Report Setup

Template Name: NUTECH.TPL ▼
Directory: C:\GENIE2K\CTLFILES\
Section Name: Header ▼
Error Multiplier: 2.000000

Start on:
☒ Page One
☒ New Page
☒ New File

Output to:
☐ Screen
☐ Printer

Activity Units: pCi Multiplier: 1E+006

OK Cancel Help Execute

Standard Report

Standard Report Setup

Template Name: NUTECH.TPL ▼
Directory: C:\GENIE2K\CTLFILES\
Section Name: Peak Analysis ▼
Error Multiplier: 2.000000

Start on:
☐ Page One
☒ New Page
☐ New File

Output to:
☒ Screen
☐ Printer

Activity Units: pCi Multiplier: 1E+006

OK Cancel Help Execute

ATTACHMENT 22.1.4 Analysis Sequence File – QC Spike (cont)

Standard Report

Standard Report Setup X

Template Name:	NUTECH.TPL ▼
Directory:	C:\GENIE2K\CTLFILES\
Section Name:	NID inf ▼
Error Multiplier:	2.000000

Start on:	Output to:
☐ Page One	☒ Screen
☒ New Page	☐ Printer
☐ New File	

Activity Units:	pCi	Multiplier:	1E+006

OK	Cancel	Help	Execute

Standard Report

Standard Report Setup X

Template Name:	NUTECH.TPL ▼
Directory:	C:\GENIE2K\CTLFILES\
Section Name:	MDA ▼
Error Multiplier:	2.000000

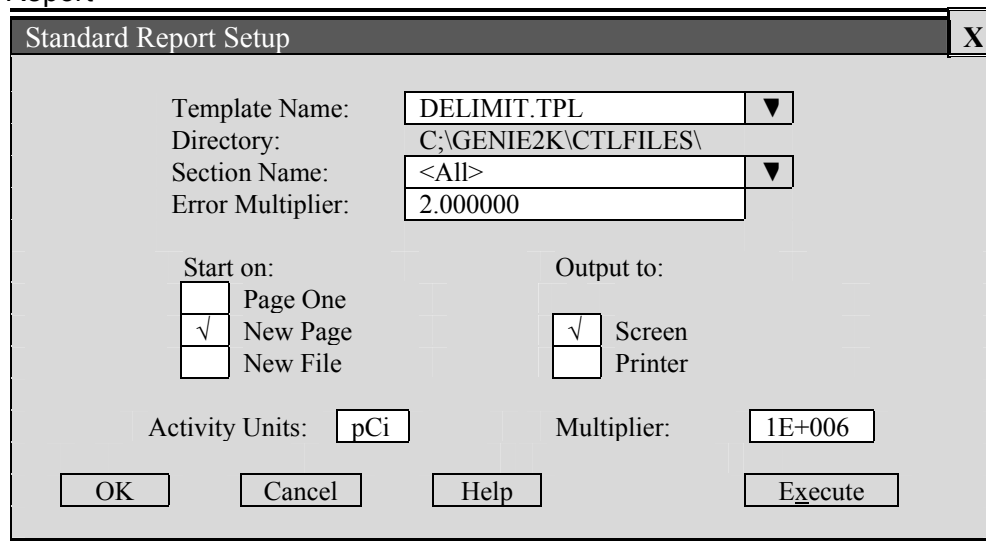
Start on:	Output to:
☐ Page One	☒ Screen
☒ New Page	☒ Printer
☐ New File	

Activity Units:	pCi	Multiplier:	1E+006

OK	Cancel	Help	Execute

ATTACHMENT 22.1.4 Analysis Sequence File – QC Spike (end)

Standard Report



The image shows a 'Standard Report Setup' dialog box with the following fields and options:

- Template Name: DELIMIT.TPL (dropdown menu)
- Directory: C:\GENIE2K\CTLFILES\ (text field)
- Section Name: <All> (dropdown menu)
- Error Multiplier: 2.000000 (text field)
- Start on:
 - ☐ Page One
 - ☒ New Page
 - ☐ New File
- Output to:
 - ☒ Screen
 - ☐ Printer
- Activity Units: pCi (text field)
- Multiplier: 1E+006 (text field)
- Buttons: OK, Cancel, Help, Execute

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ATTACHMENT 22.1.5 Analysis Sequence File – BACKGROUND – Empty Cave

The following Sequence Steps are established for the analysis sequence called –BACKGROUND.

ANALYSIS SEQUENCE EDITOR – BKGCOUNT.ASF		X
Sequence Title		
Background Count w / Report		
Current Steps		
Reporting Standard		
Peak Locate – Unidentified 2 nd Diff.		
Peak Area – Sum / Non-linear LSQ fit		
Reporting Standard		

The following are the setpoints and conditions in each of the Analysis Sequence Steps associated with this file.

Standard Report

Standard Report Setup		X
Template Name:	NUTECH.TPL	▼
Directory:	C:\GENIE2K\CTLFILES\	
Section Name:	Header	▼
Error Multiplier:	2.000000	
Start on:		Output to:
☐ Page One		☒ Screen
☐ New Page		☐ Printer
☒ New File		
Activity Units:		Multiplier:
OK		Cancel
Help		Execute

ATTACHMENT 22.1.5 Analysis Sequence File – BACKGROUND – Empty Cave (cont)

Peak Locate – Unidentified 2nd Diff.

Peak Locate Unidentified 2 nd Diff. Setup				X
Search Region				
Start Channel	1	Stop Channel	4096	
Significance Threshold		5.00	Select..	
Tolerance:	0.50	keV	☐	Add to existing results
☐ Energy	☐ FWHM	☐ Generate Report		
OK	Cancel	Help	Execute	

Peak Area- Sum/Non-linear LSQ fit

Sum / Non-linear LSQ FIT Setup				X
Peak Area Region				
Start Channel	1			
Stop Channel	4096			
Continuum		4	Channels	
☐	Channels	☐	FWHM	
Contiuum function:		Step	▼	
Residual Search				
☐	Perform Search	Threshold	4.00	
Minimum Separation [FWHM]		1.00		
ROI Limits Determination				
Max. num. FWHMs between peaks		5.00		
Max. num. FWHMs for left limits		2.00		
Max. num. FWHMs for right limits		2.00		
		☐	Generate Report	
OK	Cancel	Help	Execute	

ATTACHMENT 22.1.5 Analysis Sequence File – BACKGROUND – Empty Cave (end)

Standard Report

Standard Report Setup		X
Template Name:	NUTECH.TPL ▼	
Directory:	C:\GENIE2K\CTLFILES\	
Section Name:	Peak Analysis ▼	
Error Multiplier:	2.000000	
Start on:		Output to:
☐	Page One	☒ Screen
☒	New Page	☒ Printer
☐	New File	
Activity Units:		Multiplier: 0
OK	Cancel	Help
		Execute

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ATTACHMENT 22.1.6 Analysis Sequence File – Proficiency Sample Evaluation

The following Sequence Steps are established for the analysis sequence called –Pe_asf1.
This sequence is use for the normal analysis of soil samples.

ANALYSIS SEQUENCE EDITOR – PE_ASF1.ASF		X
Sequence Title		
Pe-asf1		
Current Steps		
Peak Locate – Library Simple		
Peak Area – Sum / Non-linear		
Area Correction – Std. Bkg. Subtract		
Efficiency Correction - Standard		
Nuclide Identification – NID w/ Interference Corrr.		
Detection Limits – Curie MDA		
Reporting Standard		
Reporting Standard		
Reporting Standard		
Reporting Standard		
Reporting Standard		

The following are the setpoints and conditions in each of the Analysis Sequence Steps associated with this file.

Peak Locate – Library Simple

Simple Library Peak Locate Setup		X
Search Region		
Start Channel	1	Stop Channel 4096
Nuclide Library: C:\Genie2K\CAMFILES\PE_LIB.nlb		Select..
Tolerance	2.0 keV	☒ Add to existing results
☒ Energy	☐ FWHM	
☐ Auto-generate ROIs	ROI Width +/- 1.00	☐ Generate Report
☐ Check for adjacent peaks		
OK	Cancel	Help
		Execute

ATTACHMENT 22.1.6 Analysis Sequence File – Proficiency Sample Evaluation (cont)

Peak Area- Sum/Non-linear LSQ fit

Sum / Non-linear LSQ FIT Setup				X
Peak Area Region			☐	95% Critical level test
Start Channel	1		☐	Use fixed FWHM
Stop Channel	4096		☒	Use fixed tail parameters
Continuum	2.00	Channels	☐	Fit singlets
☐ Channels		☐ FWHM	☒	Display ROIs
			☐	Reject zero area peaks
Contiuum function:		Step ▼		
Residual Search				
☐ Perform Search	Threshold	4.00		
	Minimum Separation [FWHM]	1.00		
ROI Limits Determination				
Max. num. FWHMs between peaks	5.00			
Max. num. FWHMs for left limits	2.00			
Max. num. FWHMs for right limits	2.00		☐	Generate Report
OK		Cancel	Help	Execute

Area Correction- Std. Bkg Subtract

Setup for Standard Bkg. Subtract				X
Bkg. File:	C:\Genie2K\CAMFILES\G00D01B.cnf	Select..		
Tolerance:	2.00	keV	☐	95% Critical level test
☒ Energy	☐ FWHM		☐	Generate Report
OK		Cancel	Help	Execute

Efficiency Correction - Standard

Efficiency Correction Setup		X
Efficiency Calib. Type:	Dual ▼	
☐ Generate Report		
OK	Cancel	Help
Execute		

ATTACHMENT 22.1.6 Analysis Sequence File – Proficiency Sample Evaluation (cont)

NID w/Interference Correction

NID plus Interference Correction Setup				X
NID range				
Start Channel	1	Stop Channel	4096	
NID Library:	C:\Genie2K\CAMFILES\PE_LIB.nlb	Select..		
☒	Perform MDA Test			
☐	Inhibit Acquisition Time Decay Correction			
Tolerance	2.00 keV	NID Confidence threshold:	0.300	
☒ Energy	☐ FWHM	MDA Confidence factor:	5.00 %	
Cascade Correction				
Coincidence library	C:\GENIE2K\CAMFILE\cai_lib.clb	Select		
Geometry composer file		Select		
☐	Perform cascade correction	☐ Generate Report		
OK	Cancel	Help	Execute	

Minimum Detectable Activity (MDA) Setup				X
Confidence Factor	5.00 %			
☒	Perform variable ROI widths:	ROI width +/-	3.00 FWHM	
☐	Inhibit Acquisition Time Decay Correction			
Add Constant	2.71	Multiplier:	3.29	
Cascade Correction				
Coincidence library	C:\GENIE2K\CAMFILE\cai_lib.clb	Select		
Geometry composer file		Select		
☐	Perform cascade correction	☐ Generate Report		
OK	Cancel	Help	Execute	

ATTACHMENT 22.1.6 Analysis Sequence File – Proficiency Sample Evaluation (cont)

Standard Report

Standard Report Setup X

Template Name: NUTECH.TPL ▼
Directory: C:\GENIE2K\CTLFILES\
Section Name: Header ▼
Error Multiplier: 2.000000

Start on:
☒ Page One
☒ New Page
☒ New File

Output to:
☒ Screen
☐ Printer

Activity Units: pCi Multiplier: 1E+006

OK Cancel Help Execute

Standard Report

Standard Report Setup X

Template Name: NUTECH.TPL ▼
Directory: C:\GENIE2K\CTLFILES\
Section Name: Peak Analysis ▼
Error Multiplier: 2.000000

Start on:
☐ Page One
☒ New Page
☐ New File

Output to:
☒ Screen
☐ Printer

Activity Units: pCi Multiplier: 1E+006

OK Cancel Help Execute

ATTACHMENT 22.1.6 Analysis Sequence File – Proficiency Sample Evaluation (cont))

Standard Report

Standard Report Setup		X
Template Name:	NUTECH.TPL	▼
Directory:	C:\GENIE2K\CTLFILES\	
Section Name:	NID inf	▼
Error Multiplier:	2.000000	
Start on:		Output to:
☐ Page One		☒ Screen
☒ New Page		☐ Printer
☐ New File		
Activity Units:	pCi	Multiplier: 1E+006
OK	Cancel	Help
		Execute

Standard Report

Standard Report Setup		X
Template Name:	NUTECH.TPL	▼
Directory:	C:\GENIE2K\CTLFILES\	
Section Name:	MDA	▼
Error Multiplier:	2.000000	
Start on:		Output to:
☐ Page One		☒ Screen
☒ New Page		☐ Printer
☐ New File		
Activity Units:	pCi	Multiplier: 1E+006
OK	Cancel	Help
		Execute

ATTACHMENT 22.1.6 Analysis Sequence File – Proficiency Sample Evaluation (end)

Standard Report

Standard Report Setup		X	
Template Name:	DELIMIT.TPL	▼	
Directory:	C:\GENIE2K\CTLFILES\		
Section Name:	<All>	▼	
Error Multiplier:	2.000000		
Start on:		Output to:	
☐	Page One	☐	Screen
☒	New Page	☒	Printer
☐	New File		
Activity Units:	pCi	Multiplier:	1E+006
OK	Cancel	Help	Execute

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ATTACHMENT 22.1 – Prescribed Set Points for Normal Operation (Continued)

NOTE

Library information should be taken from the most current data available from the Idaho National Engineering and Environmental Laboratory *Gamma-ray Spectrum Catalogue* as maintained by the National Nuclear Data Center at Brookhaven National Laboratory.

NOTE

Library – List 2 is used in the normal analysis of soil samples. The daughter isotopes assumed to be in equilibrium are identified, but reported as the parent.

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ATTACHMENT 22.1.7 Analysis Library - List 2 (Greater Than 1.5 Days)

Nuclide of Interest	Half-Life (sec)	Nuclide Identified	Energy (keV)	Energy Uncertainty	Yield (%)	Yield Uncertainty
K-40	4.030E+016	K-40	*1460.810	0.0000	10.6700	0.1300
Cs-137	9.512067E+008	Cs-137	*661.650	0.0000	85.12	0.0000
Ra-226	1601 y	Pb-214	@241.980	0.0000	7.4300	0.0000
		Pb-214	*295.210	0.0000	19.3000	0.0000
		Pb-214	@580.100	0.0000	0.3520	0.0000
		Bi-214	609.310	0.0000	46.1000	0.0000
		Bi-214	1120.290	0.0000	15.1000	0.0000
		Bi-214	1238.110	0.0000	5.7900	0.0000
		Bi-214	1764.490	0.0000	15.4000	0.0000
Ac-227	6.87015E+008	Rn-219	*401.810	0.0000	6.4000	0.0000
		Pb-211	404.850	0.0000	3.7800	0.0000
		Pb-211	427.090	0.0000	1.7600	0.0000
Ac-228	1.4 E+010 y t _{1/2} of Th 232	Pb-212	@209.250	0.0000	3.8900	0.0000
			238.620	0.0000	43.3000	0.0000
			@240.980	0.0000	4.1000	0.0000
			@300.090	0.0000	3.2800	0.0000
		Ac-228	338.320	0.0000	11.2700	0.0000
			340.960	0.0000	0.3700	0.0000
		Tl-208	*583.140	0.0000	30.3700	0.0000
		Ac-228	911.210	0.0000	25.8000	0.0000
		Ac-228	@964.600	0.0000	4.9900	0.0000
		Ac-228	968.970	0.0000	15.8000	0.0000
Th-230	7.42987E+012	Th-230	@1459.91	0.0000	0.8300	0.0000
			*67.670	0.0000	0.3770	0.0000
			*163.350	0.0000	5.0800	0.0000
			205.310	0.0000	5.0100	0.0000
			@234.800	0.0000	3.0000	0.0000
			@235.970	0.0000	12.3000	0.0000
			@338.310	0.0000	2.7900	0.0000
U-235	7.04 E+008 y (2.250E+013)	Th-227	@342.500	0.0000	0.3900	0.0000
		Th-234	*63.290	0.0000	4.8000	0.0000
		Th-234	1001.00	0.0000	0.8370	0.0000
Am-241	432.7 y	Am-241	*59.540	0.5000	35.9000	0.0500

ATTACHMENT 22.1.8 Analysis Library - Calibration Source Mixed Gamma

NOTE

The following values are to be used against the certified calibration standard and as applicable (•) the certified calibration check source

Nuclide of Interest	Half-Life (sec)	Energy (keV)	Energy Uncertainty	Gammas per sec	Yield (%)	Gamma per sec Uncertainty
Am-241 •	432.2(7) y (1.362E+010)	59.5412	0.0001	1671	35.9	5.0
Cd-109	462.6(4) d (3.997E+007)	88.034	0.001	2352	3.61	4.6
Co-57	271.79(9) d (2.348E+007)	122.061	0.0003	1273	85.60	4.4
Co-57	271.79(9) d (2.348E+007)	136.473	0.0005	1273	10.68	4.4
Ce-139	137.640(23) d (1.189E+007)	165.853	0.007	1755	79.886	4.7
Hg-203	46.612(18) d (4.027E+007)	279.197	0.001	4058	81.46	4.6
Sn-113	115.09(4) d (9.944E+007)	391.688	0.015	2471	64.0	4.6
Cs-137 •	30.07(3) y (9.489E+008)	661.657	0.003	1749	85.1	4.6
Y-88	106.65(4) d (9.215E+006)	898.042	0.003	6135	93.7	4.6
Co-60	5.2714(5) y (1.664E+008)	1173.237	0.004	3067	99.9736	5.0
Co-60 •	5.2714(5) y (1.664E+008)	1332.501	0.005	3088	99.9856	4.8
Y-88	106.65(4) d (9.215E+006)	1836.063	0.012	6427	99.2	4.6

ATTACHMENT 22.1.9

Acquisition Setup Values

Acquire Setup - Detector 1

Acquire Setup

Modes

☒

PHA +

☐

PHA -

☐

LFC +

☐

LFC -☐☐

Time Preset

☒

Live Time

☐

Real Time

600

☒

sec

☐

min☐

External

☐

Start

☐

Stop

Input Size

4096

←

→

256

4096

Conditional Preset

☒

None

☐

Integral☐☐

ROI Selection

Value:

Start Chan.

1

Stop Chan.

4096

±

=

Current

Acquire Setup - Detector 2

Acquire Setup

Modes

☒

PHA +

☐

PHA -

☐

LFC +

☐

LFC -☐☐

Time Preset

☒

Live Time

☐

Real Time

600

☒

sec

☐

min☐

External

☐

Start

☐

Stop

Input Size

4096

←

→

256

4096

Conditional Preset

☒

None

☐

Integral☐☐

ROI Selection

Value:

Start Chan.

1

Stop Chan.

4096

±

=

Current

ATTACHMENT 22.1.10 MCA Adjust Dialog Values

Adjust – ADC Detector 1 – Page 1 of 2

Adjust					X
	☒ ADC	☐ AMP	☐ HVPS		
Next	Conv. Gain	Offset	LLD	ULD	Exit
Prev.	4096	0	1.00%	110.00%	Help
	256 16384	0 16256	0.0 100.0	0.0 110.00	

Adjust – ADC Detector 1 – Page 2 of 2

Adjust					X
	☒ ADC	☐ AMP	☐ HVPS		
Next	Zero	Coinc. Mode			Exit
Prev.	0.020%	☐ Anti			Help
	-3.00 3.00	☒ Coinc.			

Adjust – AMP Detector 1 – Page 1 of 3

Adjust					X
	☐ ADC	☒ AMP	☐ HVPS		
Next	Course Gain	Fine Gain	S-fine Gain	BLR Mode	Exit
Prev.	x5	2.4880x	1.00053x	☐ Sym	Help
		1.000 3.000	0.9980 1.0020	☐ ASym	

Adjust – AMP Detector 1 – Page 2 of 3

Adjust					X
	☐ ADC	☒ AMP	☐ HVPS		
Next	PWR	Auto P/Z	Pole Zero	Preamp typ	Exit
Prev.	☐ Off	Start	2923	☐ TRP	Help
	☒ On		0 4095	☒ RC	

ATTACHMENT 22.1.10 MCA Adjust Dialog Values (cont.)

Adjust – AMP Detector 1 – Page 3 of 3

Adjust

X

ADC

AMP

HVPS

Next

Prev.

Shaping Mode

Gaussian

Triangular

Imp. Polarity

Positive

negative

Inh. Polarity

Positive

Negative

Exit

Help

Adjust – HVPS Detector 1 – Page 1 of 2

Adjust

X

ADC

AMP

HVPS

Next

Prev.

Voltage

3003v

-3.00

3.00

Status

Off

On

Ov / In Status

Clear

Overlatch

Disable

Enable

Exit

Help

Adjust – HVPS Detector 1 – Page 2 of 2

Adjust

X

ADC

AMP

HVPS

Next

Prev.

Inh. Latch

Disable

Enable

Exit

Help

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ATTACHMENT 22.1.10 MCA Adjust Dialog Values (cont.)

Adjust – ADC Detector 2 – Page 1 of 1

Adjust					X
☒ ADC	☐ AMP	☐ HVPS			
Next	Conv. Gain	Offset	LLD	ULD	Exit
Prev.	4096	0	1.00%	110.00%	Help
	256 16384	0 16256	0.0 100.0	0.0 110.00	

Adjust – AMP Detector 1 – Page 1 of 3

Adjust					X
☐ ADC	☒ AMP	☐ HVPS			
Next	Course Gain	Fine Gain	S-fine Gain	BLR Mode	Exit
Prev.	x5 ▼	2.4880x	1.00053x	☐ Sym	Help
		1.000 3.000	0.9980 1.0020	☐ ASym	

Adjust – AMP Detector 2 – Page 2 of 3

Adjust					X
☐ ADC	☒ AMP	☐ HVPS			
Next	PWR	Auto P/Z	Pole Zero	Imp. Polarity	Exit
Prev.	☐ Off	Start	2816	☒ Positive	Help
	☒ On		0 4095	☐ Negative	

Adjust – AMP Detector 2 – Page 3 of 3

Adjust					X
☐ ADC	☒ AMP	☐ HVPS			
Next	Preamp Type	Inh. Polarity	Exit		
Prev.	☐ TRP	☒ Positive	Help		
	☒ RC	☐ Negative			

ATTACHMENT 22.1.10 MCA Adjust Dialog Values (end)

Adjust – HVPS Detector 2 – Page 1 of 1

Adjust

X

ADC

AMP

•

HVPS

Next

Status

Voltage

HVPS Reset

Exit

Prev.

Off

•

On

3000.0V

Ok

Positive

•

Negative

Help

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ATTACHMENT 22.1.11

Prescribed Counting Times

Geometry	Analysis	Counting Time – sec (min.)
Empty Cave	Background - Daily analysis	2700
	Background – Weekly analysis	57600
Calibration Standard	Calibration	3600
	Calibration Check	2700
Tuna Can	Background – Daily analysis	2700
	Sample Count	2700
	Lab Control Sample	2700
Proficiency Sample	Sample Count	2700

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ATTACHMENT 22.2 Sample Tracking Form –Gamma Spectroscopy

FUSRAP Maywood Storage Site – Radiochemistry Lab Sample Tracking Form - Gamma Spectroscopy							
Date Initiated		Detector		Initials		Notebook Page #	
STF #	02-	Matrix	SOIL	RLM Review Init. / Date			
Sample	ID #	Type	Size g	Collection		Analysis Date	Atten. W/D
				Date	Time		
	62621 - 513	CAL CK	350.0	10-1-2001	12:00		NA
	010950	LCS	387.2	9-1-2001	12:00		NA
		BLANK					
1							
		DUP					
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
		DUP					
12							
13							
14							
15							
16							
17							
18							
19							
20							

Blank QC data and Calibration QC Data run daily as note below		Comments:	Init	Date
BLANK QC Date	CAL QC Date			

ATTACHMENT 22.3 GLOSSARY OF TERMS

ADC – Analog to Digital Converter – a Nuclear Instrumentation Module (NIM) capable of returning an analog pulse from an Alternating Current system to a Digital Direct Current system.

AIM - Acquisition Interface Module, a NIM that acts as a Multi-Channel Analyzer (MCA)

Calibration Standard - a NIST traceable radioactive source used for calibration and quality control of a detector

Cave – a virgin lead shield, with a single or split clamshell door, housing a detector and preamplifier

CQCSM – Contractor Quality Control System Manager

Cryostat - a Dewar and a vacuum chamber, which includes the cold-finger and detector.

Dead Time - the time span the ADC is busy processing a signal and is unable to process a new input signal

Desktop Inspector® - electronic assembly equivalent to the sum components of an ADC, HV power supply, and MCA known as NIMs

Duplicate sample – for gamma spectrometry purposes a recount of a previous sample. The sample is required to be shaken and placed into a different orientation to qualify.

FUSRAP – Formerly Utilized Sites Remedial Action Program

FWHM (Full Width Half Maximum) - the full width of a gamma-ray peak distribution measured at half the maximum peak height above the continuum (background)

FWTM (Full Width Tenth Maximum) - the full width of a gamma-ray peak distribution measured at one-tenth the maximum peak height above the continuum (background)

Geometry - the relationship (orientation) of a standard sample or source to the detector

H.V.P.S. - High Voltage Power Supply

LCSF - Laboratory Control Sample - Found value (see Standard Library LCS description in Appendix B).

LCST - Laboratory Control Sample - True value (see Standard Library LCS description in Appendix B).

LREP – Laboratory Replicate – a sample prepared in duplicate with another sample and considered to be equivalent

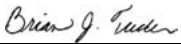
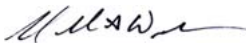
MCA – Multi Channel Analyzer – a unit capable of viewing a series of channel returns and determining the calculated area of data returned for analysis

NIMBIN/NIMRACK – a Bin or Rack containing Nuclear Instrumentation Modules

MB - Method Blank.

REG – Regular, a normal sample

UPS - Uninterruptible Power Supply

	Procedure No. SOP 622 Revision No 0 Date of Revision February 10, 2003 Last Review Date February 10, 2003 Page 1 of 29
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site	
Subject: ORTEC Gamma Spectrum Analyzer Operation	
PREPARED BY:  Radiochemistry Laboratory Mgr 02/10/03 REVIEWED BY:  Project Chemist 02/10/03	REVIEWED BY:  Project Health Physicist 02/10/03 APPROVED:  Project Manager 02/10/03

1.0 PURPOSE

- 1.1 The purpose of this procedure is to detail the operation of the Ortec – DSPEC Jr. Gamma Spectrometry System for identification and quantification of gamma-emitting radionuclides of interest to the FUSRAP Maywood Superfund Site.
- 1.2 This procedure covers normal operations performed as part of daily sample analyses of the USACE FUSRAP Maywood Radiochemistry Lab (the Lab).
- 1.3 This SOP covers operations defined as normal or daily operations and prescribes the manner in which those methods can be nominally performed.
 - 1.3.1 Special operations are to be performed as directed by the Radiochemistry Lab Manager and in accordance with the manufacturers' operation manuals.
 - 1.3.2 Technicians can learn more advanced techniques detailed in the manufacturer's operation manual and implement those methods upon successful demonstration of proficiency with the Radiochemistry Laboratory Manager.

NOTE

In this procedure, computer commands are stated in **BOLD** type. Programs are referred to in *Italicized* type. Commands to be typed in by the Technician are in quotation marks: "command".

2.0 METHOD SUMMARY AND VALIDATION

- 2.1 The system is first calibrated for energy and efficiency with a NIST traceable standard of known activity contained in a geometry that is typical of those used in the analysis of the sample.
- 2.2 A homogenous, weighed aliquot of the sample is placed into a container with an identical geometry. The sample matrix, the shape and size of the container, and the distance from the detector must all exactly match those of the calibration standard.
- 2.3 The sample is counted for a sufficient period to meet the detection limit that is required.
- 2.4 After counting, the spectrum is analyzed for the presence, identification, and quantification of any gamma-emitting radionuclide.

- 2.5 After the analysis is printed, the printout is reviewed for completeness and quality requirements acceptability.
- 2.6 This method is developed in accordance with the procedures specified in EPA Method 901.1, DOE Ga-01-R, and Manufacturer's recommendations (refer to Section 22.0 References).
 - 2.6.1 EPA Method 901.1 and DOE Ga-01-R were designed for the determination of gamma emitting radionuclides in drinking water, without separating them from the sample matrix.
 - 2.6.2 This method has been expanded to include other matrices including groundwater, soil, sludge, non-aqueous liquid, air filter, vegetation, biota and solid materials.
 - 2.6.3 The major principals in gamma spectrometry remain the same and are equally applicable to both the original and this modified method. Therefore, method validation will not be addressed.

3.0 RESPONSIBILITIES

- 3.1 Radiochemistry Laboratory Manager (RLM)
 - 3.1.1 Ensuring this procedure reflects actual operation parameters in the Laboratory.
 - 3.1.2 Annually reviewing and revising as required this procedure.
 - 3.1.3 Coordination with the Project Manager, Project Chemist, and USACE to resolve problems related to receipt and preparation of samples into the Laboratory that could prevent completion of required analysis.
 - 3.1.4 Initiation of corrective action and performance of any follow-up, as required, to ensure the quality of operation of the instrument and data produced is maintained.
 - 3.1.5 Training Laboratory personnel in the use and performance of this procedure to assure that suitable proficiency is achieved and maintained.
 - 3.1.6 Instructing Laboratory personnel in associated laboratory safety (including radiation safety), hazard communications, and hazardous waste management.
 - 3.1.7 Ensuring the control and periodic transmittal of the Lab's associated Quality Assurance (QA) records.
 - 3.1.8 Responding to and documenting of associated periodic surveillance and/or audits, in conjunction with the CQCSM and in accordance with FMSS procedures.
 - 3.1.9 Responding in a timely manner to associated audit and/or surveillance findings.
 - 3.1.10 Overseeing operation, maintenance, and calibration of the Gamma Spectrometry system and associated lab instrumentation.
 - 3.1.11 Reviewing and ensuring submittal of completed data packages and electronic data to the data users and data validation group.

3.2 Radiochemistry Laboratory Technicians (RLTs)

- 3.2.1 Performing this procedure as written.
- 3.2.2 Reporting any problems in the performance of this procedure to the RLM for immediate resolution.
- 3.2.3 Ensuring that adequate Laboratory supplies are available for daily operation in accordance with this procedure.
- 3.2.4 Developing and maintaining the associated Laboratory Quality Assurance records developed by this procedure.
- 3.2.5 Maintaining the laboratory sample database.

3.3 QA Officer

- 3.3.1 Ensuring the Quality Control requirements set for the analysis of samples and operation of the gamma spectroscopy system at FMSS is maintained.
- 3.3.2 Performing routine scheduled and unscheduled audits of the Lab in the performance of this procedure and the maintenance of the required Quality Control Records.
- 3.3.3 Documenting periodic surveillances and/or audits associated with this procedure in conjunction with the CQCSM and in accordance with FMSS procedures.
- 3.3.4 Providing technical assistance to the staff of the Radiochemistry Laboratory.

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4.0 SAFETY PRECAUTIONS

WARNING

This procedure employs the use of Liquid Nitrogen (LN_2) a cryogenic gas. Cryogenic gases are at extremely cold temperatures ($\text{LN}_2 = -195.8^\circ\text{C}$). Human tissue will freeze immediately upon contact with the liquid. DO NOT open LN dispensing valves, touch hoses, or work near the area of LN dispensing without the proper Personal Protective Equipment (PPE) consisting of at a minimum, cryogenic gloves and a full-face shield.

- 4.1 Use extreme caution when handling Liquid Nitrogen (LN_2) or contacting surfaces cooled by LN_2 .
 - 4.1.1 Nitrogen is a colorless, odorless, tasteless gas, which acts as a simple asphyxiant
 - 4.1.2 Liquid Nitrogen because of its low temperature (-210°C) causes severe frost burn damage to tissues.
 - 4.1.3 Avoid skin contact with Liquid Nitrogen (LN_2) or surfaces cooled by LN_2 to avoid frostbite.
 - 4.1.4 Always use proper eye and skin protection when handling LN_2 or surfaces cooled by LN_2 .
 - 4.1.5 Ensure adequate ventilation is maintained when handling LN_2 .
- 4.2 DO NOT perform inspections or diagnostics on an electrically energized system.
 - 4.2.1 The electronics of the detector system operates under High Voltage conditions.
 - 4.2.2 Approximately 3000 volts of DC current is applied to the detector.
 - 4.2.3 The power is carried to the detector from the DSPEC unit.
 - 4.2.4 Ensure the High Voltage is OFF prior to making changes or inspecting the wiring associated with the detector.
- 4.3 High Voltage is NOT to 'ON' during overnight periods of non-use.
 - 4.3.1 The inability of the Lab personnel to respond to eccentric changes in line voltage and the potential for damage to the instrument require this step.
 - 4.3.2 Turn OFF the HV at the end of the counting day.

5.0 INTERFERENCES

- 5.1 Dead times greater than 15% reduce the effectiveness of the sample count, increase total counting time, and may result in an error in the calculation of the activity of the sample.
 - 5.1.1 High activity samples are the cause of high dead time.
 - 5.1.2 To lower the dead time perform one or more of the following:
 - 5.1.3 Reduce the size of the sample aliquot
 - 5.1.4 Increasing the distance from the detector
 - 5.1.5 Change the geometry of the sample
 - 5.1.6 Add shielding between the detector and the sample container.
- 5.2 These changes must be reflected by corresponding changes in the calibration standards or by applying an approved correction factor.
- 5.3 Metals, such as lead, strongly attenuate gamma rays, even when present in solution, leading to inaccurate results.
 - 5.3.1 Attenuation corrections must be applied to those samples such as soils where the characterization of the soil has been determined.
 - 5.3.2 Solid samples that have been digested may require dilution.

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6.0 APPARATUS AND MATERIALS

- 6.1 Digital Gamma Ray Spectrometer – DSPEC jr TM, and associated cabling; Advanced Measurement Technologies, a/k/a: AMETEK or ORTEC.
- 6.2 HPGe detector- Closed-end Coaxial, P- type, 2.0 keV resolution @ 1332 keV, Canberra Industries.
- 6.3 Cryostat; 30L LN₂, Canberra Industries.
- 6.4 Preamplifier –low noise, high speed FET, AMETEK.
- 6.5 Low Background Virgin Lead Shield with clamshell top, Approximately 24” x 18” cylindrical with 4” thick lead shield and Aluminum and Copper liner; Canberra Industries.
- 6.6 LN₂ Transfer Hose approximately 8 feet long, Canberra Industries.
- 6.7 Uninterruptible Power Supply – 55 min load protection, 570 W, 120V.
- 6.8 Personal Computer, minimum specifications: Pentium 4, 1.4 MHz, 256 MB SDRAM, with USB interface, and associated cables and electrical wiring.
- 6.9 Computer Monitor, 17”, LCD; Dell or equivalent.
- 6.10 Printer, Laser Jet or Bubble Jet.
- 6.11 USB Hub Port, and associated cables and wiring.
- 6.12 Software- May be updated to the most current version as required by manufacturer for support purposes.
 - 6.12.1 Gamma Vision® - 32, HPGe Gamma Ray Spectrum Analysis and MCA Emulation, Ver. 5.34; OTREC
 - 6.12.2 Gamma Vision® - Report Writer, Ver. 2.03, ORTEC
 - 6.12.3 Windows 98® or Windows 2000®
 - 6.12.4 Microsoft Excel® 97
 - 6.12.5 Microsoft Word® 97
 - 6.12.6 Microsoft Access® 97

7.0 REAGENTS AND STANDARDS

- 7.1 Liquid Nitrogen, commercial grade.
- 7.2 Mixed Gamma calibration standard - 60 to 1800 keV, NIST traceable; soil density (1.6), consisting of Co57, Co60, Y88, Cd109, Sn113, Cs137, Ce139, Hg203, and Am241 to a total activity 2-3 μCi , contained in a tuna can (230 mL) geometry, Analytics, Inc
- 7.3 Mixed Gamma calibration standard - 60 to 1800 keV, NIST traceable; water density (1.0), consisting of Co57, Co60, Y88, Cd109, Sn113, Cs137, Ce139, Hg203, and Am241 to a total activity 2-3 μCi , contained in a tuna can (230 mL) geometry, Analytics, Inc.
- 7.4 Lab Control Standard; Mixed gamma, with Isotopes of Concern (IOCs), Pb214, Ac228, and Th234, in relative ratio to sample activities measured, approximately 1 –2 pCi/g, developed at a density compatible with sample analysis, and contained in a tuna can (230 mL) geometry.

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8.0 SAMPLE PRESERVATION AND STORAGE

- 8.1 Soil samples to be analyzed by gamma spectroscopy require NO preservation.
- 8.2 Aqueous samples should be preserved within 5 days of collection for all determinative methods, preferably to a pH of 2.0 with Nitric Acid..
- 8.3 Samples must be stored and handled in such a manner that they will not become contaminated by, nor will they contaminate other samples or standards.
 - 8.3.1 The samples may be hazardous and the radioactive activity levels should have been pre-screened prior to sample prep.
 - 8.3.2 Treat samples with higher levels of activity with special precaution.

NOTE

Samples are identified by Radiation Protection personnel with a 2"x2" NaI rate meter reading. Readings greater than 20000 cpm (20K) are to be considered a high-level activity.

- 8.4 Homogeneity of the sample is crucial to accurate results.

NOTE

If Step 8.4 is inadequate, the sample aliquot will not be representative of the bulk sample and ALL subsequent work will be unreliable.

- 8.4.1 ALL samples must be thoroughly mixed.
- 8.4.2 Solid samples must be completely crushed, pulverized, homogenized, and evenly split to an appropriate aliquot.
- 8.4.3 Review SOP 641, Receipt and Preparation of Soil Samples for Analysis by Gamma Spectroscopy and any other applicable SOP for the particular details of the sample preparation procedure for each of these matrices, OR refer to Rad Lab supervision.
- 8.5 Dust is a perennial problem when dealing with pulverized samples and it may be particularly hazardous with samples that are highly siliceous and/or contain anomalous levels of radiogenic materials.
 - 8.5.1 Nominally samples that are analyzed by Gamma Spectroscopy are in sealed cans and therefore the loss of dust to the air is eliminated.
 - 8.5.2 Dust in the processing of the sample may be inadvertently transported to the exterior surfaces of sample containers present in the prep area.
 - 8.5.3 A smear survey of sample containers may be performed prior to removal from the prep area.

- 8.5.4 If the container is contaminated and cannot be decontaminated sufficiently, considerations are to be made as to whether to place a sample container in a plastic bag prior to analysis on the detector.

NOTE

Calibration standards are supplied from the vendor in site-specific sample containers. These containers are NOT sealed, but are ONLY taped shut. Calibration Standards of this type are always maintained in a plastic bag to prevent loss and contamination.

- 8.5.5 A visual inspection of the sample or calibration standard or check source shall be performed prior to use for leakage and geometry control.
- 8.5.6 Samples or Lab Control Standards that have containers that exhibit problems may be transferred to another container.
- 8.5.7 Calibration standards are to be placed into a plastic bag and transferred to the Company of Origin for reconfiguration and Certification.

9.0 HOLDING TIMES

- 9.1 Analysis can be performed anytime within a year unless stated otherwise by regulation or client requirements.
- 9.1.1 Concern must be weighed for samples containing short-lived isotopes.
- 9.1.2 ALL IOCs should be counted prior to 4 half-lives ($t_{1/2}$) of the most limiting isotope.
- 9.1.3 Decay correction of the sample is performed up to 12 $t_{1/2}$ by the Gamma Spectrometry analysis program.
- 9.1.4 For quality purposes 4 $t_{1/2}$ is at least 6.25% of the original activity and can be recounted for accurate results.

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10.0 OPERATING CONDITIONS

10.1 Set-Up the System

NOTE

Initial setup shall be performed by a qualified individual as indicated by the Radiochemistry Laboratory Manager or a person under the direct supervision of that individual. The steps described in this Section are generalized and not intended to be a detailed account of operating the system.

- 10.1.1 Place the Lead Shield (Cave) in a position of stability and ease of access in the counting room.
- 10.1.2 Level the cave.
- 10.1.3 Place the detector Dewar in a level position under the cave.
- 10.1.4 Remove the HPGe detector and Preamplifier/cryostat finger unit from its shipping container.

NOTE

HPGe crystals may be warmed to room temperature and subsequently re-cooled. These cycles shall be minimized to extend the life of the crystals.

- 10.1.5 Install the cryostat finger into the Dewar.
- 10.1.6 Position the detector within the cave such that the detector preamp is positioned below the cave opening.
- 10.1.7 Tighten the setscrews on the Dewar ring to secure the cryostat finger.
- 10.1.8 Fill the Dewar with LN per the following Section, Filling the Dewar with Liquid Nitrogen (LN or LN₂)
- 10.1.9 Complete the electrical connections between the preamp and the DSPEC unit.
- 10.1.10 Complete the electrical connections between the DSPEC and USB Hub Port.
- 10.1.11 Complete the electrical connections between the USB Hub Port and the Gamma Spec Computer (the computer).
- 10.1.12 Plug the DSPEC units and computer into a designated UPS.
- 10.1.13 Complete the wiring connections between the Monitor, Keyboard, and Mouse and the computer.
- 10.1.14 Turn on the computer.
- 10.1.15 Install as necessary the Gamma Vision-32 operating system program per the Manufacturer's requirements.
- 10.1.16 Allow the Dewar and crystal to sit for at least 12 hours without energizing the system.
- 10.1.17 Refill the Dewar after 12 hours.

10.2 Filling the Dewar with Liquid Nitrogen (LN or LN₂).

WARNING

This procedure employs the use of Liquid Nitrogen (LN₂) a cryogenic gas. Cryogenic gases are at extremely cold temperatures (LN₂ = -195.8°C). Human tissue will freeze immediately upon contact with the liquid. DO NOT open LN dispensing valves, touch hoses, or work near the area of LN dispensing without the proper Personal Protective Equipment (PPE).

- 10.2.1 Notify other personnel in the Lab and area of the Dewars that Liquid Nitrogen transfer is to be performed.
- 10.2.2 Place the LN Transfer hose onto the fill port of the Dewar collar.
- 10.2.3 Open the LN discharge valve greater than one-quarter of full turn, but no more than one-half of full turn.

CAUTION

The opening of the Liquid Nitrogen cylinder discharge valve can result in the immediate freezing of water vapor from the atmosphere present at the valve. This freezing of the water vapor can result in the valve retaining an ice plug. The ice plug can prevent the valve from reseating when being closed. This is minimized by immediately opening the valve greater than one-quarter turn full open.

- 10.2.4 Throttle the discharge valve as necessary to reduce violent sputtering of the LN.

NOTE

The initial release from the cylinder will be a mixture of liquid and saturated vapor. A distinct, audible change will occur in the discharge as the mixture turns to primarily liquid. There is also an audible change noted as the Dewar fills with liquid. Experience will guide the technician in preventing overfill of the Dewar.

- 10.2.5 Slowly open the discharge valve as liquid is added to the Dewar.
- 10.2.6 Observe and listen to the discharge into the Dewar.
- 10.2.7 When the Dewar is full, Close the LN discharge valve.
- 10.2.8 Remove the dispensing hose from the Dewar slowly allowing LN to drain from the hose as it is removed.
- 10.2.9 Place the dispensing line down in a safe manner in its prescribed retention spot.

10.3 Initial Set-Up for Detector Operation.

- 10.3.1 Turn on the computer and monitor.
- 10.3.2 Press the **On/Off** button on the DSPEC.
- 10.3.3 Press the **Light** (a pictogram light bulb) button on the DSPEC.
- 10.3.4 Click on **Start** on the Windows taskbar.
- 10.3.5 Select Programs, *GammaVision 32*, and *GammaVision*.
- 10.3.6 Alternatively double click on the *GammaVision* icon on the Windows Desktop.
- 10.3.7 Select the Detector 1, **1 MCB 129**, or Detector 2, **2 MCB 130**, by clicking on the pull-down window on the right hand side of the toolbar.
- 10.3.8 Place the appropriate calibration source in the detector well.
- 10.3.9 Click on **File**.
- 10.3.10 Click on **Settings**.
- 10.3.11 Select the **Integer.Spc**, Save File Format.
- 10.3.12 Type in the Sample Description Box "DET "X" CAL CHK "DATE in MMDDYY format" and the Calibration Source ID number.
- 10.3.13 Type in the Sample Quantity Box "the Assayed weight of the Calibration Source".
- 10.3.14 Type in the Collection Date and Time Boxes "the Assayed Date of the Calibration Source".
- 10.3.15 Click on **Acquire** and **MCB Properties**.
- 10.3.16 Select the Tab - **ADC**.
- 10.3.17 Set the **Conversion Gain** to the spectrum channel factor required by the Radiochemistry Lab Manager.

NOTE

Typically the system is set to 8192 to provide a gain of 0.25 keV/ch.

- 10.3.18 Select the Tab – **High Voltage (HV)**.
- 10.3.19 Set the **Target** voltage to the setting recommended by the Detector Manufacturer.
- 10.3.20 Set the **Shutdown** to (ORTEC).
- 10.3.21 Set the **Polarity** to (+).
- 10.3.22 Click **On**.
- 10.3.23 Observe the **HV** readout on the DSPEC.
- 10.3.24 IF the HV rises to approximately the setting made for the Detector, Proceed with Detector operation.
- 10.3.25 IF the HV does NOT rise or exceeds the setting made, Click the HV **Off** and check all connections with Rad Lab Supervision.

11.0 PROCEDURE

11.1 Energy Calibration

NOTE

This operation is to be performed under the direction of the RLM.

Perform the energy calibration ONLY in conjunction with an Efficiency Calibration.

Acquisition time must be enough to obtain a minimum on 10000 counts in the least activity nuclide of the calibration source.

- 11.1.1 Start the acquisition of a Spectrum per the requirements of Section 11.6, Simple Sample Analysis..
- 11.1.2 Enter the weight, mass, or size of the calibration standard sample as recorded on the Certificate of Assay.
- 11.1.3 Enter the calibration standard collection date (MM: DD: YY) and time (HH: MM: SS)
- 11.1.4 Click on **OK**.
- 11.1.5 Allow the spectrum to acquire.
- 11.1.6 Upon completion of the spectrum acquisition, Click on **Calibrate**.
- 11.1.7 Click on **Energy** to open the Energy Calibration windows.
- 11.1.8 If a Energy Table appears, Click on the **Flag** to drop down the menu and Click **Destroy** to delete the table from acting upon this operation
- 11.1.9 Move the Calibration window to the side to allow full viewing of the spectrum.
- 11.1.10 Using the **Peak** button on the Calibrate window, Move the cursor line to the upper most energy peak (Y-88 at 1836.01 keV).
- 11.1.11 Click on **E =** in the Calibration window.
- 11.1.12 Enter the energy for the peak as designated by the Calibration Library.

NOTE

Use of the energy line value from the Certificate of Assay may be slightly different than values identified for use at Maywood.

- 11.1.13 Click **Enter**.

- 11.1.14 Repeat the previous Steps for each major energy line in the spectrum as identified on the Certificate of Assay.

NOTE

There are nominally 12 energy lines from 59.45 to 1836.01 keV in the mixed gamma standard used at FMSS.

- 11.1.15 Upon completion, Click on the **Flag** in the Calibration window to drop the menu.
- 11.1.16 Select **Graph**.
- 11.1.17 Observe the shape of the Graph, it should be a straight line from a zero axis point.
- 11.1.18 Observe the values of the Delta's in the Energy Table.
- 11.1.19 If the Graph is not linear in appearance, or the Delta's exceed $\pm 0.5\%$, contact Rad Lab Supervision for guidance.
- 11.1.20 If the requirements are acceptable, Click on **Save** to save the Energy Calibration window.
- 11.1.21 When prompted, Save the File in the appropriate Calibration Folder, under the Detector number, as "DET "X" "YYYY" CAL MMDDYY.ent". Where "X" is the Detector number, "YYY" is the Calibration Source ID number, MMDDYY is the Month Date and Year of the Energy Calibration, and ".ent" is the computer suffix identifying an energy calibration.
- 11.1.22 Close the Calibration Window.

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11.2 Efficiency Calibration

NOTE

This operation is to be performed under the direction of the RLM.

- 11.2.1 Select **Calibrate** from the Menu Bar.
- 11.2.2 Select **Efficiency** to open the Efficiency Calibration windows.
- 11.2.3 If a Efficiency Table appears, Click on the **Flag** to drop down the menu and Click **Destroy** to delete the table from acting upon this operation
- 11.2.4 Using the **Peak** button on the Calibrate window, Move the cursor line to the lower most energy peak (Am-241 at 59.45 keV).

NOTE

The energy shown in the “at ____ keV” window does not need to match the energy identified in the Certificate of Assay for the isotope. The energy should be within 0.5 keV of the isotopes designated decay energy.

- 11.2.5 Click **Calc** on the Calibration window to open the Efficiency Calculation Worksheet.
- 11.2.6 Click **From Library** in the Nuclide portion of the Efficiency Calculation Worksheet.
- 11.2.7 Verify that the Worksheet has clearly identified the peak as Am241 and that the Half-Life (in days) and Gamma/100 d % (GPS) corresponds to the values identified on the Certificate of Assay, COA.
- 11.2.8 Enter the Activity of the Calibration Source for the identified nuclide at the noted energy as stated on the COA.
- 11.2.9 Select **GPS**, **μCi**, or **Bq** for the activity as identified by the COA.

NOTE

If necessary refer to the RLM for the GPS for the isotope at the given energy.

- 11.2.10 Enter the **Uncertainty** as identified on the COA.
- 11.2.11 Enter the **Date** and **Time** of the Assay as identified on the COA.
- 11.2.12 Click **Calculate Efficiency** and observe the number to be a power of E –002 or –003.
- 11.2.13 Click **OK**.

- 11.2.14 Repeat the previous steps for each peak identified on the COA.
- 11.2.15 Click on the **Flag** on the Calibration window to display the efficiency graph.
- 11.2.16 In the **Mode** section of the Calibration window, Select an appropriate curve calculation method for the points.

NOTE

The Fitting Modes require a minimum number of points per type used. Linear mode requires 2 points. Quadratic requires three points and Polynomial requires five points.

- 11.2.17 Observe the results of the **Fit** and the **Delta** values obtained from the curve calculation fit.
- 11.2.18 If **Linear** or **Quadratic** is chosen, Then Click on **Knee** to open the Knee window.
- 11.2.19 Select an appropriate value for the **Knee** between 145 keV and 170 keV.
- 11.2.20 Change the **Fit** used or the position of the **Knee** to obtain the best possible Fit with the smallest ranges and with a **Delta** less than $\pm 0.500\%$.

NOTE

Personnel learning to perform this function shall refer to Lab Supervision for approval of the **Fit**, **Delta**, and **Knee** value finally determined for use.

- 11.2.21 If the requirements are acceptable, Click on **Save** to save the Efficiency Calibration window.
- 11.2.22 When prompted, Save the File in the appropriate Calibration Folder, under the Detector number, as "DET "X" "YYYY" CAL MMDDYY.eft". Where "X" is the Detector number, "YYY" is the Calibration Source ID number, MMDDYY is the Month Date and Year of the Energy Calibration, and ".eft" is the computer suffix identifying an efficiency calibration.
- 11.2.23 Close the Calibration Window.

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11.3 Creating a Calibration.

- 11.3.1 Click on **Calibrate** and **Save Calibration**.
- 11.3.2 As prompted, Select the Energy Calibration and Efficiency Calibration files to be used as the full calibration.
- 11.3.3 When prompted, Save the File in the appropriate Calibration Folder, under the Detector number, as “DET “X” “YYYY” CAL MMDDYY.clb”. Where “X” is the Detector number, “YYY” is the Calibration Source ID number, MMDDYY is the Month Date and Year of the Energy Calibration, and “.clb” is the computer suffix identifying the calibration.
- 11.3.4 Close the Calibration Window.
- 11.3.5 Ensure the new calibration file is identified in the operating **Sample Description Files** for the detector.

11.4 Library Selection

NOTE

Libraries are predetermined based on requirements for the sample being analyzed or on the client analysis requirements. Job Batches are preset with the nominal library for the Calibration of the detector (Calib.lib), for typical isotopes of interest for natural uranium and thorium decay schemes found in the soil analyzed (Maywood.lib), or for Barium tracer analysis of samples (BaTrace.lib). Refer questions regarding changing libraries to Rad Lab Manager.

- 11.4.1 From the Menu Bar, Click on **Library**.
- 11.4.2 Click on **Select File**.
- 11.4.3 Select the Library of interest by clicking the file name to highlight the file.
- 11.4.4 Click on **Open**.

NOTE

The Library chosen is now resident in the computer operating memory and can be referred to for information. This does not replace the Library identified in any **Job File**.

11.5 Normal Sample Analysis Using the **Job File**.

NOTE

Normal Sample Analysis includes running Blanks, Cal Checks, Weekly Background, and Regular Samples.

- 11.5.1 Enter the sample information on the appropriate STF form, Attachment 2, Example STF.
- 11.5.2 As needed, Place the sample in a plastic bag.
- 11.5.3 Place the sample in the cave with the top of the tuna can against the detector and Close the cave.
- 11.5.4 Select the **Detector**.

NOTE

Detectors are normally operated from separate **GammaVision** windows on the computer. If Only one **GammaVision** window is open and neither detector is in use in that window, then select the detector to be used.

- 11.5.5 Select **Services** then **Job Files**.
- 11.5.6 Select the appropriate **Job File** listed in the Run Jobs File window for the task to be performed.

NOTE

Job Files are designated by Detector and Task to be performed, such as DET 1 Soil Analysis or DET 2 CAL.

- 11.5.7 As prompted, Enter the **Sample Description**, **Sample Weight**, and **Sample Collection** (Date and Time).
- 11.5.8 When prompted for File Save As, Click on **Browse** and Select the File Folder for the sample data files.
- 11.5.9 Enter the Sample Identification Number as the file name and use the “.Spc” file extension, Then Click **OK** to start the sample analysis.

NOTE

Samples are saved in the STF sub-folder being used. IF a folder does not exist create the sub-folder under the STF folder. The final file save will appear by example as follows: “C:/STF/03-011/03-0001.Spc”, where 03-011 is the STF the sample is being analyzed under and 03-0001 is the Lab Sample ID number.

- 11.5.10 Upon completion of the analysis reporting, Review the reported data.

11.6 Simple Sample Analysis

CAUTION

Simple Sample Analysis is used for start-up operations or for unique sample analysis as requested by the RLM. It should not be performed outside the realm of normal QC parameters and QC counting. Perform this method **ONLY** as directed by the Radiochemistry Laboratory Manager.

- 11.6.1 Enter the sample information on the appropriate STF form.
- 11.6.2 As needed, Place the sample in a plastic bag.
- 11.6.3 Place the sample in the cave with the top of the tuna can against the detector and Close the cave.
- 11.6.4 Select the **Detector** to be used.
- 11.6.5 Click on **File**, and **Settings** and ensure the following are entered.
 - 11.6.5.1 Select **Save File Format – Integer.Spc**.
 - 11.6.5.2 Select **Sample Description** and enter the Sample Description.
 - 11.6.5.3 Select **Sample Quantity** and enter the sample quantity.
 - 11.6.5.4 Select **Collection** and enter the Collection Date and Time
- 11.6.6 Click on **Acquire** and **Acquisition Presets** and verify the correct acquisition time is set.
- 11.6.7 Click on **Acquire** and **Go** icon.
- 11.6.8 Observe the reported **Dead Time** of the acquisition.
- 11.6.9 If the **Dead Time** exceeds 15% but less than 50%, Refer this information to Rad Lab Supervision for directions on how to proceed.
- 11.6.10 If the **Dead Time** exceeds 50%, Stop the acquisition by Clicking on the **Stop** icon AND Refer this information to Rad Lab Supervision for directions on how to proceed.
- 11.6.11 Upon completion of spectrum acquisition, Click on the *Save* icon.
- 11.6.12 Save the spectrum to the appropriate file folder.

NOTE

Data and spectrum files created will be saved in the root directory as detailed in the **GammaVision File Directories**.

- 11.6.13 From the toolbar, Select **Analyze**.
- 11.6.14 From the pull-down menu, Select **Entire spectrum in memory**.
- 11.6.15 Review the data reported upon completion of reporting.

11.7 Recalling a Spectrum.

NOTE

A spectrum can be recalled and analyzed at any time, even during data acquisition.

- 11.7.1 Change the data source to the data buffer (Buffer).
- 11.7.2 Click on the **Erase Buffer** icon on the toolbar, OR Select **A**cquire, and then **C**lear from the Menu Task Bar.
- 11.7.3 Determine the spectrum file to be retrieved.
- 11.7.4 On the menu bar, Click on **F**ile.
- 11.7.5 Click on **R**ecall.
- 11.7.6 Select the file folder that contains the file of interest by clicking on the pull-down window on the Recall Spectrum File window toolbar.
- 11.7.7 Highlight the appropriate file and Click on **O**pen.

11.8 Analyzing a Spectrum displayed in the Buffer

CAUTION

Refer to the RLM prior to performing this function. Analyzing an existing file will replace the “.An1” that currently exists. If the file is REQUIRED to be maintained for QC purposes, rename and save the file prior and then reanalyze the newly renamed file.

- 11.8.1 Select the **Buffer** from the Detector window.
- 11.8.2 Open the file to be reanalyzed.
- 11.8.3 Select the appropriate Library and Calibration files to be used.
- 11.8.4 Open the Analysis Settings window and ensure the select library and calibration files are identified.
- 11.8.5 Save the Analysis Sequence File information, but DO NOT save the file with the Detector.
- 11.8.6 Select **A**nalyze, then **E**ntire Spectrum in Memory.
- 11.8.7 Review the data reported upon completion of reporting.

11.9 Creating the Peak Background Correction File.

- 11.9.1 Ensure the Detector Cave is empty, and Close the Cave.
- 11.9.2 Run the **Job File** for Weekly Background on the Detector.
- 11.9.3 Upon completion of the Background Analysis Reporting, Review the report.
- 11.9.4 Upon acceptance of the data, Click on **Analyze, Settings, Peak Background Correction, Select File**.
- 11.9.5 Select the **PBC File** to be changed, and Click **Open**.
- 11.9.6 Click on **Analyze, Settings, Peak Background Correction, Select File, Edit PBC**.
- 11.9.7 In the Edit DET "X" Wkly Bkgd window, **Cut** the existing isotopes from the PBC Table.
- 11.9.8 Click on the **Flag** and **Show Analysis**.
- 11.9.9 Select the current Weekly Background File for the Detector from the Load Analysis Results window.
- 11.9.10 Click on the **Flag** in the new Bkgd File window, and Select **Copy all to PBC**.
- 11.9.11 Close the Bkgd File window.
- 11.9.12 Click on the **Flag** in the Edit PBS window, and Select **Save As**.
- 11.9.13 Save the file as "DET 'X' WKLY BKGD.pbc".
- 11.9.14 Accept the prompt to replace the existing file.
- 11.9.15 Close the Edit PBC window.

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12.0 QUALITY CONTROL

- 12.1 Calibrate the system with an NIST traceable multi-line calibration standard yearly $\pm$ 30 days.
- 12.2 Perform a multi-line primary calibration standard check analysis as required herein:
 - Daily
 - At the start of the analysis of a Batch (STF)
- 12.3 Analyze background weekly, AND whenever radiation levels change significantly.
- 12.4 Count a Lab Control Sample (LCS) at the beginning of a Batch to verify accuracy.

NOTE

The LCS may be freshly prepared, but is generally a previously spiked sample from an external performance evaluation where sample results are recorded and known.

- 12.4.1 Use the designated Lab Control Samples identified by the Radiochemistry Lab Manager. per Section 7.0, Step 7.4..
- 12.5 Perform a daily background check prior to counting ANY samples.
- 12.6 Count a Method Blank at the beginning of each Batch to check for sample cross-contamination from the sample preparation process.
- 12.7 Count samples to meet the clients MDA or to a minimum of 0.02 pCi/unit (liter/air filter/etc.).
- 12.8 Analyze a Replicate (Duplicate) sample at a 10% interval in the Batch.

NOTE

A Lab Replicate (LREP) pair are two aliquots taken from one sample. Generally, the sample volume is sufficient to allow for two aliquots. When there is insufficient volume, the sample may be recounted provided the sample is removed from the detector, shaken, and then reoriented on the detector prior to recounting. This recount is called an Instrument Replicate as opposed to the LREP. For an Instrument Replicate recount, the sample is generally turned at least one-quarter turn.

- 12.9 Proficiency samples shall be counted at least annually to verify the method and process by analysis of an independent blind sample.
- 12.10 Analysis of at least two known samples shall be performed immediately after instrument initial set-up or method changes to verify and demonstrate the capability of the method.
- 12.11 Verify counting times are identical for ALL samples within a given geometry and method, including QC samples.
- 12.12 The RLM is to review analysis data for the results of Energy calibration normalized difference, noted data outside FWHM but within FW25M, bad peak shape, points beyond 12 half-lives, peak centroids outside of library centroids, and unresolved multiplets.

13.0 REPORTING LIMITS

- 13.1 Minimum Detectable Activity is based on the requirements of the client, site, and/or regulatory requirements and should be at the maximum 10% of the data quality objective.
- 13.2 Report values of an MDA that exceed stated requirements to Rad Lab supervision.

14.0 QUALITATIVE IDENTIFICATION INFORMATION

- 14.1 Sample data is identified by the energy lines, determined gamma per seconds, and yield associated with an identified Radionuclide.
- 14.1.1 This data is normally drawn from the library information supplied by ORTEC in the GammaVision program.
- 14.1.2 The Radiochemistry Lab Manager may use an alternate source such as the Idaho National Laboratory Gamma Spectrum Catalog as deemed appropriate.
- 14.1.3 The RLM or QA Officer shall approve changes to the Library or the use of outside data sources.
- 14.2 Data qualitative acceptance criteria are identified in SOP 601 – Internal Data Evaluation.

15.0 DATA REVIEW

- 15.1 Review the first Section of the Report for the following:
- Spectrum Filename - should mimic sample information
 - Acquisition Information - Dead time <15%
 - Calibration – the current calibration in use for that detector
 - Library - matches with client information of sample or with method of analysis (Maywood.Lib / Cal.Lib)

NOTE

Two libraries are used in the application of the WAN32 analysis program. These are the primary library discussed above and the Suspect or “Unidentified” nuclide library. The primary library is site specific. The Suspect library is generic yet specific to naturally occurring decay schemes and to major fission fragments.

- Analysis Parameters - Activity scaling factor equivalent to one divided by sample size
 - Corrections - Sample should NOT be decay corrected and the peak Background Correction (.Pbc) has been applied if a soil sample is analyzed
 - Energy calibration normalized difference - ≤ 0.400 (Any value greater than this number to be reviewed by the RLM for determination of data acceptance)
- 15.2 Review the Unidentified Peaks for Energies of Concern and counts in the peaks identified.
- 15.2.1 IF significant activity is identified in an Unidentified Peak, report the finding to the RLM.

15.3 Review the Identified Peak Summary.

- 15.3.1 Verify the peaks of the Isotopes of Concern have been identified.
- 15.3.2 Verify the Key Energy Lines are identified and contain measurable counts (either positive or negative).
- 15.3.3 Verify the Key Energy lines are identified within ± 0.5 keV.
- 15.3.4 Verify the FWHM stated is within the range of values of normal operation, ranging from 0.8 at 122 keV to 1.8 at 1332 keV.
- 15.3.5 Note any Key Line energies identified by a suffixed "s" or "D".
- 15.3.6 Review the Summary of Library Peak Usage.
- 15.3.7 Verify the Key Line Energies are used in the calculation of Isotope Average Activity.

15.4 Review the Summary of Radionuclides In Sample

- 15.4.1 Verify that all Isotopes of Concern are identified with a positive or negative result.
- 15.4.2 Examine the 2σ errors and reported MDA.
- 15.4.3 Report ANY concerns in data developed to Rad Lab Supervision.

15.5 Verify results are within quality control limits for operation in accordance with SOP 601 – Internal Data Review.

15.6 Notify Rad Lab supervision, WHEN data fails quality control requirements, OR data appears to be suspect.

16.0 **RECORDS**

- 16.1 Summary of sample analyses, arranged in increasing order of sample number.
- 16.2 If necessary, a case narrative briefly describing the sample preparation and analysis, problems encountered and corrective action taken during the process of sample preparation and analysis.
- 16.3 If requested, a summary of QC sample analyses.
- 16.4 If requested, a flagging of reported values in accordance with EPA or USACE flagging requirements.

17.0 **PREVENTIVE MAINTENANCE**

- 17.1 Fill Dewars at least once a week to maintain cooling.
- 17.2 Clean inside of shielded counting chamber by wiping with a damp cloth followed by a wipe down with a dry cloth at least once a month.
- 17.3 Visually inspect the detector end-cap for damage.
- 17.4 Maintain clean and safe electrical wiring and connections.
- 17.5 Track the detector's operation (FWHM, normalization of energy fit, background, etc.) to detect problems such as gain shift or resolution or efficiency fluctuations are observed.

18.0 POLLUTION PREVENTION

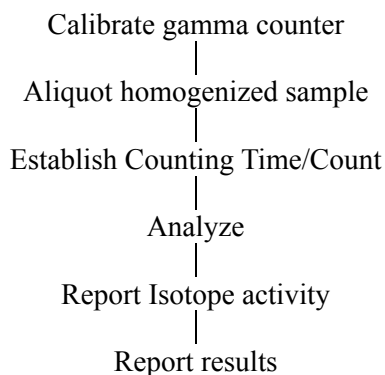
- 18.1 ALL steps possible and practical shall be taken to ensure the requirements of local, state, and federal regulatory agencies are met when disposing of wastes to the local environment.
- 18.2 ALL waste products should be characterized to identify the chemical(s) inherent in the waste, volume produced during analysis, and disposal pathway.
- 18.3 Liquid wastes, disposed of by way of the lab drainage system, shall NEVER be disposed of in quantities OR contain material(s) that cannot be handled by the local sewage treatment system.
 - 18.3.1 Waste disposed should be pretreated as necessary prior to disposal to a condition that can be handled by the local sewage treatment system (e.g. neutralization of acids or bases).
 - 18.3.2 ALL wastes that CANNOT be handled by the local sewage system shall be contained and disposed of through proper waste disposal techniques and with waste brokers licensed to handle such wastes.

19.0 WASTE MANAGEMENT

- 19.1 ALL wastes are to be handled in the proper manner.
- 19.2 Exercise care during the performance of the method to ensure the production of waste is minimized.
- 19.3 ALL waste is to be disposed of in the proper designated container.
- 19.4 Wastes may be collected and stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient, for treatment prior to disposal, or for disposal.
- 19.5 ALL waste is to be deemed to contain radioactive material, AND is to be handled accordingly, UNTIL tested and released as prescribed by the lab release limits.
- 19.6 ALL waste is to be tested AND treated prior to disposal, OR properly packaged and stored for return to the originator.
- 19.7 Waste may be stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient.
 - 19.7.1 Unused sample volumes should be retained AND returned to the client when possible for disposal. The decision logic for project sample disposal is detailed in Lab SOP 612.
 - 19.7.2 Unused samples that are not returned SHALL be treated and/or disposed of properly.
- 19.8 Empty containers are to be rinsed AND/OR treated to ensure they are acceptable for disposal.
 - 19.8.1 Containers that CANNOT be treated are to be retained for disposal.
- 19.9 Used PPE is to be checked for contamination prior to normal lab disposal.
- 19.10 PPE used in the preparation or handling of known source material is to be disposed of as radioactive waste.

20.0 METHOD FLOW CHART

20.1



21.0 REFERENCES

- 21.1 Gamma Vision-32 Gamma-Ray Spectrum Analysis and MCA Emulator for Microsoft Windows 95/98 and Windows NT A66-B32 Software User's Manual.
- 21.2 *Gamma Emitting Radionuclides*, Method 901.1, Prescribed Procedures for the Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980, Environmental Monitoring and Support Laboratory, U. S. EPA.
- 21.3 *Gamma Emitting Radionuclides*, Method 7120, Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, American Public Health Association.
- 21.4 HASL 300, EML Procedures Manual, 28th Ed., Environmental Measurements Lab., U.S. Department of Energy.

22.0 ATTACHMENTS

Attachment 1 ANALYSIS SETTINGS REQUIREMENTS

The following List identifies the operational settings of several of the tabs found in format windows of the program. These are provided for baseline reference and may be varied at the discretion of the Radiochemistry Laboratory Manager. This list does not include file names, count times, or settings that are particular to a given analysis method

Analysis Options Window - Command Path: *Analyze/Settings/Sample Type*

Sample tab:

Analysis Range - Form **160 To 8144**
Random Summing 0 •
Background Type – **Auto**
Nuclide Library – **Sample Specific**
Calibration – **Sample Geometry Specific**

System tab:

MDA Type - **Traditional EG&G ORTEC**
Library - Match Width – **0.500 * FWHM (keV)**
Fraction Limit - **0.0000 %**
File for Suspected Nuclides – **C:\USER\Suspect.lib**
Peak Sensitivity – 3 •
Units - **µCi**
Multiplier - **1.0000 e +006**
Divisor - **1.0000 e+000**
Activity – **pCi**
Size – **g**

Decay tab:

Nothing Selected

Report tab:

Reporting Options - Nuclide Abundance •
 Unknown Peaks •
 Library Peak List •
 Library Peak Matrix •
Uncertainty Reporting – Activity •
 Total •
Confidence Level - 2-Sigma •
Output – Printer •

Analysis Options Window - Command Path: Analyze/Settings/Sample Type (con't)

Options tab:

Analysis Method - Program: **WAN32 Analysis**
 Priority – High •
 Additional Error - Systematic - **1.00000%**
 Random - **1.00000%**
 Peak Stripping – Library Based •
 Analysis Peak Cutoff - **100.0000%**
 Directed Fit

Corrections tab:

Peak Background Correction
 ✓ **On File – C:\STF2003\DET'X' WEEKLY BACKGROUND\DET'X'WKLYBKGD**

Isotopes tab:

NONE

MCB Properties Window - Command Path: Acquire/MCB Properties

Amplifier/HV tab:

Amplifier Gain - **0.8400**
 - X1 •
 Effective Gain – **3.500**
 Bias HV - 3000 V – ON •
 Pre-amplifier Type - Resistive Feedback •
 Rise Time - **12.00** μS

Stabilizer tab:

Gain - Center **65531**
 - Width **1**
 - Adjustment **0.0000%**

 Zero - Center **0**
 - Width **1**
 - Adjustment **0.0000%**

Advanced tab:

Rise - Time - **12.00**
 - Cusp - **1.00**
 Baseline Restore - **Auto**
 Flattop - Width - **1.20**
 Tilt - **0.01770**
 Pole Zero - **2109**

Attachment 2
 Example - Sample Tracking Form

Date Initiated		Detector		Initials		Notebook Page #	NA	
STF #	03-	Matrix	SOIL	RLM Review Init. / Date				
Sample	ID #	Type	Size g	Collection		Analysis		Atten. W/D
				Date	Time	Date	Time	
QC		CAL CK	350.0	10/1/02	12:00			D
QL		LCS	299.0	9/1/02	12:00			D
QB		Method Blank						D
QDB		Daily Blank						D
QC		CAL CK	350.0	10/1/02	12:00			D
QDB		Daily Blank						D
QC		CAL CK	350.0	10/1/02	12:00			D
QDB		Daily Blank						D
QC		CAL CK	350.0	10/1/02	12:00			D
QDB		Daily Blank						D
1		REG						
		LREP						
2		REG						
3		REG						
4		REG						
5		REG						
6		REG						
7		REG						
8		REG						
9		REG						
10		REG						
11		REG						
		LREP						
12		REG						
13		REG						
14		REG						
15		REG						
16		REG						
17		REG						
18		REG						
19		REG						
20		REG						

Comments:

- Subject: Operation of the Protean WPC-9550 Alpha- Beta Gas Proportional Automatic Planchet Counter

- 3.1.5 Training Laboratory personnel in the use and performance of this procedure to assure that suitable proficiency is achieved and maintained.
- 3.1.6 Instructing Laboratory personnel in associated laboratory safety (including radiation safety), hazard communications, and hazardous waste management.
- 3.1.7 Control and periodic transmittal of the Laboratory's associated Quality Assurance records.
- 3.1.8 Responding to and documenting of associated periodic surveillance and/or audits, in conjunction with the CQCSM and in accordance with FMSS procedures.
- 3.1.9 Responding in a timely manner to associated audit and/or surveillance findings.
- 3.1.10 Overseeing operation, maintenance, and calibration of associated lab instrumentation.
- 3.1.11 Reviewing and ensuring submittal of completed data and electronic data to the data users and data validation group.

3.2 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLTs)

- 3.2.1 Performing this procedure as written.
- 3.2.2 Reporting any problems in the performance of this procedure to the Laboratory Manager for immediate resolution.
- 3.2.3 Ensuring that adequate Laboratory supplies are available for daily operation in accordance with this procedure.
- 3.2.4 Developing and maintaining the associated Laboratory Quality Assurance records developed by this procedure.
- 3.2.5 Maintaining the laboratory sample database.

3.3 QA OFFICER:

- 3.3.1 Ensuring the Quality Control requirements set for the analysis of samples and operation of the Protean WPPC-9550 system at FMSS is maintained.
- 3.3.2 Performing routine scheduled and unscheduled audits of the Lab in the performance of this procedure and the maintenance of the required Quality Control Records.
- 3.3.3 Documenting periodic surveillances and/or audits associated with this procedure in conjunction with the CQCSM and in accordance with FMSS procedures.
- 3.3.4 Providing technical assistance to the staff of Radiochemistry Laboratory.

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4.0 SAFETY PRECAUTIONS

- 4.1 P-10 gas is generally pressurized to around 2500 psi, therefore, do not open the valve until the regulator is installed. Gas contaminants increase as the gas is depleted from the tank. It is good practice to replace a tank before the primary pressure drops below 200 psi.
- 4.2 Quality of gas is of paramount importance for consistent operation. Gas contaminants are detrimental to the gas multiplication necessary to detect and process pulses generated from alpha/beta radiation.
- 4.3 Before using a new tank of gas, disconnect the gas fitting on the rear panel of the WPC 9550 and open the tank and regulator valves fully. Adjust the regulators secondary pressure to 10 psi and allow the gas to flow for about 15 seconds. Connect the gas line to the WPC 9550 and adjust the front panel flow meter to 60 cc/min.
- 4.4 The instrument should be allowed to purge for at least one hour before counting samples or standards. The purging will start automatically.
- 4.5 The nominal flow rate is 60 cc/min. Setting the flow rate about 100 cc/min can rupture the window.
- 4.6 Do not allow the sample to extend beyond the top surface of the sample carrier. This may jam the changer mechanism or tear the window.
- 4.7 Disconnect the P-10 gas flow anytime maintenance is required.
- 4.8 Gloves must be worn while handling the lead shield to prevent lead contamination.

5.0 INTERFERENCES

6.0 APPARATUS AND MATERIALS

- 6.1 Barcoded plastic sample carriers to include snap in adapters to accommodate two inch diameter samples 5/16 inches deep.
- 6.2 Planchets 2 inches in diameter and 5/16 inches deep.
- 6.3 P-10 counting gas consisting of 90% argon and 10% methane.
- 6.4 Any printer with Epson MX or IBM Pro printer compatibility.
- 6.5 Computer System.

7.0 REAGENTS AND STANDARDS

- 7.1 NIST traceable calibration standards including Th-230 and Tc-99.
- 7.2 Commercial grade P-10 gas.

8.0 SAMPLE PRESERVATION AND STORAGE

- 8.1 Air samples are to be stored in the air sample storage boxes by type.
- 8.2 Environmental air samples will be shipped to an outside lab after each quarter.
- 8.3 Swipes may be discarded after counting unless specified otherwise by surveyor.

9.0 HOLDING TIMES

- 9.1 Air samples must be counted within 6 months of receipt date.

10.0 OPERATING CONDITIONS AND CALIBRATION

10.1 DETECTOR VOLTAGE DETERMINATION

NOTE

The calibration of the system is a three-stage process requiring the 1) Detector Voltage Determination, 2) Efficiency/Crosstalk Determination and 3) Control Chart Limits.

- 10.1.1 To acquire beta plateau data, use the Tc-99 source. It is not necessary to run alpha plateaus or change the alpha only operating voltage from the factory set 705 Volts.
- 10.1.2 The entire operation will require 40 counting intervals to collect the plateau data. the instrument acquires 40 data points in 30 volt increments beginning at 705 volts and ending at 1875 volts.
- 10.1.3 Press the **CAL** key on the front panel.
- 10.1.4 Using the arrow keys on the front panel, highlight *Detector Voltage Determination* on the screen and press **ENTER** on the front panel.
- 10.1.5 Use the arrow keys to highlight the *Time Preset* field. Enter 2 minutes and press **ENTER**.
- 10.1.6 Place the Tc-99 source in the sample stack and select *Advance* twice to position the carrier onto the slide.
- 10.1.7 Select *Acquire* to cause the source to be placed under the detector.
- 10.1.8 When the entire run is completed, the cursor will be positioned at the point where the system suggests the new beta operating voltage be set.

NOTE

When the entire run is completed, the "B" will be positioned on the display at the point where the system suggests the new beta operating voltage be set.

- 10.1.9 The bottom line of the plateau display will indicate the alpha and beta operating voltages with an "A" and "B" respectively. New operating points may now be set by using the up and down arrows to select which voltage is to be set.

10.2 EFFICIENCY/CROSSTALK CALIBRATION

- 10.2.1 Press the **CAL** key on the front panel.
- 10.2.2 Using the arrow keys on the front panel, highlight *Efficiency/Crosstalk Determination* on the screen and press **ENTER** on the front panel.
- 10.2.3 Select sample type (AirEnvi, AreaAir or BZAir) and press **ENTER** on the front panel.
- 10.2.4 Use the QC 1 Carrier for AirEnvi, AreaAir and swipes. Use QC 4 for BZAir and use QC 2 for swipes.
- 10.2.5 Put the selected Carrier and source in the sample stack.
- 10.2.6 Select *Acquire* on the screen.
- 10.2.7 Enter Preset Time of 2 minutes for AirEnvi , AreaAir or swipes and 5 minutes for BZAir.

10.2.8 The source will count for the desired preset time and the efficiency/crosstalk will be calculated.

10.2.9 Select *Print* from the screen to print desired efficiency.

10.2.10 For sample types that will have the same efficiency calculation (AirEnv and AreaAir), the *Copy* key may be selected to copy from one sample type to another.

10.3 CREATING CONTROL CHART LIMITS

10.3.1 Press the **CAL** key on the front panel.

10.3.2 Select *Control Charts Limits* from the menu.

10.3.3 Select *Chart* from the name field.

10.3.4 Pressing the **ENTER** key will toggle through the control chart names. When the chart of interest is displayed, select *Acquire*.

10.3.5 Load the Alpha source in the QC 1 carrier.

10.3.6 Enter Repeats: 20.

10.3.7 Select *Advance* twice until QC 1 carrier is in place.

10.3.8 Select Start. The source will now count 20 times, acquiring alpha limits data.

10.3.9 Repeat steps 11.3.1 through 11.3.8 with all remaining sources (using proper QC carrier for each source).

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11.0 PROCEDURE

11.1 COUNTING A QUALITY CONTROL SAMPLE (DAILY QC CHECK OR BACKGROUND)

- 11.1.1 Place the Calibration Check Source in the appropriate carrier for the source (QC 1 for Th-230, QC 2 for Tc-99, QC 3 for background, and QC 4 for Th-230 button source)

NOTE

For air sample counting, a daily background and alpha source is required. The background carrier is counted with an empty planchet.

NOTE

All QC carrier information has already been predetermined. For setup instructions for QC carriers, see the WPC-9550 Operations Manual.

- 11.1.2 Load the selected carrier into the left tower. The white end plate should be on the top of the
- 11.1.3 Select **DATA** from the front panel.
- 11.1.4 Highlight menu and toggle through the choices until the carrier that is loaded is highlighted.
- 11.1.5 Select *Acquire* from menu and **ENTER** from front panel.
- 11.1.6 Select *Advance* from menu and **ENTER** from front panel. Do this twice.
- 11.1.7 Now the carrier is in place to be counted. Select *Start* from the menu and **ENTER** from the front panel. This will begin the selected source or background count.
- 11.1.8 Once counting is complete, the carrier will not reload in the left tower. This must be done manually by selecting *Reverse* from the menu and **ENTER** from the front panel.
- 11.1.9 To review the counts against the control chart information accumulated during calibration for this carrier, select *View* from the menu.
- 11.1.10 Press *Next* from the menu until the current date appears.
- 11.1.11 Compare today's QC data to the acceptable limits.
- 11.1.12 Determine if the count is within acceptable count range that is displayed.
- 11.1.13 If the counts are outside the acceptable count range, repeat steps 11.3.2 through 11.3.12.
- 11.1.14 If the source or background counts fall out of acceptable count range twice for that day, notify RLM.

11.2 COUNTING SAMPLES

- 11.2.1 Select samples to be counted, and appropriate carrier for sample type (Routine 2 for AE samples, Routine 3 for GA samples, and Routine 5 for BZ samples).

NOTE

The counting times for the various Routine carriers have already been predetermined. For setup instructions for Routine carriers, see the WPC-9550 Operations Manual.

- 11.2.2 Load background filter in Carrier 1.
- 11.2.3 Load air samples in carriers beginning with Carrier 2.
- 11.2.4 Place the Routine Carrier in the left sample stack.
- 11.2.5 Place the sample carriers in the sample stack with Carrier 1 on top.
- 11.2.6 Place the white end plate on top of the stack.
- 11.2.7 Select the **COUNT** button from the front panel.
- 11.2.8 Select *Remove* from the display.
- 11.2.9 Select the **ENTER** button from the front panel.

11.3 UPLOADING SAMPLE INFORMATION FROM PROTEAN

- 11.3.1 From the Protean computer, click on **PIC Routines** icon on desktop.
- 11.3.2 Select *Enable Macros*.
- 11.3.3 From the menu at the top of the page, select *Pview*. Select *View Routine*. This will list each sample type. Click on the selection and click *OK*.
- 11.3.4 The data that will display on the spreadsheet will be previous data counted. In order to upload most current data from the Protean, click on the left icon at the top of the spreadsheet (PIC Upload).
- 11.3.5 A window will appear asking for the Instrument ID Number. Select *I* and click on *OK*. This will begin the upload procedure.
- 11.3.6 Once upload is complete, a window will appear with the question "Merge Instrument Data with Existing Inputs?" Click on *NO*.
- 11.3.7 The next window will be a "Routine 2 Warning". Click on *OK*. If additional "Routine Warning" windows appear, click on *OK*.
- 11.3.8 The "Update Procedure Complete" window will appear. Click on *Ok*.
- 11.3.9 Save the file using the format asrMMDDYYXX. The XX represents sample type (AE for Air Environmental, GA for General Area, and BZ for Breathing Zone). Select the two-letter sample type.

12.0 QUALITY CONTROL

- 12.1 Verify results are within quality control limits for operation in accordance with Radiation Lab Quality Assurance requirements.
- 12.2 Notify Rad Lab supervision, WHEN data fails quality control requirements, OR data appears to be suspect.
- 12.3 Calibrate the system with NIST traceable sources yearly.

13.0 LIMITS

- 13.1 The DAC for Environmental Air Samples is 2.8E-14.
- 13.2 The DAC for General Area and Breathing Zone Air Samples is 2.5E-12.
- 13.2 Smear limits will vary with survey type.

14.0 QUALITATIVE IDENTIFICATION INFORMATION

14.1 Not Applicable

15.0 DATA REVIEW

15.1 All air sample records will be reviewed by Radiochemistry Lab Technician, Radiochemistry Lab Manager and Radiation Safety Officer.

16.0 RECORDS

- 16.1 Protean Logbook
- 16.2 Detector High Voltage Determination - hardcopy
- 16.3 Efficiency Calibration – hardcopy
- 16.4 Control Charts - hardcopy
- 16.5 Sample Count Raw Data - hardcopy
- 16.6 Generated Air Sample Report – electronic file and hardcopy
- 16.7 Sample Tracking Form

17.0 PREVENTIVE MAINTENANCE

- 17.1 Ensure P-10 gas is replaced before pressure drops below 200 psi.
- 17.2 Ensure the gas front panel flow meter is always set to 60 cc/min.
- 17.3 Ensure samples are loaded properly to avoid tearing the window.
- 17.4 Maintain clean and safe electrical wiring and connections.

18.0 POLLUTION PREVENTION

- 18.1 ALL steps possible and practical shall be taken to ensure the requirements of local, state, and federal regulatory agencies are met when disposing of wastes to the local environment.
- 18.2 ALL waste products should be characterized to identify the chemical(s) inherent in the waste, volume produced during analysis, and disposal pathway.
- 18.3 Liquid wastes, disposed of by way of the lab drainage system, shall NEVER be disposed of in quantities OR contain material(s) that cannot be handled by the local sewage treatment system.
- 18.4 Waste disposed should be pretreated as necessary prior to disposal to a condition that can be handled by the local sewage treatment system (e.g. neutralization of acids or bases).
- 18.5 ALL wastes that CANNOT be handled by the local sewage system shall be contained and disposed of through proper waste disposal techniques and with waste brokers licensed to handle such wastes.

19.0 WASTE MINIMINAZATION

- 19.1 ALL wastes are to be handled in the proper manner.
- 19.2 Exercise care during the performance of the method to ensure the production of waste is minimized.
- 19.3 ALL waste is to be disposed of in the proper designated container.
- 19.4 Wastes may be collected and stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient, for treatment prior to disposal, or for disposal.
- 19.5 ALL waste is to be deemed to contain radioactive material, AND is to be handled accordingly, UNTIL tested and released as prescribed by the lab release limits.
- 19.6 ALL waste is to be tested AND treated prior to disposal, OR properly packaged and stored for return to the originator.
- 19.7 Waste may be stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient.
- 19.8 Used PPE is to be checked for contamination prior to normal lab disposal.
- 19.9 PPE used in the preparation or handling of known source material is to be disposed of as radioactive waste.

20.0 METHOD FLOW CHART

- 20.1 See Figure 1

21.0 REFERENCES

Protean Instrument Corporation Model WPC 9550 Manual
Protean Instrument Corporation Multi-Detector System Operations Manual
EPA 600 4-80-032; Prescribed Procedures for Measurement of Radioactivity in Drinking Water
USACE Kansas City and St. Louis Radiological Data Evaluation Guidance – 2000
Maywood FUSRAP Superfund Site Laboratory Quality Assurance Manual

22.0 ATTACHMENTS

- 22.1 Glossary of Terms
- 22.2 Method Flow Chart-Figure 1

ATTACHMENT 22.1 GLOSSARY OF TERMS

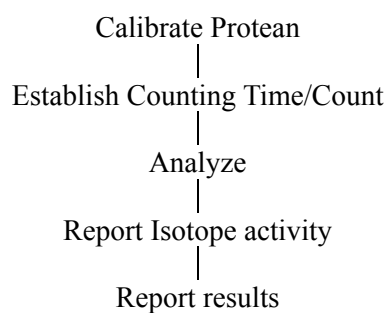
Calibration Standard - a NIST traceable radioactive source used for calibration and quality control of a detector

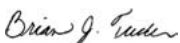
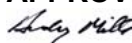
CQCSM – Contractor Quality Control System Manager

FUSRAP – Formerly Utilized Sites Remedial Action Program

Geometry - the relationship (orientation) of a standard sample or source to the detector

FIGURE 1



Procedure No. SOP 641 Revision No 0 Date of Revision April 11, 2003 Last Review Date April 11, 2003 Page 1 of 19	
STANDARD OPERATING PROCEDURE FUSRAP Maywood Superfund Site Subject: Receipt and Preparation of Soil Samples for Analysis by Gamma Spectrometry	
PREPARED BY:  Radiochemistry Laboratory Mgr 02/20/03 REVIEWED BY:  Project Chemist 02/20/03	APPROVED:  Project Manager 02/20/03

1.0 PURPOSE

This procedure provides consistent methodology and guidelines for receipt and preparation of soil samples for analysis by gamma spectrometry.

2.0 METHOD SUMMARY AND VALIDATION

Soil samples are taken from the field as either Grab or Core samples. Grab samples are taken in the field and placed into sample containers. The Grab samples arrive at the Lab and analysis requirements are determined. Samples are analyzed either "Wet" and/or as "Dry". Wet analyses are performed "as is". Dry analysis requires drying and pulverizing of the sample. Core samples are identified as to a location(s) in the core at which samples are to be taken. The core samples are opened and the appropriate sample is removed, dried, pulverized, transferred and weighed into a sample container.

The method to dry and pulverize the sample is based on ASTM Standards. No method validation is required.

3.0 RESPONSIBILITIES

3.1 RADIOLOGICAL LABORATORY MANAGER (RLM)

- 3.1.1 Implementation of this SOP.
- 3.1.2 Training Laboratory personnel to assure that suitable proficiency in the performance of the SOP is achieved and maintained.
- 3.1.3 Initiation of corrective action, as necessary and performance of any follow-up, as required.
- 3.1.4 Coordination with the Radiation Safety Officer (RSO), Quality Assurance (QA) Officer, Sample Custody Officer, Project Manager or USACE to resolve problems

related to receipt and preparation of samples into the Laboratory that could prevent completion of required analysis.

3.2 RADIOCHEMISTRY LABORATORY TECHNICIANS (RLTs)

- 3.2.1 Reporting any problems in the performance of this procedure to the Laboratory Manager for resolution.
- 3.2.2 Accepting receipt of Laboratory samples.
- 3.2.3 Ensuring that adequate Laboratory supplies are available for daily operation.
- 3.2.4 Maintenance of associated Laboratory Quality Assurance records.
- 3.2.5 Performing sample receipt and preparation in accordance with the requirements of this procedure.
- 3.2.6 Producing the records developed by this procedure.

3.3 SAMPLE CUSTODY OFFICER (SCO)

- 3.3.1 Provide Sample Identification numbers to the samplers.
- 3.3.2 Resolving conflicts in Chain-of-Custody information or Sample Identification numbering.

3.4 QA OFFICER

- 3.4.1 Ensuring the Quality Control requirements set for the preparation of soil samples at FUSRAP Maywood Superfund Site (FMSS) is maintained.
- 3.4.2 Performing routine scheduled and unscheduled audits of the Lab in the performance of this procedure and the maintenance of the required Quality Controls.
- 3.4.3 Documentation of periodic surveillance and/or audits, in conjunction with the CQCSM and in accordance with FMSS procedures.
- 3.4.4 Providing technical assistance to the staff of the Radiological Laboratory.

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4.0 SAFETY PRECAUTIONS

CAUTION

Unknown constituents may be encountered during sample preparation, i.e. chemicals, metals etc. A review of field notes concerning the samples should be made to initially determine the level of personal protection required for handling of samples. DO NOT manipulate the sample directly by hand to prevent possible cuts or punctures. Use transfer utensils to handle or mix the sample. Should an unusual situation occur during sample preparation, appropriate actions shall be taken to assure personal safety.

WARNING

Ovens operated in drying samples are at extremely high temperatures (greater than 100° C). Do not touch any material in the oven without thermal resistant gloves.

- 4.1 Samples received in the Lab are considered Radioactive Material until determined otherwise. The main isotopes of concern in the Radioactive Material received at FMSS are from Alpha emitting radioisotopes. Gamma and Beta radiation is also present and to be considered a present hazard.
- 4.2 Radioactive materials may pose an internal and/or external exposure hazard. Individuals receiving or preparing samples shall be trained in the proper handling of radioactive materials and the methods of maintaining personal exposures As Low As Reasonably Achievable (ALARA).
- 4.3 Concern should be taken when storing samples to maintain background area radiation levels for the counting equipment as low as reasonably achievable.
- 4.4 Dried material formed from sample preparation can easily be dispersed in the air. Transfers of dried material should be performed in the fume hood.
- 4.5 Sample manipulation in preparation can result in the spread of contamination. Care in handling samples and proper radiological controls shall be maintained at all times. Maintain good housekeeping in the sample preparation area.
- 4.6 Multiple samples are to be carried in a sample transfer container to prevent possible spillage of material from an accidental dropping of the samples.
- 4.7 Motorized/rotating equipment is used in the preparation of samples. An energized pulverizer SHALL NOT be opened. Ensure the pulverizer has stopped rotation and is de-energized prior to removing sample or opening for decontamination or maintenance.
- 4.8 All sample preparation shall be performed under the appropriate site specific Hazardous Work Permit (HWP).

- 4.9 All personnel shall frisk their hands, feet, and frontal body area at a minimum upon completion of working in the sample preparation area.

5.0 INTERFERENCES

- 5.1 Rocks and stones are to be examined to determine whether they are to be pulverized.
- 5.1.1 Rocks smaller than an elliptical form of 3/4 inch by 1/8 inch may be placed in the Pulverizer.

CAUTION

The technique of hammering a stone or rock may result in physical harm or harm to objects in the area. Only trained and qualified technicians shall perform this function unaided.

- 5.1.2 Large objects may be “hammered” to attempt size reduction.
- 5.2 Rocks and stones that are NOT pulverized should be placed in the bottom of the sample to prevent shielding of the gamma energy emitted by the sample’s radioactive material.
- 5.3 The counting dead time must remain below 15%. This may not be the case for samples with high levels of activity and steps must be taken to lower their dead time. These steps may include reducing the size of the sample aliquot and/or by increasing the distance and/or by changing the geometry and/or by addition of shielding between the detector and the sample container. These changes must be reflected by corresponding changes in the calibration standards or by applying a correction factor.

6.0 APPARATUS AND MATERIALS

- 6.1 Top Loading Balance; 0.1 gram (g) – 5000.0 g, Ohaus ®
- 6.2 Convection Oven; 3 cubic feet 260°C maximum $\pm$ 1% at 100°C, Mammoth Industries
- 6.3 Fume Hood; 32” x 59” x 59”, Class A air flow
- 6.4 Pulverizer; capable of reduction to 500 μ , Bico Industries
- 6.5 Weight Set; 1.0 g to 1000.0 g range, ASTM Class 1 Certified Stainless Steel (minimum)
- 6.6 Sample Container “Tuna Can”; 230 milliliter (mL) volume cylindrical container with sealable lid, Embarcadaro
- 6.7 Sample Container Sealer; Embarcadaro
- 6.8 Air Sampler with Filter/Cartridge Assembly
- 6.9 Sample transfer container
- 6.10 Sample drying pan, aluminum approximately 2” x 3” x 6”
- 6.11 Gloves Cotton liner, Nitrile, and Thermal Insulation
- 6.12 Hacksaw or other cutting instrument
- 6.13 Alpha Survey Meter – Ludlum Rate Meter Model 2241 and Ludlum Probe Model 435
- 6.14 Smears - 2” cloth disc

7.0 REAGENTS AND SOLUTIONS

- 7.1 ALCONOX – Dry powder
- 7.2 Water

8.0 SAMPLE PRESERVATION AND STORAGE

- 8.1 Samples must be stored and handled in such a manner that they will not become contaminated by, nor will they contaminate other samples or standards. The samples may be hazardous and the radioactive activity levels should have been pre-screened prior to sample prep. Treat samples with higher levels of activity (>200 counts per minute [cpm]) with special precaution.
- 8.2 Soil samples to be analyzed gamma spectroscopy require NO preservation.
- 8.3 Homogeneity of the sample is crucial to accurate results. If this step is inadequate, the sample aliquot will not be representative of the bulk sample and ALL subsequent work will be unreliable.
 - 8.3.1 ALL samples must be thoroughly mixed.
 - 8.3.2 Solid samples must be completely crushed, pulverized, homogenized, and evenly split to an appropriate aliquot.
- 8.4 Dust is a perennial problem when dealing with pulverized samples and it may be particularly hazardous with samples that are highly siliceous and/or contain anomalous levels of radiogenic materials.
 - 8.4.1 Exercise particular care when transferring a pulverized sample to the counting container.

9.0 HOLDING TIMES

- 9.1 Analysis can be performed anytime within a year. However, concern for the half-life of the isotope of interest must be weighed. Samples containing short-lived isotopes should be counted prior to 4 half-lives ($t_{1/2}$) of the most limiting isotope. However, this direction is often rendered moot at the Maywood site because quick turnaround times are usually required by the Project.
 - 9.2.1 USACE requirements are to perform the initial analysis within six months of sampling.
 - 9.2.2 Decay correction of the sample is performed up to 12 $t_{1/2}$ by the Gamma Spectrometry analysis program.
 - 9.2.2 For quality purposes 4 $t_{1/2}$ is at least 6.25% of the original activity and can be recounted for accurate results.

10.0 OPERATING CONDITIONS

- 10.1 The area of the Prep Lab shall be clean and well organized.
- 10.2 The ventilation flow in the Prep Lab shall be such that the sample material is NOT disturbed during manipulation and preparation.

11.0 PROCEDURE

NOTE

An original, complete Chain-of-Custody (COC) must accompany all samples received by the lab. The COC shall be maintained at all times to ensure sample integrity. Samples shall not be accepted without a completed and signed COC.

NOTE

All samples received by the lab from the FMSS staff are considered clean of external contamination. Radiation levels may be written on core samples

11.1 SAMPLE CONTAINER CONTROL

- 11.1.1 Sample containers to be utilized for sample analysis shall be controlled by the Lab.
- 11.1.2 Inventory shall be maintained sufficient to meet project requirements.
- 11.1.3 Sample containers shall be stored in an area, which will minimize the potential of contamination and/or damage.
- 11.1.4 Sample containers suspected of having become contaminated shall not be utilized unless appropriate methods, smears, wipe tests etc, have proven the sample container(s) to be free of contamination.
- 11.1.5 Damaged containers shall not be used for analysis.

11.2 SAMPLE RECEIPT

- 11.2.1 Upon receipt of samples, verify the samples are labeled.
- 11.2.2 Verify the label on the samples received against the COC in the presence of the Relinquisher.
- 11.2.3 IF the COC is in conflict with the samples discuss the problem with the Relinquisher, and resolve ANY problems with FMSS Sample Coordinator prior to proceeding.
- 11.2.4 If the sample label information or COC information is to be altered after conversation with the FMSS Sample Coordinator, make the changes as follows by pen and black ink notation.
- 11.2.5 Relinquisher - Make a notation by a single lineout of the data in error, and date, the initials of the person who corrected the data, and the correct data.
- 11.2.6 Lab Tech - Make a notation in the Comments Section of the COC of the change and the date, time, and name of person authorizing the change.
- 11.2.7 Identify the purpose of the transfer in the appropriate field of the COC.
- 11.2.8 Sign and date the appropriate fields of the COC as Relinquisher or Receiver as appropriate.
- 11.2.9 Log the receipt of the samples into the Laboratory Database Chain-of-Custody Entry screen,

11.3 BALANCE PERFORMANCE CHECKS

- 11.3.1 Perform a full-scale check of the balance weekly and a range check daily prior to operation.
- 11.3.2 Complete the weighings as required by the schedule in Attachment 3, Balance Performance Check Requirements.
- 11.3.3 Verify the balance is ON and has been energized for at least ten minutes.
- 11.3.4 Place a weighing boat on the balance and tare the balance.
- 11.3.5 Using tongs or wearing lint free clean cotton glove, place weight(s) on the balance and allow the balance to stabilize.
- 11.3.6 Record the weight determined in the Balance Lab Notebook.
- 11.3.7 Remove the weight and replace it in the weight box.
- 11.3.8 Verify scale response is within $\pm 0.1\%$ of the calibrated value for each weight used for the scale check.
- 11.3.9 Observe the previous 5 readings of the Balance check for trends.
- 11.3.10 If a trend upward or downward is noted, contact the Rad Lab Manager for instructions.

- 11.3.11 If the balance is checked within tolerance without a definitive trend, proceed with the weighing of samples.

11.4 PREPARATION

- 11.4.1 Verify the balance has been through a Daily Performance Check. or Weekly Performance Check as required.
- 11.4.2 Obtain direction from the Task Manager, Field Engineer, or Radiation Protection whether the sample is to be counted as a screening sample or a definitive sample.
- 11.4.3 Log the sample into the Sample Preparation Log, identifying the sample number and collection date.
- 11.4.4 Proceed with Section 11.3 for Screening samples (wet), or proceed with Section 11.4 for Definitive samples (dry/equilibrated), or Section 11.5 for Core samples.

11.5 SCREENING (WET) SAMPLES

NOTE

Screening samples are normally placed in counting containers in the field. These samples need not be transferred to another container for counting.

- 11.5.1 Survey the sample for removable contamination by smear.
- 11.5.2 Perform decontamination with a Masslin cloth as necessary to meet appropriate site-specific release limits.
- 11.5.3 Place a weigh boat on the balance and tare the balance.
- 11.5.4 Place the sample in the weigh boat.
- 11.5.5 Weigh the sample and container and record the weight to the nearest tenth of a gram in the Sample Preparation Log.
- 11.5.6 Subtract the mean weight of a sample container and tape from the sample-determined weight.
- 11.5.7 Record the final sample weight in the Sample Preparation Logbook
- 11.5.8 Record on the container to one side of the label the weight of the sample.
- 11.5.9 Place the sample container(s) in a clean plastic bag.
- 11.5.10 Transfer the samples to the counting room.

11.6 DEFINITIVE (DRY/EQUILIBRATED) SAMPLES

11.6.1 Energize a Drying Oven, set at 110°C, at least one hour prior to drying any sample.

NOTE

An additional hour may be added to the drying time, if the oven is turned on at the time of starting preparation of the sample.

- 11.6.2 If the sample is sent to the lab in a sample container, proceed to Section 11.5.
- 11.6.3 If the sample is to be taken from a Geoprobe® core, complete Section 11.7 and return to Step 11.6.4 upon completion.
- 11.6.4 Weigh a drying pan and record the weight in the Sample Preparation Log.
- 11.6.5 Mark the drying pan, by permanent ink marker, with the sample identification number and the weight of the pan.
- 11.6.6 Transfer completely the sample contents to the drying container.
- 11.6.7 Weigh the sample and record gross wet weight in the Sample Preparation Log.
- 11.6.8 Place the sample into the convection oven.
- 11.6.9 Dry the sample for at least 4 hours and preferably for 8 to 10 hours.
- 11.6.10 Remove the sample from the oven and allow the sample to cool to room temperature in a dry location (approximately 15 minutes) such as a dessicator.
- 11.6.11 Weigh the sample and record the dry weight in the Sample Preparation Logbook.
- 11.6.12 Place the sample back into the dry location and wait for fifteen minutes.
- 11.6.13 Weigh the sample and record the dry weight in the Sample Preparation Logbook.
- 11.6.14 If the variance in sample weight is less than 0.2 grams from the first weighing, then proceed to Step 11.5.17.
- 11.6.15 If the variance in sample weight is greater than 0.2 grams from the first weighing, then place the sample back into the dry location for fifteen minutes and repeat the Steps beginning from Step 11.5.3.
- 11.6.16 If the sample does not obtain a steady weight after the second waiting period, then return the sample to the oven for at least one hour and then return to Step 11.4.10.
- 11.6.17 Transfer the sample to the pulverizer and pulverize the sample.
- 11.6.18 If necessary, apply a sample identification label with the appropriate information pertaining to the sample on a new container; otherwise use the original container.
- 11.6.19 Place the sample container in a tared weighing boat on the balance.
- 11.6.20 Weigh the sample container and lid, and record the weight in the Sample Preparation Logbook.

- 11.6.21 Tare the balance.
- 11.6.22 In the fume hood, carefully transfer the pulverized sample to the counting container.
- 11.6.23 Place the container lid on top of the container.
- 11.6.24 Weigh the container and record the gross dry weight of the sample on the sample container.
- 11.6.25 Determine the net sample weight and record the results in the Sample Preparation Log.
- 11.6.26 Seal the lid of the counting container using the container sealer.
- 11.6.27 Visually inspect the container for completion of seal.
- 11.6.28 Note any discrepancies in the Sample Preparation Log.
- 11.6.29 For every twenty samples, perform a leak test by submerging the sample container in warm water.
- 11.6.30 If no leak results, log the results of the leak test in the Sample Preparation Log as Satisfactory and proceed to Step 11.5.34.
- 11.6.31 If a leak should occur, log the results of the leak test as unsatisfactory noting the rate of the leak and the point and number of leaks as Comments in the Sample Preparation Logbook.
- 11.6.32 Open the container and return to Step 11.5.4 to dry the sample.
- 11.6.33 Record the seal date on the container.
- 11.6.34 Survey the sample for removable contamination by smear.
- 11.6.35 Perform decontamination with a Masslinn® cloth as necessary to meet appropriate site-specific release limits.
- 11.6.36 Transfer the sample to the counting lab.
- 11.6.37 Decontaminate the Pulverizer after each sample to minimize the possibility of cross-contamination of samples.
 - Using professional judgment in determining the level of decontamination required.
 - Use ALCONOX and Water as needed.

11.7 CORE SAMPLE PREPARATION

NOTE

For Safety considerations, two technicians are required to cut core samples.

- 11.7.1 As directed by the FMSS Sample Coordinator, obtain a sample from a Geoprobe® core.
- 11.7.2 Locate the core to be sampled.
- 11.7.3 Log the core identification number in the Sample Preparation Logbook..
- 11.7.4 Place the core onto the dedicated bench.
- 11.7.5 Measure the location of the sample from the upper end cap as indicated (normally the black cap).
- 11.7.6 Mark two points for cutting 3 inches to either side of the sample point.
- 11.7.7 Using a dedicated hacksaw, slowly cut the core casing.
- 11.7.8 Using the dispersal tool, dispense the sample from the casing into a drying pan.
- 11.7.9 Perform Steps 11.6.4 through 11.6.37 to completion.
- 11.7.10 Decontaminate the hacksaw, dispersal tool, and work area after each sample using professional judgement in determining the level of decontamination required to minimize the possibility of cross-contamination of samples.

11.8 METHOD BLANK AND DAILY BLANK SAMPLES

- 11.8.1 Energize a Drying Oven, set at 110°C, at least one hour prior to drying any sample.

NOTE

An additional hour may be added to the drying time, if the oven is turned on at the time of starting preparation of the sample.

- 11.8.2 Obtain a sample of Ottawa sand from the designated reagent fiber box.
- 11.8.3 Weigh a drying pan and record the weight in the Sample Preparation Log.
- 11.8.4 Mark the drying pan, by permanent ink marker, with the sample identification number and the weight of the pan.
- 11.8.5 Transfer completely the sample contents to the drying container..
- 11.8.6 Weigh the sample and record gross wet weight in the Sample Preparation Log.
- 11.8.7 Place the sample into the convection oven.
- 11.8.8 Dry the sample for at least 4 hours and preferably for 8 to 10 hours.

- 11.8.9 Remove the sample from the oven and allow the sample to cool to room temperature in a dry location (approximately 15 minutes) such as a desiccator.
- 11.8.10 Weigh the sample and record the dry weight in the Sample Preparation Logbook.
- 11.8.11 Place the sample back into the dry location and wait for fifteen minutes.
- 11.8.12 Weigh the sample and record the dry weight in the Sample Preparation Logbook.
- 11.8.13 If the sample weight is less than 0.2 grams in variance from the first weighing then proceed to Step 11.8.16.
- 11.8.14 If the sample weight is greater than 0.2 grams in variance from the first weighing, then place the sample back into the dry location for fifteen minutes and repeat the Steps from Step 11.8.12.
- 11.8.15 If the sample does not obtain a steady weight after the second waiting period, then return the sample to the oven for at least one hour and then return to Step 11.4.10.

NOTE

Step 11.8.16 is performed ONLY on Method Blank samples. Daily Blank samples are not pulverized to prevent possible contamination. Proceed to Step 11.8.17.

- 11.8.16 Transfer the Method Blank sample to the Pulverizer and pulverize the sample.
- 11.8.17 If necessary, apply a sample identification label with the appropriate information pertaining to the sample on a new container; otherwise use the original container.
- 11.8.18 Place the sample container in a tared weighing boat on the balance.
- 11.8.19 Weigh the sample container and lid, and record the weight in the Sample Preparation Logbook.
- 11.8.20 Tare the balance.
- 11.8.21 In the fume hood, carefully transfer the pulverized sample to the counting container.
- 11.8.22 Place the container lid on top of the container.
- 11.8.23 Weigh the container and record the gross dry weight of the sample on the sample container.
- 11.8.24 Determine the net sample weight and record the results in the Sample Preparation Log.
- 11.8.25 Seal the lid of the counting container using the container sealer.
- 11.8.26 Visually inspect the container for completion of seal.
- 11.8.27 Note any discrepancies in the Sample Preparation Log.
- 11.8.28 For every twenty samples, perform a leak test by submerging the sample container in warm water.
- 11.8.29 If no leak results, log the results of the leak test in the Sample Preparation Log as Satisfactory and proceed to Step 11.5.34.

- 11.8.30 If a leak should occur, log the results of the leak test as unsatisfactory noting the rate of the leak and the point and number of leaks as Comments in the Sample Preparation Logbook.
- 11.8.31 Open the container and return to Step 11.8.4 to dry the sample.
- 11.8.32 Record the seal date on the container.
- 11.8.33 Survey the sample for removable contamination by smear.
- 11.8.34 Perform decontamination with a Massillon cloth as necessary to meet appropriate site-specific release limits.
- 11.8.35 Transfer the sample to the counting lab.
- 11.8.36 Decontaminate the Pulverizer after each sample to minimize the possibility of cross-contamination of samples.
 - Using professional judgment in determining the level of decontamination required.
 - Use ALCONOX and Water as needed.

12.0 QUALITY CONTROL

- 12.1 Oven temperature should be maintained within $110 \pm 5^{\circ}\text{C}$. This is to ensure complete drying, yet not promote possible splattering of the material from rupture of vapor entrapped in the soil.
- 12.2 Balances are to be checked with only ASTM Class 1 certified stainless steel weights per Section 6.5 of this SOP.

13.0 REPORTING LIMITS

- 13.1 NONE

14.0 QUALITATIVE IDENTIFICATION INFORMATION

- 14.1 NONE

15.0 DATA REVIEW

- 13.1 Data developed from the logging of balance weight checks shall be reviewed for trending and error considerations.

16.0 RECORDS

16.1 CHAIN OF CUSTODY

16.2 BALANCE CALIBRATION CERTIFICATE

16.3 BALANCE CALIBRATION CHECK LOGBOOK

16.4 SAMPLE PREPARATION LOGBOOK

16.5 HAZARDOUS WORK PERMIT (APPROVED) AND ASSOCIATED SIGN IN SHEET FOR PREPARATION AREA

17.0 PREVENTIVE MAINTENANCE

- 17.1 Pulverizer is to be inspected at end of week for general condition.
- 17.2 Pulverizer is to be checked for bearing operation and sealing every six months.
- 17.3 Oven temperatures are to be verified against a NIST-traceable thermometer every six months and recorded in Lab Notebook.
- 17.4 Balances shall be inspected yearly by certified technician.

18.0 POLLUTION PREVENTION

- 18.1 ALL steps possible and practical shall be taken to ensure the requirements of local, state, and federal regulatory agencies are met when disposing of wastes to the local environment.
- 18.2 ALL waste products should be characterized to identify the chemical(s) inherent in the waste, volume produced during analysis, and disposal pathway.
- 18.3 Liquid wastes shall be minimized due to the current nature of the Lab design and operating conditions.
 - 18.3.1 Water waste is to be retained and allowed to evaporate.
 - 18.3.2 Wet (by water) materials shall be placed in a controlled condition and allowed to dry.
 - 18.3.3 After wet materials have dried, they are to be surveyed for contamination and disposed of accordingly.
- 18.4 ALL wastes shall be contained and disposed of through proper waste disposal techniques and with waste brokers licensed to handle such wastes.

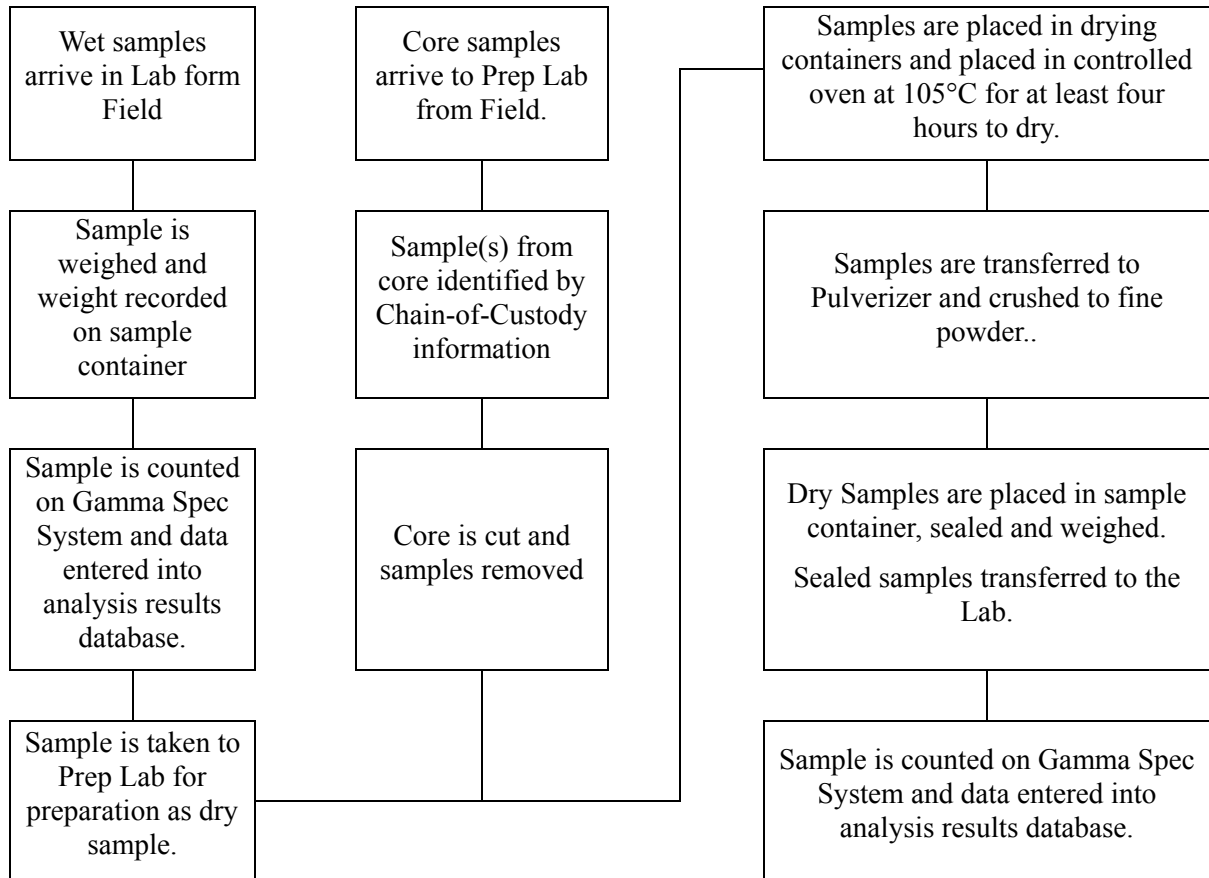
19.0 WASTE MANAGEMENT

- 19.1 ALL wastes are to be handled in the proper manner.
- 19.2 Exercise care during the performance of the method to ensure the production of waste is minimized.
- 19.3 ALL wastes shall be disposed of in properly designated containers.
- 19.4 Wastes may be collected and stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient, for treatment prior to disposal, or for disposal.
- 19.5 ALL waste is to be deemed to contain radioactive material, AND is to be handled accordingly, UNTIL tested and released as prescribed by the lab release limits.
- 19.6 ALL waste is to be tested AND treated prior to disposal, OR properly packaged and stored for return to the originator.
- 19.7 Waste may be stored in designated containers and locations, until the material is deemed ready and suitable for return to the authorized recipient.
 - 19.7.1 Unused sample volumes should be retained AND returned to storage.
 - 19.7.2 Samples are to be treated and disposed of properly.
- 19.8 Empty containers are to be rinsed AND/OR treated to ensure they are acceptable for disposal.
 - 19.8.1 Containers that CANNOT be treated are to be retained for disposal.
- 19.9 Used personal protective equipment (PPE) is to be checked for contamination prior to normal lab disposal.
- 19.10 PPE used in the preparation or handling of known source material is to be disposed of as radioactive waste.

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20.0 METHOD FLOW CHART

Receipt and Preparation of Soil Samples



21.0 REFERENCES

ASTM C999-90; Standard Practice for Soil Sample Preparation for the Determination of Radionuclides

ASTM E 898-88; Standard Method of Testing Top-Loading, Direct Reading Laboratory Scales and Balances

Radiological Laboratory Quality Assurance Plan; FUSRAP Maywood Superfund Site.

Chemical Data Quality Management Plan (CDQMP); FUSRAP Maywood Superfund Site.

SOP-504, Labeling, Packaging, and Shipping Environmental Samples

22.0 ATTACHMENTS

22.1 Scale Calibration Log (Weekly and Daily Check Logs)

22.2 Sample Preparation Log

Attachment 22.2a Balance Calibration Check Log

Weekly Performance

Weight (g) Increment	Date	Date	Date	Date	Date	Date
0.1						
0.5						
1.0						
2.0						
5.0						
10.0						
50.0						
100.0						
200.0						
300.0						
500.0						
1000.0						

Attachment 22.2b Balance Calibration Check Log

Daily Performance

Weight (g) Increment	Date	Date	Date	Date	Date	Date
0.1						
1.0						
10.0						
50.0						
100.0						
500.0						

APPENDIX B

SECTIONS E AND F OF EM 200-1-3 REQUIREMENTS FOR THE PREPARATION OF SAMPLING AND ANALYSIS PLANS

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Appendix E

Sample Manipulation Instructions

E.1 Filtration Techniques (Liquid Media)

E.1.1 Scope and application. This instruction outlines two different techniques for the filtration of aqueous media (i.e., ground water, surface water, and potable water). The procedures address in-line filtration, where the filter assembly is under positive pressure, and vacuum filtration, where the filter assembly is under negative pressure. In addition, the procedures describe and recommend specific filtration equipment. Filtration of aqueous samples is performed when the removal of silt algae, particulates, and other debris is desired. Predominantly, filtration is employed when water samples are to be tested for dissolved metals. However, many regulatory agencies no longer accept filtered samples as representative of "dissolved metals" concentrations. Therefore, the position of the regulators should be investigated to assure acceptance of the data generated from these types of samples. An alternative procedure to filtration may be the use of low-flow sampling techniques. Filtered samples for metals (dissolved fractions) should be analyzed in conjunction with nonfiltered samples to determine the metal concentration in solution versus metals associated with solids. Analysis of both filtered and unfiltered samples will allow the determination of metal concentration associated with the solid. Samples requiring organic analyses are not filtered unless specifically requested in the field sampling plan. Filtration techniques for ground water should be conducted in the field shortly after collection and before the addition of preservatives. A delay in the filtration of these samples may allow potential changes in carbon dioxide and oxygen concentrations, effectively changing the water pH and Eh, and leading to metals precipitation. These particulates are then erroneously filtered and may lead to a negative bias in the filtered sample results.

E.1.2 Filtration techniques. The following instructions will focus on in-line positive and negative pressure filtration of aqueous media. In-line filtration is recommended because it provides better consistency through less sample handling and minimizes sample exposure to the atmosphere. In the instructions, specific types of filtration devices will be referenced. For assessment of dissolved concentrations of major ions and trace metals, 0.1- μ m filters are recommended, although 0.45- μ m filters are normally used for most regulatory programs. In addition, analytical methods used to determine dissolved metal concentrations have historically used 0.45- μ m filters to separate dissolved and particulate phases. Therefore, if the filter pore size is changed, comparability between existing and newly generated data must be evaluated. Filters must be prerinsed following manufacturers' instructions. When no recommendations for prerinsing exist, pass a minimum of 1 L of water through the filter prior to sampling. For ground water this is done after purging is complete and before the sample collection.

E.1.2.1 Positive pressure filtration. Positive pressure filtration methods are preferred for aqueous sample filtration. Aqueous samples that may require positive pressure filtration include ground water samples, surface water samples, and potable water supply samples. To filter an aqueous sample using the positive pressure technique, a pump, filter, and tubing are required. The following are examples of equipment that may be used for positive pressure in-line filtration.

E.1.2.1.1 Pump system.

- High-flow range: 3 - 2,300 mL/min
- Low-flow range: 6 - 460 mL/min
- System flow control: $\pm 10\%$

E.1.2.1.2 Filter assembly.

- Groundwater sampling capsule: 6 to 12 mm (1/4 to 1/2 in.), tapered barb fitting
- Pore size: 0.45 mm or as dictated by project
- Continuous use pressure: 413.6 kPa (60 psi) at ambient conditions
- Maximum momentary pressure: 689 kPa (100 psi) at ambient conditions

E.1.2.1.3 Filtration procedure.

Use polytetrafluoroethylene (PTFE) (PTFE is commonly referred to using the registered name of Teflon) tubing for pump and filter connections.

Connect the appropriately sized in-line filter to the discharge tubing from the pump. Make sure the flow arrow on the filter is pointing in the correct direction and the system is leakproof.

Apply pressure to the liquid sample (via pump) to force it through the filter directly into the appropriate sample container at a pressure recommended by the equipment manufacturer.

Replace the in-line filter when the flow becomes too restricted because of a buildup on the filter. To replace the filter, discontinue pumping (turn off pump), relieve the pressure in the system (line between the pump and the filter), and disconnect the filter and replace with a new one.

- Preserve the sample as necessary and verify that the pH is sufficient for the criteria.

Verify that a PTFE liner is present in the cap. Secure the cap tightly.

- Label the sample bottle with an appropriate label. Be sure to include all necessary information.
- Record the information in the field logbook and field sheet, and complete all chain-of-custody documents (see Instruction F-1, "Documentation," Appendix F).
- Release the pressure in the filtration equipment, disconnect sample filtration device from the discharge tubing, and thoroughly decontaminate or properly dispose of all equipment and materials in accordance with the project sampling and analysis plan.

E.1.2.2 Negative pressure filtration. Aqueous samples that may require negative pressure filtration include ground water samples, surface water samples, and potable water supply samples. To filter an aqueous sample using the negative pressure technique, a pump, filter, sample collection container, and tubing are required. The following equipment may be used for negative pressure (vacuum) filtration:

E.1.2.2.1 Pump system, hand-operated vacuum/pressure pump

- Maximum vacuum: 25 in. Hg
- Maximum pressure: 103.4 kPa (15 psi)
- Composition: metal or polyvinyl chloride (PVC)

E.1.2.2.2 Filter assembly, Nalgene filter funnel/collection flask

- Filter composition: cellulose nitrate
- Pore size: 0.45 μ m or as dictated by project
- Collection flask capacity: 500 mL (16.5 fl oz)
- Composition of assembly: Polystyrene (sterilized)

E.1.2.2.3 Filtration procedure.

Select a presterilized filter assembly with a filter of appropriate pore size.

Connect vacuum tubing to the pump and the filter assembly. Use PTFE tubing for pump and filter connections and verify that it is leakproof.

Pour the aqueous sample into the filter funnel portion of the filtration assembly. Avoid excessive turbulence or agitation of the sample, or transferring solids that may have settled to the bottom of the sample container.

Using a vacuum pump, create a negative pressure as recommended by the equipment manufacturer in the collection vessel of the filtration assembly to start the filtration process.

- Collect the filtrate (sample) into the collection flask or other vessel.

Replace the filter funnel portion of the assembly when the filter becomes too restricted because of solids buildup on the filter. To replace the filter, depress the pressure/vacuum release button, disconnect the filter funnel and replace it with a new one, create a vacuum with the hand pump, and continue filtering the remaining sample.

- Release the negative pressure at the vacuum pump and in the filtration equipment; disconnect the collection flask.
- Transfer the filtrate from the collection flask into appropriate sample containers, avoiding excessive turbulence or agitation to the sample.
- Preserve the sample as necessary and verify that the pH is sufficient for the criteria.

Verify that a PTFE liner is present in the cap. Secure the cap tightly.

- Label the sample bottle with an appropriate label. Be sure to include all necessary information.
- Record the information in the field logbook and field sheet, and complete all chain-of-custody documents (see Instruction F-1, "Documentation," Appendix F).
- Discard or decontaminate all sample filtration equipment and materials in accordance with the project sampling and analysis plan.

E.1.3 Potential problems.

E.1.3.1 One inherent problem associated with the filtration of aqueous environmental samples is the filter becoming clogged. The following are some considerations regarding liquid filtration:

- Always have extra filters available at the sampling site.
- Prefilter dirty samples with a larger pore size filter.
- For highly turbid samples a negative filtration system may be more efficient.
- Avoid pouring sediments from the bottom of the collection flask into the filter funnel.
- When the filtrate flow becomes too slow because of filter loading, change the filter. Avoid increasing the pressure and rupturing the filter membrane.

E.1.3.2 To verify the effectiveness of the decontamination procedures, as well as to evaluate the cross-contamination potential of the filter media, recommend collection of equipment blanks. A detailed discussion of equipment blanks is contained in Instruction G-2 (Appendix G).

E.1.4 Other filtration procedures. The filtration techniques outlined in the preceding paragraphs provide some specifics for filtering various liquid media in the field. Other guidelines for filtration techniques exist, i.e., American Society for Testing and Materials (ASTM). As with any technique, the technical team should consider their project objectives and how their procedure will affect the chemistry of the sample before analysis. Such factors as aeration, agitation, temperature, pressure, adsorption, chemical compatibility, etc., should all be considered.

E.2 Homogenizing Techniques

E.2.1 Scope and application. This instruction provides guidance for homogenizing samples. Proper homogenization is vital to accurately assessing the condition of a particular site. Correct homogenization techniques are also important for preparing the necessary quality control (QC) samples associated with a typical sampling event. Homogenization techniques should not be used when samples for volatile organic analyses (VOA) or other parameters that require undisturbed samples are collected.

E.2.2 Sample handling and mixing. An integral part of any sampling investigation is obtaining samples that truly represent the site under investigation. Therefore, applying proper homogenization techniques will help ensure that conditions are being accurately represented. Generation of field control samples (e.g., replicate samples) provides a means for evaluating matrix heterogeneity and the sampling and handling techniques of field personnel. However, for this evaluation to be meaningful, field sampling personnel must be able to properly homogenize and divide collected samples.

E.2.2.1 Sampling equipment composition. The composition of sampling equipment can affect sample analytical results. Sampling materials used must be properly decontaminated and must not contaminate the sample being collected. The standard materials for sampling equipment used to collect samples for trace organic compounds or metals analyses are given in Table E.1. This table may be used as a guide to select the proper sampling instruments.

Table E.1
Standard Materials for Sampling Equipment

Analysis/Site Condition	Preferred Material
Metals	Glass or PTFE
Organics	Stainless steel, glass, or PTFE
Corrosive Soil/Waste	Glass or PTFE

E.2.2.2 Required sample volumes. The volume of sample obtained should be sufficient to perform all required analyses with an additional amount collected to provide for quality control needs, including any split or replicate samples. The volume of sample required by the laboratory depends on the analyses to be performed. Volumes and containers identified in Appendix B are sufficient volumes for the prescribed analysis. If deviations from these volumes are necessary due to low sample yields, the laboratory receiving the sample and conducting the analyses should be consulted for alternative volume requirements. The volumes of samples collected from waste sources at hazardous waste sites or samples from sources that are known to be toxic should be kept to an absolute minimum since disposal costs of excess sample material are high. The laboratory or project personnel may require that excess sample volume be returned to the site because of the hazardous nature of the samples or because of sensitive political issues surrounding the project. If samples are being collected for bench-scale or pilot-scale remediation studies, larger volumes may be necessary. This scenario normally involves sending large bulk volumes to a laboratory to undergo various applications/manipulations to identify the optimum conditions for remediation of a particular waste stream. The data user (i.e., design engineer) or laboratory should be contacted to determine the volume of material required.

E.2.2.3 Aqueous samples. Aqueous samples are typically considered homogeneous because of the physical properties of water, such as diffusion and the ability to flow and freely mix. Therefore, aqueous samples do not require mixing. However, when solids are present within the aqueous samples, viscous or semisolid liquids are encountered, and the sample will require mixing. These samples can be shaken well

or stirred thoroughly with a tool of appropriate composition. The sampler may also encounter portions of the media that are immiscible with water and separate into distinct phases. In these situations, it is advisable to collect a sample from each layer/phase as well as a homogenized sample. When multiple phases are sampled, the sample should be homogenized in the laboratory to achieve the most homogeneous sample. Water samples (potable well, monitoring well, surface water) should be obtained by alternately filling sample containers from the same sampling device for each parameter. Split and replicate samples will be collected simultaneously with the primary samples. Containers for VOA will be filled first, followed by containers for semivolatile organics, metals, cyanide, and water quality parameters. Each VOA container should be completely filled immediately, rather than splitting the water between bottles and filling the bottles incrementally. The containers will all be filled from the sampling device if possible. If this is not possible, a minimum of two containers (one for the primary sample and one for the split sample) will be filled from each sampling volume. If more than two containers can be filled from one sampling volume, the number of containers filled should be an even number (i.e., two or four) so that an equal number of containers for the primary and split samples are prepared. The remaining portions of the sample will then be prepared by splitting each sampling volume between containers for the primary and replicate samples.

E.2.2.4 Solid samples. Obtaining samples in a soil or sediment matrix requires homogenization of the sample aliquot prior to filling sample containers. However, volatile organic samples are the exception; samples being analyzed for volatile organic compounds (VOCs) must always be taken from discrete locations prior to mixing. Refer to Instruction E-4 for additional information on the collection, handling, and storage of solid VOC samples. This practice is necessary to prevent loss of volatile constituents and to preserve, to the extent practicable, the physical integrity of the volatile fraction. Homogenization of the sample for remaining parameters is necessary to create a representative sample media. Moisture content, sediments, and waste materials may inhibit the ability to achieve complete mixing prior to filling sample containers. Consequently, alternative procedures may need to be pursued, i.e., kneading, particle size reduction (PSR), or particle size separation (PSS). However, it is extremely important that solid samples be mixed as thoroughly as possible to ensure that the sample is as representative as possible of the sample location.

E.2.2.4.1 Before sample mixing is performed, instructions on the removal of extraneous sample materials (grass or materials in "root zone," leaves, sticks, rocks, etc.) should be given. This can be accomplished by the removal of material by a gloved hand, or through the use of PSS devices (i.e., sieves). Other procedures employed may include PSR techniques. This may be as simple as breaking up large material with a hammer, or may include more elaborate techniques (grinder or mill). However, many of these PSR devices are difficult to decontaminate, and may not be conducive to trace level chemical analyses.

E.2.2.4.2 Homogenization procedures may be accomplished by several methods. The method best suited for the media will depend on the physical characteristics of the solid material (e.g., heterogeneity of media, maximum particle size present, moisture content, etc.). In general, homogenization is accomplished by filling a properly decontaminated container with the sample and mixing it with a decontaminated implement. The container should be large enough to hold the sample volume and accommodate the procedures without spilling. In most cases, the method of choice for mixing is referred to as cone and quartering and can be performed in a bowl or tray of an appropriate material (depending on the analytical parameters to be performed). First all the soils will be disaggregated to less than 6-mm (1/4-in.) diameter as the sample is mixed. The soils are then gathered into a pile in the middle of the container and divided into quarters. Each quarter is mixed, then soils from opposite corners are mixed together again. Soils are then partitioned into quarters again, and this time adjacent corners are mixed together, then the whole combined again. The extent of mixing required will depend on the nature of the sample and should achieve a consistent physical appearance before sample containers are filled. The soils are then divided into final quarters, which are equally subsampled to fill the appropriate containers. If the solid medium is not amenable to cone and

quartering techniques due to the high moisture content or high cohesiveness of the waste, recommend kneading techniques be pursued. First place the sample into a clean noncontaminating bag, and knead materials thoroughly to mix the sample.

E.2.3 Potential problems.

E.2.3.1 The true homogenization of soil, sediment, or sludge samples may be difficult to accomplish under field conditions. However, the homogenizing techniques may be evaluated with the use of a noninterfering dye. The noninterfering dye should be added to the sample medium prior to homogenizing procedures. The resulting distribution of the dye throughout the sample medium during the mixing will indicate the effectiveness of the procedures and areas requiring further mixing.

E.2.3.2 Another important aspect of obtaining a representative sample is to employ proper subsampling techniques. Recommend as a final step of the mixing that the material as a whole be subsampled as equally as possible. This may be accomplished by the procedures already noted or as follows. Flatten the piled material into an oblong shape. Using a flat-bottomed scoop, collect a strip of material across the entire width of the short axis. Repeat this procedure at evenly spaced widths until the sample containers are filled. If the material is cohesive, the solid medium may be flattened, and cut into cubes. Collect random cubes into a subsample, which will be rekneaded and placed into the appropriate sample containers.

E.3 Compositing Samples

E.3.1 Scope and application. This instruction provides information on the various types of composite sampling techniques and the proper procedures to obtain a composite sample. The technique of compositing discrete samples is typically employed when the site under investigation is quite large to improve the precision (lower the variance) of the estimated average contaminant concentrations, especially when contamination exhibits a short-range heterogeneity, and to decrease the probability of making a wrong decision based on limited data. Consultation with data users should be done to determine the appropriateness of applying compositing schemes to meet project objectives. Compositing scenarios that employ a retesting scheme may also be effective in identifying hot spots if a majority of the discrete samples are anticipated to be nondetect and there is adequate sensitivity of the analyses. In this case, the maximum number of discrete samples composited should be determined based on the dilution factor imposed and the sensitivity of the analyses in relation to the project decision level. Compositing schemes are of most benefit when analytical costs are high or analysis is time-consuming relative to sampling costs. Composite sampling may also decrease overall sampling and analytical costs. Composite sampling is not specific to one matrix. Rather it can be utilized for solid, semisolid, liquid, and air matrices.

E.3.2 Compositing techniques. Composite samples consist of a series of discrete grab samples that are mixed together to characterize the average composition of a given material. The discrete samples used to make up a composite sample are typically of equal volume, but may be weighted to reflect an increased flow or volume. Regardless, all discrete samples must be collected in an identical fashion. Likewise, the number of grab samples forming a composite should remain consistent (i.e., a number and pattern for collection of grab samples within a grid should be selected and, for a given grid size, should not be changed). Five types of composite samples are discussed in the following sections.

E.3.2.1 Flow-proportioned composite. Flow-proportional composite samples are collected proportional to the flow rate during the compositing period by either a time-varying/constant volume or a time-constant/varying volume method. This type of sampling is usually associated with wastewater or storm water runoff sampling. To enhance the representativeness of the flow-proportioned composite sample, suggest collection using an automatic sampler that is paced by a flowmeter. Automatic samplers reduce human error, and can directly correlate flow with both sample size and time. Figure E-1a and c illustrate flow-proportioned composite sampling.

E.3.2.2 Time composite. A time composite sample is composed of a varying number of discrete samples collected at equal time intervals during the compositing period. The time composite sample is typically used to sample wastewater and streams, and in some air sampling applications. Time composite samples are typically obtained using automated programmable samplers. When a large number of locations must be sampled, automatic samplers may be set up to sample these locations simultaneously with minimal supervision and costs. In hazardous situations, use of automatic samplers can reduce personnel contact with hazardous waste streams or with potentially dangerous sampling environments. The disadvantages of automatic sampling equipment are its high cost and extensive maintenance requirements. These disadvantages can be offset by reduced labor requirements, proper maintenance, and the proper choice of equipment. When access to the waste stream is relatively easy and sufficient labor is available, manual methods are also quite effective. The most significant disadvantage of manual sampling is that it is labor-intensive, particularly with respect to long-term composite sampling. Figure E-1b illustrates equal time compositing.

E.3.2.3 Areal composite. Areal composite samples are samples collected from individual grab samples collected in an area or on a cross-sectional basis. Areal composites are made up of equal volumes of grab samples where all grabs are collected in an identical manner. Areal composite sampling is typically used for estimating average contaminant concentrations in surface soils or sediments. This is especially

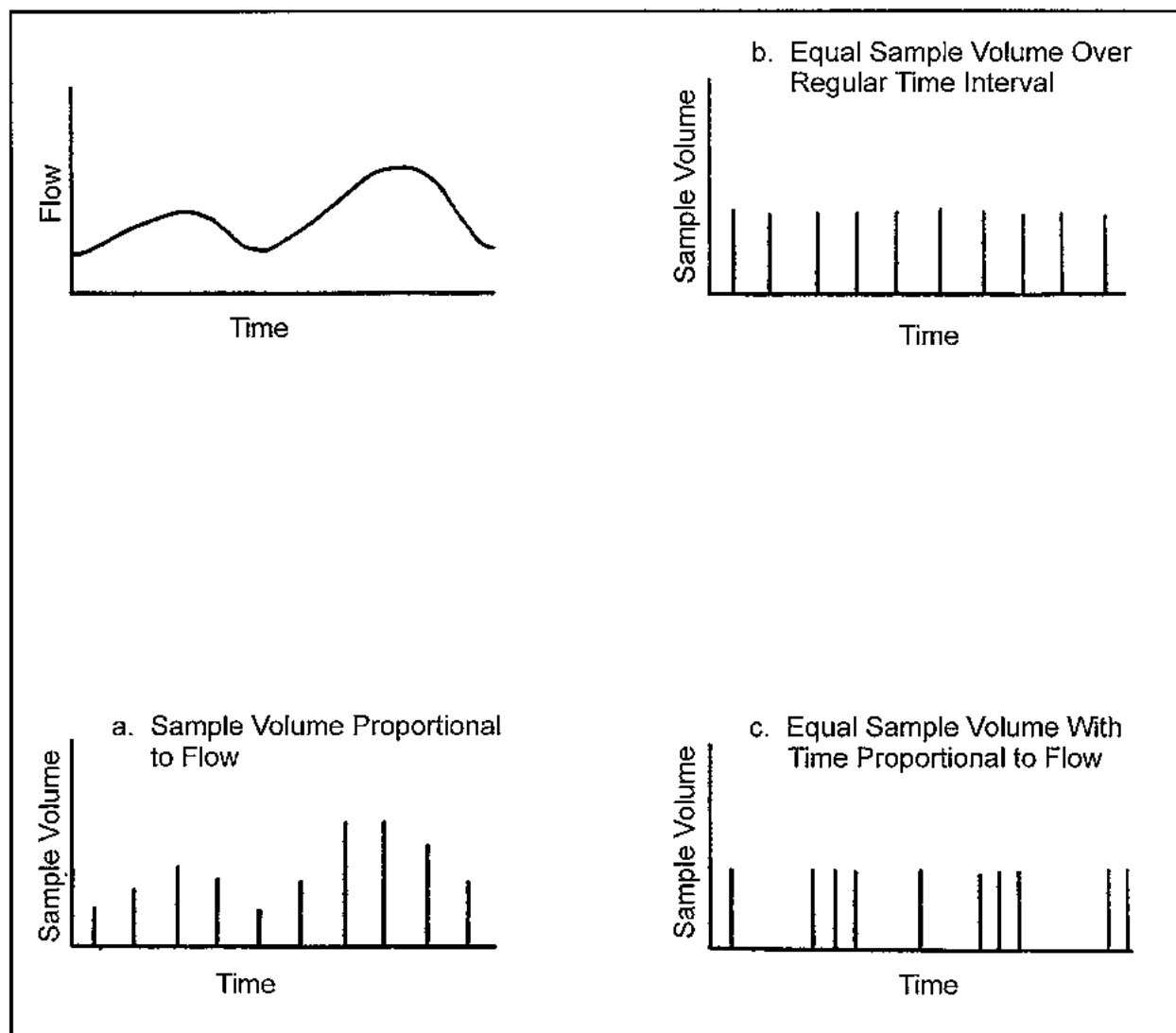


Figure E-1. Composite sampling methods

useful when contaminants are present in a nugget form (i.e., TNT chunks, lead shot, etc.), exhibiting large differences in concentration in a small area (short-range heterogeneity). Grid sizes should be kept moderate (1.5 to 3 m (<5 to 10 ft) in diameter), if project objectives and intended use of the data are to maintain aspects of a “discrete” sample while providing better overall coverage. Reference Jenkins et al. (1996a) for additional details on the use of short range areal composite sampling techniques.

E.3.2.4 Vertical composite. Vertical composite samples are also collected from individual grab samples but taken from a vertical cross section. Vertical composites are also made up of equal volumes of grab samples where all grab samples are collected in an identical manner. Vertical profiles of a soil borehole or sediment columns are examples of vertical compositing.

E.3.2.5 Volume composite. Volume composite samples are collected from discrete samples whose aliquot volumes are proportional to the volume of sampled material. This type of composite is usually

associated with hazardous waste bulking operations, where the composite sample is intended to represent the combined or bulked waste. Discrete samples are typically combined within a group of compatible wastes to undergo physical and chemical testing to define disposal options or determine acceptability at a treatment, storage, and disposal facility.

E.3.3 Compositing grab samples. In general, compositing grab samples lends itself to lowering analytical costs because it reduces the number of analyses. Collecting composite samples also requires project-specific decisions for several key points, including the type of composite sampling technique that will meet the project needs (i.e., time composite, areal composite, etc.); the total number of composite samples needed; the number of grab samples in each composite; and the size and pattern of the sampling grid. These issues may depend on the size of the area under investigation, the nature of the contaminants, and the position of the regulators. Good documentation of sampling locations is also essential in all field sampling, particularly when several grab samples are being homogenized to form a composite. If a contaminant is detected in a composite sample, each of the discrete grab samples that made up the composite should be analyzed individually to determine the actual distribution of the contamination. Procedures should be established between the project manager and the laboratory to ensure that holding times for the discrete grab samples are not exceeded. However, caution should be exercised when reviewing this type of confirmatory analysis due to the lag time between sample analyses and expiration of the holding times of the samples.

E.3.3.1 Solid matrix. Composite samples should be prepared as follows:

- Collect discrete grab samples using the appropriate instructions as outlined in Appendices C and D. To obtain a representative composite sample, it is important that all grab samples are collected in identical fashion.
- Homogenize the individual discrete samples as outlined in Instruction E-2, and place them into properly labeled sample containers.
- Assemble the sample containers that contain the grab samples that will make up a specific composite sample.
- Remove an appropriate volume of discrete sample (aliquot) from each sample container and place it into a clean stainless steel mixing bowl. Each aliquot amount should be taken in an identical fashion to facilitate representativeness. Avoid generating excess contaminated soil when possible.
- Homogenize the aliquots as described in Instruction E-2.
- Remove sample amounts from the homogenized composite sample and place them into the proper containers for shipment to the laboratory.
- Place the individual homogenized discrete samples in proper storage conditions after aliquots are removed for compositing, when a retesting scheme is employed, or if it is of benefit to the project. If the composite sample results do not appear to be accurate or if evidence of contamination exists, subsequent analyses of the individual grab samples that composed the composite may confirm the results and provide discrete information.

E.3.3.2 Liquid matrix. The preparation of liquid matrix composite samples is typically easier than that of solid matrices due to the tendency of liquids to homogenize easily. Also, it is common practice to send liquid grab samples to the laboratory for compositing because of the difficulties in handling larger sample volumes (4 to 16 L (1 to 4 gal) for a typical wastewater sampling event) and to minimize the potential

to introduce contaminants. When liquid composite samples are to be generated in the field, the following procedure should be used:

- Assemble all sample containers that contain the grab samples that will make up a specific composite sample.
- Shake or stir the individual containers to homogenize.
- Using clean glass or disposable pipets, deliver aliquots of the homogenized grab samples directly into a sample container to be sent to the laboratory. (It will require five 200-mL (7-fl-oz) aliquots from five discrete grab samples to generate a 1,000-mL (33-fl-oz) composite sample).
- Seal the container and shake well to mix. Avoid stirring samples if possible to lower the potential of introducing contaminants.
- At some sites it may be beneficial to save and store the individual homogenized grab samples after aliquots are removed for compositing. If the composite sample results do not appear to be accurate, subsequent analyses of the individual grab samples that composed the composite may confirm the results. Confirmatory analyses of these samples would likely be for informational purposes only since the holding times of the samples may have expired.

E.3.4 Potential problems.

E.3.4.1 Compositing does not allow the spatial variability of contamination or discrete information to be determined. Additional analyses of the individual grab samples are required.

E.3.4.2 Low concentrations of contaminants in individual grab samples may be diluted so that the total composite concentration is below the detection limit. In this case, the existence of the contamination in individual samples would go unnoticed. Therefore, the maximum number of discrete samples composited should be based on the dilution factor from the compositing and the analytical sensitivity in comparison to the project decision level and sensitivity requirements.

E.3.4.3 When the sampled medium is not amenable to mixing techniques (samples are moist and clayey), it may be very difficult to create a homogeneous sample mixture. Consequently, the resulting composite may not represent an average of all the grabs.

E.3.4.4 Compositing techniques should not be employed when chemical interactions may diminish the integrity of the sample (i.e., VOC samples).

E.3.4.5 Compositing schemes are not efficient when the goal is to identify hot spots and there is a high probability that the discrete samples contain detectable concentrations. The amount of retesting may be significant to achieve the objectives.

E.3.4.6 Compositing schemes are not efficient if analytical costs are low.

E.3.4.7 Obtaining samples by an automatic sampling device is typically difficult for the first-time user. However, after the sampler has become familiar with the sampling device and any problems have been addressed, these devices prove to be quite reliable.

E.4 Collection, Handling, and Storage of Solid Samples for VOC Analysis

E.4.1 Scope and application.

E.4.1.1 This instruction presents guidance for the collection and handling of surface/subsurface sediments, soils, and solid hazardous waste materials taken for VOC characterization. The procedures include collection, handling, storage, and onsite preparation for analysis of discrete samples; and collection, handling, and storage of discrete samples for offsite sample preparation. Information concerning the selection and application of the sampling devices available for subsurface bulk sample collection can be found in Instructions C-5 and C-6, Appendix C, and Instruction D-1, Appendix D.

E.4.1.2 Special procedures are necessary for VOCs, since in most solid matrices these analytes coexist in gaseous, liquid, and solid (sorbed) phases. Loss of analyte from any one phase may render the sample unrepresentative of the material as a whole. Therefore, sample collection, handling, and analysis must be performed under conditions that maintain the accountability of VOCs in all phases. In general, uncontrolled VOC losses occur through two mechanisms: volatilization and degradation. Volatilization losses occur whenever gaseous molecules are allowed to move away freely. This loss mechanism usually dominates whenever a new surface is created. Traditional sampling procedures used for acquisition of solid VOC samples are very susceptible to this type of loss. Further losses during transport and storage are common if fine soil grains are present on the threads of the vial or at sealing surfaces, thereby preventing a good seal. The most significant VOC losses, however, are due to the reopening of the vial and sample handling at the laboratory. In general, the extent to which VOCs are lost will depend on the vapor phase concentration (analyte vapor pressure), extent of surface area exposure, length of exposure, and porosity of the sample matrix. However, studies have shown VOC losses of a magnitude 10X and higher are common. Degradation losses are usually attributable to biological processes. Aerobic biological degradation dominates, because traditional intrusive collection methods expose the sample to oxygen in the atmosphere. The rate of biological degradation depends on several factors, including the indigenous microbiological population, chemical properties of the VOC, nutrients, moisture, and temperature. Aromatic compounds are quite susceptible to this loss mechanism, and preservation by cooling to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ has been found to be insufficient in retarding biological degradation.

E.4.1.3 Solid sample preparation for VOC analysis is typically performed by vapor partitioning (i.e., purge-and-trap or headspace), or by methanol extraction. Refer to Method 5035, EPA/SW-846, for these sample collection procedures. In general, when VOC analysis is performed by gas chromatography or gas chromatography/mass spectrometry, vapor partitioning methods are used for solid samples thought to be contaminated with VOCs at levels lower than 0.2 mg/kg (Method 5035, low-level method). In contrast, solid samples thought to have concentrations above 0.2 mg/kg are analyzed after extraction (dilution) with methanol (Method 5035, high-level method). Method 5035 has been designed to improve the sample handling and preservation procedures and minimize the negative bias in VOC results by incorporating several preparatory steps traditionally performed in the laboratory into the field. These sample collection procedures differ significantly from traditional methods and impact several technical personnel in both the field and laboratory. These changes require increased coordination and communication between parties involved to ensure successful acquisition of representative solid VOC samples. The procedures discussed in this instruction are for clarification and implementation of SW-846 Method 5035, and are designed to limit sample VOC losses by volatilization and biodegradation. This is accomplished by stressing that samples are collected only from freshly exposed surfaces, sample collection and transfer are performed quickly and in a nondisruptive fashion whenever possible, sample procedures follow Method 5035 low-level (purge and trap), or high-level (methanol) extraction procedures, or samples are taken in an airtight vessel cooled to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$, and are held up to only 48 hours prior to analysis. It is important to recognize that Method 5035 low-level (closed-system purge-and-trap) procedure requires the laboratory to have special equipment

designed to handle VOA vials in an automated sample introduction system. Furthermore, these methods of analysis do not necessarily apply to water-soluble VOCs. For information concerning the analysis of water-soluble VOCs, refer to SW-846 Method 5000.

E.4.2 Sampling strategy and number of samples.

E.4.2.1 In general, the selection of methodology — low-level versus high-level method — will depend on project data quality objectives (DQOs) (action or decision levels), and the expected VOC concentrations of the environmental matrices to be sampled. This is illustrated in the flow chart in Figure E-2. As shown in Figure E-2, the high-level method is used when VOC action levels are relatively high or the VOC concentrations are greater than 200 g/kg. The low-level method is used when project action levels are low, or site VOC concentrations are less than 200 g/kg. When action levels are low, field screening should be performed to direct the acquisition of either low-level or high-level samples. Recommend the field screening be performed by onsite gas chromatography, or according to procedures described in Hewitt and Lukash 1997. If no field information is available, both low-level and high-level samples must be collected. The collection of both low-level and high-level samples for fixed-laboratory analyses constitutes the most conservative approach to avoid the need for remobilization/resampling efforts to obtain necessary data.

E.4.2.2 Screening techniques at the laboratory are also recommended to confirm any onsite results and to avoid damage to laboratory instrumentation. If no onsite or laboratory screening is performed, and both low-level and high-level samples are submitted to the laboratory, the laboratory should perform the high-level analyses first, and if no VOCs are detected, analyze the corresponding low-level sample. If the low-level sample is analyzed initially without further information, the laboratory runs the risk of contaminating the analytical system (requiring significant maintenance) and potentially impacting data of other samples within that analytical batch. Reanalysis using appropriate preparatory procedures is necessary for any samples that exceed the calibration range of the instrument.

E.4.2.3 Regardless of the methodology employed, several collocated samples will generally be required for each sample location (e.g., from each sampling depth or soil boring). The exact number of required collocated samples will depend on several factors, including analytical methodology (the high-level versus the low-level method), field screening results, the laboratory's protocols for screening of samples, and project requirements for field QC samples (e.g., matrix spikes and duplicates). For example, when low-level analysis is required and field screening results show site VOC concentrations to be low, at least two samples must be collected for analysis. Two samples are necessary due to the entire vial being processed during the VOC analysis. The second vial allows the laboratory an opportunity to perform an additional low-level analysis should the first analysis be unacceptable. When low-level analysis is required and the site VOC concentrations are unknown, at least two samples must be collected for potential low-level analysis and one sample must be collected for potential high-level analysis. The high-level sample is subsampled and the aliquot of methanol extract diluted for VOC analysis. Therefore, one high-level sample can accommodate multiple high-level analyses. Finally, if the laboratory plans to screen the samples, an aliquot of the high-level sample may be used, or an additional sample may be collected.

E.4.2.4 For acquisition of QC samples, field screening information becomes even more important. In order to avoid the need to collect both low-level and high-level QC samples, field screening should be performed, or alternative collection procedures (i.e., EnCore™) employed for these QC samples. For example, the field duplicate typically requires one additional collocated sample, while the matrix spike/matrix spike duplicate requires an additional two samples. However, if no information on site VOC concentrations is available, this could expand to three samples for the field duplicate (two for low-level and one for high-level), and six additional samples for the matrix spike/matrix spike duplicate. In addition to the samples

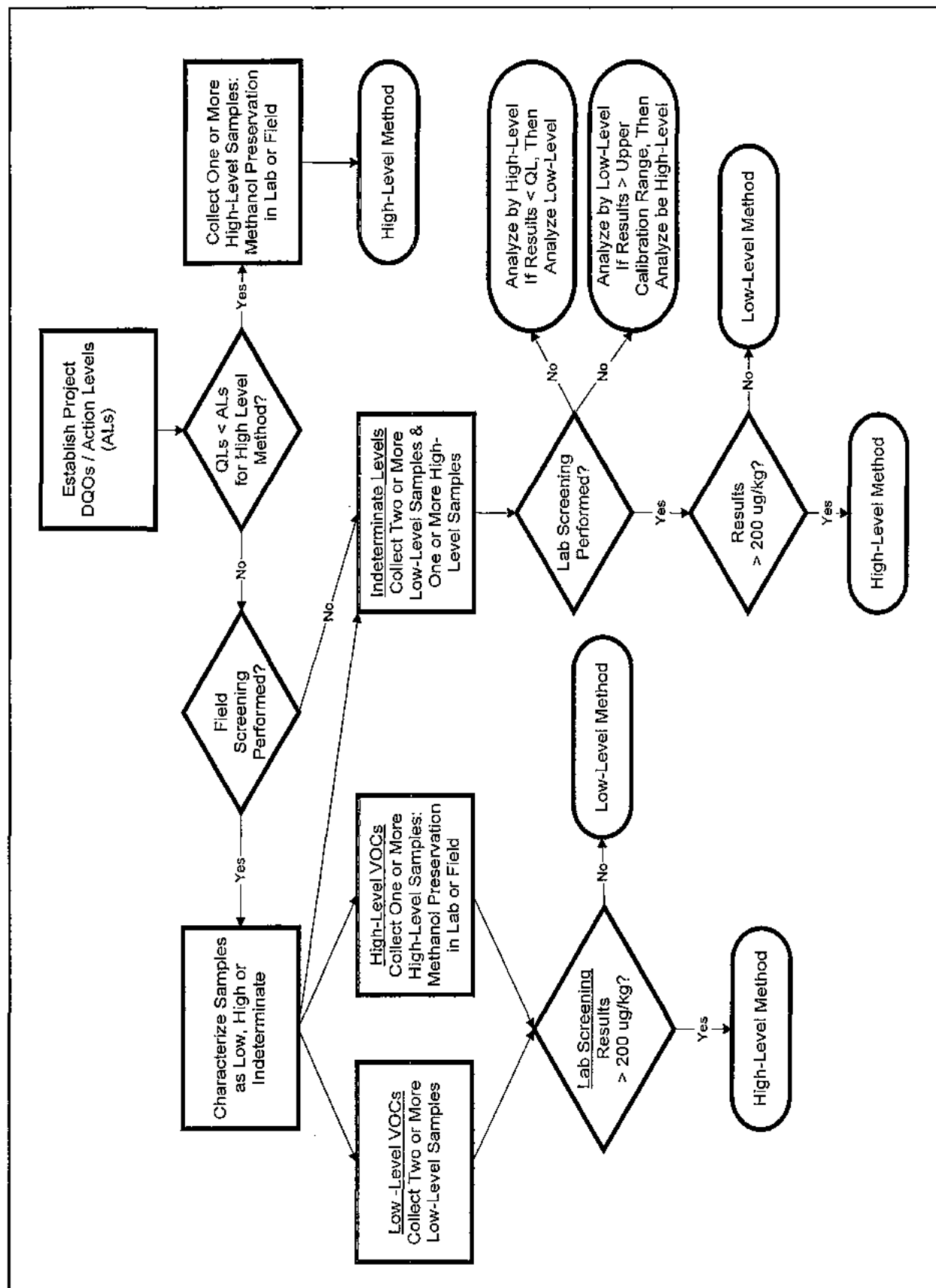


Figure E-2. VOC analysis decision tree

collected for VOC analysis, another collocated sample must be collected for a moisture content determination in order to report the VOC results on a dry-weight basis. Samples for moisture content determinations may be collected in conventional VOA vials and cooled to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Proper project coordination between field and laboratory personnel and implementation of onsite and/or laboratory screening processes can help reduce the numbers of samples to manageable quantities.

E.4.3 Sample collection summary. In order to minimize VOC losses, Method 5035 sample collection and preparation procedures dramatically modify both the low-level and high-level VOC methods. The revised sample collection techniques greatly reduce the time in which samples are exposed to atmospheric conditions. Initially to help maintain the physical structure of samples of a cohesive granular material, a hand-operated coring device must be used to collect the appropriate sample size for laboratory analysis (e.g., cylindrical soil columns are extruded into vials using disposable plastic syringes with the tapered front ends removed). However, some materials (e.g., cemented or noncohesive granular material) may be too difficult for coring tools to penetrate or contain. These materials can be sampled by fragmenting a larger portion of the material with a clean chisel to generate aggregate(s) of a size that can follow sampling protocol 2 (placed into a VOA vial or bottle containing chemical preservative). When aggregate(s) are transferred, precautions must be taken to prevent compromising the sealing surfaces and threads of the container. Losses of VOCs using this procedure are dependent on the location of the contaminant relative to the surface of the material being sampled. Therefore, caution should be used during data interpretation. As a last resort when this task cannot be performed onsite, a large consolidated sample can be collected in a vaportight container and transported to the laboratory for subsampling. Sample protocol 2 presents a sample being added to collection vials containing chemical preservatives such as sodium bisulfate solution or methanol for the low-level and high-level methods, respectively. Field personnel transfer samples immediately into preweighed vials containing chemical preservatives without additional sample handling. The vials and chemical preservative are weighed in the field before use, and are reweighed after the sample aliquot addition to obtain the net sample weight. Alternatively, samples for both the low-level and high-level methods may be collected following sample protocol 1. Sampling is performed with a coring device, which becomes the sample container and is hermetically sealed (e.g., EnCore™ sampler from En Chem, Inc.) and stored at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for a maximum of 48 hours.

E.4.3.1 Sampling protocol 1.

E.4.3.1.1 Sampling protocol 1 consists of a coring device that also serves as a shipping container. Presently, the EnCore™ sampler is the only commercially available coring device that was designed to collect, store, and transfer soils with minimal loss of VOCs. The disposable EnCore™ sampler is designed to be a single-use coring device that stores the soil sample in a hermetically sealed, headspace-free containment that maintains sample integrity. Most soils that require sampling will consist of cohesive granular materials, which allow the use of such a coring device. However, the sampling protocol will not be applicable to all solid environmental matrices. Some geological materials are impossible to core (e.g., gravels and hard dry clays). Refer to sampling protocol 2 for guidance on handling these materials. The EnCore™ sampler has a hand-operated coring tool available for obtaining 5-g and 25-g samples. The 25-g sampler is designed for the zero headspace extraction for purposes of the VOC Toxicity Characteristic Leaching Procedure testing. Note that the 25-g sampler should not be used to collect, store, and transfer soils from the field for subsampling in the laboratory into 5-g aliquots. This additional sample handling would defeat the benefit that the EnCore™ sampler affords.

E.4.3.1.2 Advantages of sampling protocol 1 include the simplified field procedures, which do not require sample weighing or addition of preservatives in the field. Because sample preparation is performed at the laboratory, exposure hazards and Department of Transportation (DOT) shipping issues arising from

the field application of chemical preservatives such as methanol are also avoided. However, samples must be stored at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and prepared for analysis within 48 hours of collection. The short holding time for sample preparation usually requires additional coordination with the analytical laboratory and may involve higher analytical costs. The following is general guidance for the collection of a soil sample using the EnCore™ sampler:

- After the split spoon is opened and a fresh surface is exposed to the atmosphere, the sample collection process should be completed in a minimal amount of time with the least amount of disruption (disaggregation) as possible. Visual inspection and an appropriate screening method (e.g., photoionization detector or flame ionization detector readings) may be selected to determine the interval of the soil core to be sampled.
- Rough trimming of the sampling location surface layers should be considered if the material may have already lost VOCs (been exposed for more than a few minutes) or if it may be contaminated by other waste, different soil strata, or vegetation. Surface layers can be removed by scraping the surface using a clean spatula, scoop, or knife.
- Insert the clean coring tool into a fresh surface for sample collection. Take care not to trap air behind the sample. An undisturbed sample is obtained by pushing the barrel of the coring tool into a freshly exposed surface and removing the corer once it is filled.
- The exterior of the barrel should be quickly wiped with a clean disposable towel to ensure a tight seal and the cap snapped on the open end.
- The sampler should be labeled, inserted into the sealable pouch, and immediately cooled to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$.
- Repeat this procedure to collect separate collocated samples for moisture content and any QC samples.
- Prepare the shipment to go to the laboratory. If samples are going to be shipped near the weekend or holiday, recommend coordinating with the receiving laboratory to ensure holding time of 48 hours for the EnCore™ sample is met.

E.4.3.2 Sampling protocol 2.

E.4.3.2.1 Sampling protocol 2 is applicable to all solid matrices. However, if soils are not retained within the coring device (i.e., wet enough to flow), it may be necessary to cover the open end of the coring device with aluminum foil in a manner that will maintain sample integrity until the material is transferred to appropriate sample vials. When gravel, or a mixture of gravel and fines, that cannot be easily obtained using coring tools is sampled, a sample may have to be transferred using a clean spatula or scoop. The collection vial will contain the chemical preservative; therefore, samples should be dislodged with minimal splashing and without the spatula or scoop contacting the liquid contents. For some solids, a wide-bottom funnel or similar channeling device may be necessary to facilitate transfer to the container and prevent compromising the sealing surfaces of the container. Losses of VOCs are likely because of the additional sample handling and the noncohesive nature of the material, which exposes more surface area to the atmosphere. Another potential source of error during the subsampling process is the separation of coarser materials from fines, which can skew the concentration data if the VOC contamination is associated with particular particle sizes, which are not properly represented in the sample. Also, due to an aqueous acidic

solution of sodium bisulfate being used to preserve samples for the low-level analyses, samples must be tested for carbonate interferences in the field before the samples are containerized. If carbonates are present, the sodium bisulfate may potentially react with the carbonates producing effervescence, which promotes the loss of VOCs. The high-level method is not affected by the presence of carbonates. In these cases, alternative procedures (i.e., EnCore™ or high-level method) should be used. All sampling difficulties should be well documented in field logbooks and caution used in the interpretation of the data obtained from these types of materials. Finally, recommend the field personnel become familiar with the volume of material needed to reach the estimated 5 (or project-specific) grams. For cohesive soils, recommend approximating a mark on the disposable syringes to help guide the acquisition of the soils needed. For other materials, preweighing materials to the volume needed, which are then discarded, will help visualize the amount of material to be transferred when sampling time and sample handling are critical.

E.4.3.2.2 All of the sample containers used should be made of glass and have a thick septum cushion between the sealing material (PTFE) liner and cap (rigid plastic screw cap or aluminum crimp top). PTFE-lined caps for bottles should have flexible septum backing and be at least 10 mils thick to ensure a liquid or airtight seal. The sample containers (VOA vials) containing appropriate volume and grade (e.g., purge-and-trap grade methanol) chemical preservative should be prepared by the laboratory prior to shipment to the field. Surrogate compound(s) may be added by the laboratory at this time to allow an assessment of the sampling procedures. The laboratory should be responsible for providing trip blanks and ambient blanks (e.g., methanol). Note that the sample vials for the Method 5035 low-level method are designed to be placed directly on the laboratory's instrument (i.e., auto sampler) so that they remain within the closed system up to and during VOCs analysis. Therefore, it is critical that only the 40-mL VOA vial (and not the 60-mL VOA vial) containing the magnetic stir bars be used for the low-level analysis. Recommend that disposable stir bars be used since memory effects have been reported with magnetic stir bars that have been reused without effective decontamination. Recommend the laboratory note the tare weight of the sample vial with preservative (and stir bar, if necessary) on the sample label before sample vial shipment. After this initial weighing, sample containers should be opened only to transfer sample into them. After the sample transfer into the collection vessel, the sample container is reweighed in the field (and again in the laboratory prior to analyses). The difference in the weight, measured before and after the sample is introduced, is used to establish the sample wet weight. Any discrepancies between field weights and laboratory weights must be thoroughly documented to assess the loss of sample or extract and the acceptability of the sample for analysis as outlined in Section E.4.4.1. The following is general guidance for the collection of soil samples for field preservation for Method 5035 low-level or high-level methods.

- Solid matrices should be screened for carbonates. Refer to Section E.4.3.2.1 if carbonates are present.
- Field personnel should record the weight of the sample vials containing preservative to verify consistency with the laboratory tare weight and ensure no loss during initial transport of the sample containers to the field. Note any discrepancies back to the laboratory and in the field logbook.
- The coring device should be prepared as follows: cut off tapered front end of a disposable plastic syringe and remove the rubber cap from the plunger. A mark may be placed on the syringe to approximate the volume of material needed.
- After the split spoon is opened and a fresh surface is exposed to the atmosphere, the sample collection process should be completed in a minimal amount of time with the least amount of disruption (disaggregation) as possible. Visual inspection and an appropriate screening method

(e.g., photoionization detector or flame ionization detector readings) may be selected to determine the interval of the soil core to be sampled.

- Rough trimming of the sampling location surface layers should be considered if the material may have already lost VOCs (been exposed for more than a few minutes) or if it may be contaminated by other waste, different soil strata, or vegetation. Surface layers can be removed by scraping the surface using a clean spatula, scoop, or knife.
- Insert the clean coring tool (e.g., prepared disposable syringe) into a fresh surface for sample collection. Take care not to trap air behind the sample. An undisturbed sample is obtained by pushing the barrel of the coring tool into a freshly exposed surface and removing the corer once it is filled.
- Hold the vial or bottle containing chemical preservative at an angle when extruding the sample into the container to minimize splashing.
- Perform a visual inspection of the lip and threads of the sample vessel. Remove any foreign debris with a clean towel and cap the vial.
- Tap the vial gently while holding it in an upright position. The purpose of the agitation is to ensure that the preservative completely contacts the soil surfaces and disaggregate any large clumps. The sample vials should not be shaken vigorously or up and down.
- Measure and record the weight of each container into the field logbook and in documentation to the laboratory. Calculate the difference in weight of the container, measured before and after the sample is added, and use to determine the sample wet weight.
- Each of the samples should be immediately placed into smaller sealable plastic bags, collected within a larger plastic bag, placed inside a cooler in an upright position, and cooled to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Because of packaging constraints for shipping (e.g., need for inner receptacles), it is absolutely critical that samples be prechilled to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ prior to shipment.
- Repeat these procedures to collect separate collocated samples for moisture content and any QC samples.
- The samples are then prepared for shipment to the laboratory following the criteria and regulatory considerations described in Instruction F-2 of Appendix F.

E.4.4 Potential problems.

E.4.4.1 Field weighing. When field personnel collect samples using sampling protocol 2, they essentially perform the following activities for both the low- and high-level methods. Field personnel must weigh the vials containing the chemical preservatives (e.g., aqueous sodium bisulfate for the low-level and methanol for the high-level method), collect the samples using some type of coring device (e.g., a syringe with its tip removed), extrude the sample cores into the vials, and reweigh the filled vials (to determine the sample wet weight for analysis). A net sample weight of about 5 g is required (assuming a soil density of 1.7 g/cm^3 , this corresponds to a soil volume of about 3 cm^3). According to Method 5035, weights may be made in the laboratory and/or field. If weights are recorded in both locations, this information may be used to track any loss of sample or preservative. If field weight measurements are used, a loss of up to 0.2 g is

allowed for the vial to be considered acceptable for sample analysis. To the extent possible under field conditions, sample containers should be weighed and samples collected in a "protected" environment to permit accurate weighing and handling. Weights should be recorded to the nearest 0.1 g (or 0.01 g if balance allows) for both the low-level and high-level samples. In addition, the meniscus of the chemical preservative may be marked on the sample container to aid in the evaluation of evaporation, accidental spillage in the field, or loss during shipment. Any sample container that shows a loss of methanol (e.g., meniscus below the line marked by the lab) should be discarded.

E.4.4.2 Chemical interactions. Although not substantiated, there have been two occurrences with methanol and sodium bisulfate preservation that require discussion. In the first case, soils that contain aluminum silicates may act as a catalyst causing the conversion of methanol to acetone. The possible mechanism for this interaction is being researched. In the second case, soils like lignite or peat contain a polymeric constituent known as humic acid that may also interact with sodium bisulfate to form acetone. Until either of these two mechanisms can be confirmed or denied, projects should evaluate the potential for acetone to be a site contaminant. For example, if acetone is not an analyte of concern, then the issue may not impact project decisions. However, those projects that cannot remove acetone from the analyte list should be aware of these possible interactions and any acetone detects should be evaluated. A logical source of acetone contamination is the laboratory. Therefore, site-specific sources should always be assessed and not necessarily attributed to one of these interactions.

E.4.4.3 Shipping concerns. DOT shipping requirements need to be taken into account for the preservatives used. Depending on the quantity and method of packaging, sodium bisulfate and methanol may be DOT hazardous materials and subject to DOT hazardous materials regulations. Refer to Instruction F-2, Appendix F, for additional information.

E.4.4.4 Site safety concerns. Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Protective gloves should be worn when vials containing methanol are handled. Methanol should be stored away from open flames, areas of extreme heat, and other ignition sources. Vials containing methanol should be refrigerated (e.g., stored in coolers with ice). Sodium bisulfate is a strong mineral acid and must be handled with all safety precautions related to acids. Contact with the skin and eyes should be avoided. Protective gloves and eye protection should be worn with vials containing sodium bisulfate.

E.4.4.5 Preservative. When samples are preserved with methanol in the field, it is especially critical to avoid the introduction of contamination from external sources such as vehicular emissions or dust. Hence, when samples are preserved with methanol in the field, a methanol blank should be exposed to field conditions during the sample collection process.

E.4.4.6 Boiling point. Sampling protocol 1 using the EnCore™ sampler has not been demonstrated for compounds with boiling points less than 30 °C (e.g. bromomethane, chloroethane, chloromethane, or vinyl chloride).

E.4.4.7 Costs. Significant analytical costs may be incurred due to the level of redundant analyses (both high-level and low-level) when no site VOC concentrations are known. Recommend implementation of screening procedures at the field and/or laboratory to reduce these costs.

E.5 Laboratory Subsampling

E.5.1 Scope and application. This instruction provides direction on how to obtain a representative aliquot of sample for laboratory analysis. Obtaining this aliquot is referred to as laboratory subsampling and is performed by laboratory personnel during sample preparation steps. Current SW-846 and other standard reference methods provide little or no guidance within their preparatory methods for these critical procedures. For this reason, this instruction addresses subsampling techniques for solid, liquid, and multiphased matrices to be used by all laboratories to ensure consistency in subsampling techniques and in the resulting data. It should be noted that specific samples may require special techniques due to problematic matrices or project-specific requirements. Project-specific guidance should be obtained from appropriate project documentation (i.e., Quality Assurance Project Plan) or technical personnel. Good analytical techniques are also required during all subsampling procedures to obtain representative subsample aliquots, minimize potential bias, and accurately assess any contamination at the site. Procedures for the acquisition of soil samples for VOA sample analysis are not included here. Refer to Instruction E-4 of this appendix for information on these procedures.

E.5.2 Subsampling procedures. It is common for many analytical methods to require only a portion of the submitted sample to be subjected to the actual analysis. Excess sample volume is desirable when there is a potential that the sample will need to be reanalyzed. Because only a portion of the submitted sample is actually involved in the evaluation of the sampling location, it is important that the subsample be truly representative of the entire sample submitted. In general, subsampling techniques are distinguished by the analytical method requirements, the distribution of the contaminant within the sampled medium, and the state or condition of the aliquot to be tested. Information covering these topics are routinely available to the laboratory for all except for the contaminants distribution within the evaluated media. Therefore, unless information exists to the contrary, the laboratory should assume the contamination is distributed throughout the laboratory samples. Due to the impact of each sample on the procedures used, recommend that subsampling procedures be continuously reevaluated based on the individual matrix under assessment, subsequent analysis to be performed, and the intended use of resulting data (if known). When project DQOs dictate alternative procedures to those outlined in the following subsections, recommend project subsampling instructions be submitted along with samples to outline proper procedures to be employed. If no project instructions are provided, the following guidance should be used to establish appropriate subsampling practices. Environmental samples, which are not considered undisturbed, should be homogenized prior to arrival at the laboratory. However, laboratory personnel should not assume these samples are properly homogenized in the field. In addition, both solid and liquid matrices experience settling or phase separation during transport. Therefore, it is critical that submitted samples be properly homogenized prior to subsampling when appropriate for the analysis. Techniques used to homogenize or rehomogenize samples should be documented and executed in accordance with the guidance presented in Instruction E-2. Initial inspection of each sample to determine the sample phases, such as liquid, solid, or a combination (multiphase), is critical. Laboratory personnel should document the physical appearance of samples upon receipt, including comments about settling and phase separation. Based on the outcome of this assessment, the following procedures should be used to outline general guidelines for subsampling a variety of matrices.

E.5.2.1 Solid matrix. Soil, sediment, homogeneous and heterogeneous solid substances, concrete, paint chips, ash, etc., are to be subsampled for nonvolatile analyses according to the following guidelines. Procedures for the acquisition of soil samples for VOA sample analysis are not addressed. Refer to Instruction E-4 for information on these procedures. When solid matrices are subsampled, a decision must be made as to whether a representative subsample can be obtained without prior sample manipulation. This depends on whether the sample is homogeneous or heterogeneous in nature, as determined by visual inspection of the physical attributes of the sample, and on determining the sample particle size distribution. Particle size is

the physical dimension of the individual parts (i.e., grains of soil) of the sample. Then consider the following questions:

Is there a significant amount of oversized material (be it either naturally occurring (rocks) or artificially introduced material (debris))? Is this material intended to be included/excluded?

Are the contaminants present on a molecular scale or macroscale? For instance, are there obvious chemical inclusions (e.g., lead shot, metal chunks, tar balls, solid chemical material (grayish-white explosives)) indicating a macroscale contamination, or is contamination due to a spill/discharge that adsorbed onto individual soil particles indicating a molecular-scale contamination. Contamination on a macroscale is more susceptible to bias during subsampling procedures. Therefore, project-specific instructions (e.g., compositing scheme) should be formulated based on the purpose of the data. Refer to Instruction E-3 for additional information on this application.

Does the sample tend to segregate into various size fractions easily? Can they be mixed to produce an even distribution prior to subsampling, or do these fractions need to be physically separated and subsampled individually for recombination into an appropriate sample aliquot?

Does the sample maximum particle size meet the minimum allowable class size (as measured by U.S. Standard sieve mesh) as noted in Table E-2, as determined by the subsample mass taken?

Table E-2 Maximum Particle Size Allowed for Subsampling Solid Materials

Subsample Mass (g)	Maximum Particle Size Allowed (cm)	U.S. Standard Sieve Mesh	Wentworth Size Class
0.5 - 1	0.1	18	Coarse sand
2 - 5	0.17	12	Very coarse sand
10	0.21	10	Granule gravel
30	0.31	7	Granule gravel
50	0.37	6	Granule gravel
100	0.46	5	Pebble gravel

If conditions indicate that the sample medium is not homogeneous or that a problem may exist, additional measures may be necessary to obtain a representative sample. These may include techniques for PSR, PSS, sample homogenization, or increasing the size of the sample aliquot taken for analysis. Determining what procedures should be employed may require communication with the data user. Another important aspect of subsampling depends on the method of analysis and the size of the aliquot being taken. Analysis requiring smaller (1-2 g) aliquots (metals, explosives, etc.) requires special considerations so as not to bias the small sample size compared with analysis requiring larger (30 g, extractable organics, or 100 g, toxicity characteristic leaching procedure) analyses. In general, PSR is necessary when the maximum particle size present within the sample is larger than the recommended maximum particle size based on the mass (amount) of the sample aliquot taken for analysis. PSS techniques (sieving) should be performed after PSR, to ensure the desired particle size has been achieved. If PSR (i.e., grinding or milling) or PSS (i.e., sieving) techniques are used, care should be taken to implement the appropriate quality controls, i.e., appropriate inspection and decontamination of devices, to ensure that samples are not contaminated or cross-contaminated during their use.

E.5.2.1.1 Procedures for subsampling homogeneous materials for nonvolatile analyses.

Allow the sample and container to equilibrate to room temperature before opening the container.

Visually inspect and document the appearance of the sample prior to subsampling.

Samples received in brass liners or sections of brass liners must first be extruded onto laboratory tray or pan and mixed as described in the following paragraph.

Even if the material received appears homogeneous, the entire sample should be thoroughly mixed using an inert, noncontaminating spatula or rod material by the procedures outlined in Instruction E-2. This may be performed within the original sample container. However, it is more effective and recommended that the material be transferred onto a laboratory tray or pan.

For cohesive material, the bulk material should first be reduced in size using a stiff-bladed utensil such that the average size of any clump is approximately pea-sized (approximately 6 mm). If the solid medium is not amenable to these techniques due to the high moisture content or high cohesiveness of the waste, recommend using kneading techniques presented in Instruction E-2.

To prepare the subsample, flatten the piled material into an oblong shape. Using a flat-bottomed scoop, collect a strip of material across the entire width of the short axis. Repeat this procedure at evenly spaced widths until the sample aliquot needed is obtained.

- Alternatively, the sample should be subdivided (quartered) and approximately equal portions removed from each quarter of the sample for inclusion into a final sample aliquot that will be accurately weighed into a clean glass beaker or similar container and analyzed.

If the material is cohesive, the solid medium may be flattened and cut into cubes. Collect random cubes into a subsample that will be reknaded and placed into the appropriate sample containers.

E.5.2.1.2 Procedures for subsampling heterogeneous materials for nonvolatile analyses.

With heterogeneous material a decision must be made as to how a subsample is to be taken so project needs are met. This decision must be made in conjunction with the project personnel who submitted the samples for analysis. The following options are possible solutions in producing a representative subsample of a heterogeneous material.

Achieving a representative subsample must consider whether PSR or PSS techniques are required.

If PSR or PSS techniques are used, implement the appropriate quality controls to ensure that samples are not contaminated or cross-contaminated.

PSR should be avoided for semivolatile organic procedures due to the potential loss of more volatile analytes. Other general considerations include contamination and cross-contamination that may result from the devices used during these techniques. If PSR is necessary, mortar and pestle is usually the best alternative for semivolatile methods. Milling is also an effective technique, but samples must be dry or dried, therefore less desirable for semivolatile methods.

If PSR techniques are used that require dry samples, they should be dried at room temperature to a constant weight without exposure to direct sunlight or heat.

If the sample is amenable to PSR (e.g., grinding or milling), refer to general guidance presented previously and process the entire sample in an appropriate device (meaning that target analytes are unaffected by the use of the particular grinding apparatus).

After PSR, use appropriate sieve (PSS) to check for oversized material.

Do not rework the oversized material. Add more original sample to the PSR equipment and repeat procedures until a sufficient amount of material is generated.

Following PSR/PSS techniques, mix the sample until homogeneous and subsample as outlined previously.

If the heterogeneity is due to foreign material or debris (and project DQOs allow), physically separate the foreign material, mix the remaining homogeneous sample, and transfer an appropriately homogeneous sample to an appropriately sized aliquot to the tared testing vessel(s).

Or cone and quarter the samples as outlined in Instruction E-2, repeating this procedure until the subsample obtained meets the sample size of the analytical procedure.

For samples that segregate into size fractions easily, perform a PSS procedure (e.g., sieving).

Determine the percentage of each size fraction.

Compose a subsample that takes an appropriate percentage of each fraction.

E.5.2.2 Aqueous liquid matrix. Samples of surface water, ground water, toxicity characteristic leaching procedure extracts, wastewaters, and leachates containing <1 percent solids are sampled using the following guidelines. Evaluate the liquid sample, looking for suspended matter, multiple phases, or any other features that may require specific measures to obtain a representative subsample. This may be restricted due to the container material (i.e., amber glass). If, upon inspection, it is discovered that the sample has more than one liquid phase, or greater than 10 percent of the sample is sediment or solid fines, consult with the project technical personnel to determine sampling needs.

E.5.2.2.1 For aqueous liquids that are to be analyzed for inorganics and total metals:

Allow the sample and container to equilibrate to room temperature.

Secure the sample lid to sample jar. Then invert, or shake the sample up and down a minimum of three times.

Evaluate whether the rate that the suspended matter settles allows sufficient time to acquire a representative aliquot.

If the suspended matter settles slowly, shake the sample repeatedly and take an aliquot immediately following procedures outlined in the following procedures.

If the suspended matter settles rapidly, shake the sample repeatedly and immediately transfer to a large beaker. Add a magnetic stir bar and magnetically stir the sample until uniformly mixed. While stirring continues, take an aliquot by pipet or other subsampling means.

Remove lid and quickly yet smoothly transfer desired aliquot into an appropriately sized graduated cylinder or volumetric flask. This choice will be dependent on the required accuracy necessary for the measurement device as specified in the applicable method. If the required sample volume is small, a volumetric pipet may be used to obtain the sample.

Transfer the sample from the pipet or graduated cylinder into an appropriate container used to process the subsample further.

If the cylinder or pipet used to subsample is to be reused for other samples, thoroughly decontaminate the transfer glassware.

E.5.2.2.2 For aqueous liquids that are to be analyzed for VOA analysis, a closed system autosampler or the following may be used:

Allow the VOA vials to equilibrate to room temperature.

Suspended particulates in volatile organic samples should be allowed to settle and are not subsampled.

A gastight syringe may be inserted through the septum of the vial to withdraw the sample. Or recommend the following be done when the sample size taken is greater than 5 mL.

Remove the plunger from an appropriately sized syringe and attach a closed syringe valve. If lower detection limits are required, use a 25-mL syringe. Open the sample bottle, and carefully pour the sample into the syringe barrel to just short of overflowing. Replace the syringe plunger and compress the sample. Open the syringe valve and vent any residual air while adjusting the sample volume to 5.0 mL or 25.0 mL. This process of taking an aliquot destroys the validity of the liquid sample for future analysis; therefore, if there is only one VOA vial, the analyst should fill a second syringe at this time to protect against possible loss of sample integrity. This second sample is maintained only until the analyst has determined that the first sample has been analyzed properly. If a second analysis is needed, it should be analyzed within 24 hours. Care must be taken to prevent air from leaking into the syringe.

When sample dilution is necessary, samples can be diluted before purging. This can be performed directly in the 5-mL syringe that has been filled with reagent water through the use of appropriate microliter syringes, or with volumetric glassware, as appropriate.

Add appropriate volumes (i.e., 10.0 L) of surrogate standard solution, matrix spiking solution, and internal standard spiking solution through the valve bore of the syringe; then close the valve.

Attach the syringe-syringe valve assembly to the valve on the purging device. Open the syringe valves and inject the sample into the purging chamber. Follow appropriate procedures for purging and analysis.

E.5.2.2.3 For aqueous liquids that are to be analyzed for extractable organic analysis:

For samples destined for extractable organic analysis, it is recommended to utilize the entire contents of the 1-L sample container, and rinse the bottle with the appropriate solvent to avoid the loss of any compounds that may adhere to the walls of the container or cap.

Allow the sample and container to equilibrate to room temperature.

Mark the volume on the outside of the 1 L-sample bottle.

Note: If a bottle larger than 1 L is received, an aliquot should be poured into a graduated cylinder and then transferred into the extraction vessel. The appropriate organic solvent is then used to rinse the graduated cylinder. (Note this procedure runs the risk of generating an unrepresentative subsample.)

Make sure sample lid is attached securely and shake the sample up and down (or end over end) a minimum of three times.

Pour the sample smoothly into the extraction vessel.

Rinse the sample bottle three times with small volumes of the appropriate organic solvent and transfer these rinsates into the extraction vessel containing the sample.

Fill the sample bottle to the mark with tap water and pour the water into a graduated cylinder to determine the sample volume.

For liquid samples with suspended matter (1.0 percent), this subsampling procedure may induce analytical problems (i.e., the formation of an emulsion, or sediments clogging up separatory funnel). Deviations to these procedures (i.e., decanting the liquid with no mixing, no solvent rinsing of the bottle, etc.) should be identified within the case narrative.

E.5.2.3 Multiphase matrices - liquids/solids/sludges (both aqueous and nonaqueous). This section addresses samples considered multiphasic based on physical characteristics (mixture of solids and liquids). The choice of the procedure for handling multiphasic samples is highly dependent on project needs. Therefore, proper communication between project personnel and the laboratory is required in order to select the best approach to follow. If no clear guidance on project-specific needs is provided, analyst judgment must be used to decide what portions will be subsampled and the information documented within the case narrative. There are no specific procedures describing how samples with certain volume distributions or characteristics of liquid/solid are to be handled. However, the following general guidelines and three approaches are provided.

Nonaqueous liquids require mixing if minor particle matter is present.

Due to the different viscosities, densities, and coating properties, the weight of the subsample should typically be determined, rather than attempting to express the subsample in terms of volume. Anytime it is difficult to volumetrically measure a sample because it adheres to glassware walls, weight must be used.

If a specific and accurate weight needs to be aliquoted, a serological pipet is a good option for subsampling. Aspirate the sample, and then carefully transfer the sample into a tared vessel, controlling the addition by finger pressure on the top of the serological pipet.

E.5.2.3.1 Subsampling of samples analyzed as a single mixed phase (as received):

This approach will not provide information on the abundance of analytes in the individual phases.

The sample is mixed sufficiently to create a homogeneous sample. This is usually assessed on a visual basis. A single analysis will then be performed.

The manner in which the sample is mixed is highly dependent on sample consistency and how easily the phases mix. Some samples can simply be shaken, while others will require a spatula or mixing rod, or laboratory blender. If this is necessary, the device used to mix the sample must be noncontaminating, inert, and easily decontaminated. Usually a glass or Teflon-coated device is appropriate.

The sample is then poured, subsampled with a scoop, or transferred by some other physical means into a tared vessel and the weight of the sample is recorded. This transfer is dependent upon sample viscosity/consistency. Another consideration is not to allow the sample to resegment into the phases when aliquoting the sample.

E.5.2.3.2 Subsampling of samples analyzed as separate phases. When the phases of a multiphasic sample are to be tested individually, the phases are separated by physical means (i.e., filtration (either pressurized or nonpressurized), centrifugation, settling, or use of a separatory funnel). The technique used is dependent on items such as laboratory capabilities, sample characteristics, and analytes of interest.

If an aliquot (subsample) of a sample is to be phase-separated, this aliquot must be representative of the original sample. This means that the solid and liquid ratio of the aliquot needs to be the same as the original sample.

To accomplish this, follow the procedures in Section E.5.2.3.1 for subsampling of samples analyzed as a single mixed phase, except that the final step is to aliquot the subsample into the device used to accomplish phase separation.

Items to consider when performing the phase separation include the following: device is noncontaminating, is nonabsorbent for analytes of interest, and does not cause the loss of analytes via other means.

Once the phases are separated, the solid and liquid ratios are determined and recorded. The two portions are transferred into either sample preparation vessels, testing vessels, or appropriate storage containers for later analysis.

If the liquid portion requires subsampling, follow the procedures listed in Section E.5.2.2. If the solid portion requires subsampling, follow procedures in Section E.5.2.1.

When phases are separated and analyzed separately, the final concentration for the total sample must be calculated mathematically. The final analyte concentration is expressed as g/mL or g/g.

E.5.2.3.3 If samples are to be analyzed as separated phases and only select phases are desired, then separate the phases as described in Section 3.5.2.3.2, discard those phases that are not of interest, and transfer portions of the phase(s) to be analyzed into appropriate preparation vessels following procedures described in Sections E.5.2.1 or E.5.2.2 as necessary.

E.5.3 Potential problems.

E.5.3.1 The most significant potential problem is the high probability of a subsample taken from a heterogenous waste being nonrepresentative.

E.5.3.2 Care must be exercised so that the introduction of contamination or potential for cross-contamination from equipment used to manipulate the sample is minimized. Full decontamination protocols must be performed on equipment between each use, and/or sufficient equipment must be available for individual sample usage. Recommend implementing the appropriate quality controls to ensure that samples are not contaminated or cross-contaminated.

E.5.3.3 Subsampling the lower phases of a multiphase liquid may pose special problems. A pipet or syringe needle passing through the lighter layers may pick up and transfer contaminants that can bias analytical results. The pipet tip or syringe needle should be wiped clean before transferring lower phase subsample to a preparation flask. Removal of the lighter layer(s) prior to subsampling may be required to obtain a representative aliquot.

E.5.3.4 Clay soil samples may be difficult to subsample with a coring-type device. Some hand coring samplers are equipped with clear plastic liner tubes that make extracting the subsample from the corer much easier. However, the goal is to obtain a representative sample. In these situations, professional judgment is required and a clean stainless steel spatula may be the tool of choice.

E.6 Decontamination Procedures

E.6.1 Scope and application. This section provides instruction on deciding on an appropriate decontamination scheme(s) for the project field sampling equipment to prevent or reduce cross-contamination of project samples. The applicability of each step in a decontamination protocol and the procedures used will depend upon the contaminants present onsite, the subsequent analysis to be performed, and the composition and type of sampling devices being decontaminated. The appropriateness of the decontamination protocol is vital to the eventual validity of the analytical results and decisions made based upon those results. All sampling equipment that contacts potentially contaminated media must be cleaned before the subsequent use of that device. Devices may include bailers, pumps, shovels, scoops, split spoons, tube samplers, augers, etc. Another approach to minimizing the potential for cross-contamination may be to dedicate or use disposable sampling equipment.

E.6.2 Decontamination procedures. Refer to Table E-3 for various stepwise decontamination protocols for sampling equipment that comes in direct contact with the sample. Each protocol begins with the detergent wash, followed by a series of chemical and water rinses, and concludes with an air-drying step. Additional guidance and protocols for the staging or setup of decontamination procedures may be found in National Institute for Occupational Safety and Health (1985) and ASTM Standards D 5088 and D 5608. To

Table E-3
Recommended Decontamination Procedures¹

	Detergent Wash	Tap Water	Inorganic Desorbing Agents	Tap Water	Organic Desorbing Agents	Deionize d Water	Air Dry
VOA							
Low MW CMPDS ²					Methanol		
BN/PEST/PCBS							
High MW CMPDS ²					Hexane		
Organic Bases ³			(1%)		Isopropyl alcohol		
Organic Acids ⁴					Isopropyl alcohol		
Trace metals			(10%)				
Salts							
Acidic CMPDS							
Basic CMPDS (caustic)			(1%)				

¹ Solvent rinses vary in polarity which leads to varying solubilizing properties. The selection of appropriate solvent rinses should first consider if a known or suspected contaminant requires removal from sampling equipment. Optimum solvents for contaminants are noted. Secondly, identify whether the subsequent analytical protocol would be impacted by the proposed solvent or an impurity thereof (e.g., residual acetone present in isopropyl alcohol would be measured with certain volatile organics analysis).

² MW CMPDS = molecular weight compounds.

³ Organic bases include amines, hydrazines.

⁴ Organic acids include phenols, thiols, nitro and sulfonic compounds.

evaluate and document the effectiveness of the decontamination protocol, recommend the acquisition of final rinsates or wipe samples after equipment decontamination procedures are completed. Refer to Instruction G-2, Appendix G, and Instruction C-7, Appendix C, for information on the acquisition of rinsates and wipe samples, respectively.

E.6.2.1 Reagents. Reagents necessary will vary based on the protocol chosen. The following outlines general guidance for the typical reagents used to support decontamination procedures. The detergent wash is a nonphosphate detergent solution used with brushing or circulating techniques to remove gross contamination, and/or as a mild neutralizing agent. Tap water from a water system of known chemical composition is considered a control rinse water. Inorganic desorbing agents are dilute nitric or hydrochloric acid rinses. Due to their corrosive nature, the inorganic desorbing rinses may be omitted from decontamination procedures associated with metallic or stainless steel sampling devices at the discretion of project personnel. Solvent rinses (i.e., isopropyl alcohol, methanol, or hexane) are used as an organic desorbing agent. The solvent chosen must be effective in removing the organic contamination present, but must also be compatible with the subsequent analyses performed. Care should be taken to use an appropriate grade of solvent to minimize the potential introduction of impurities present in the organic desorbing rinse that may interfere or contribute to the subsequent analysis. For this reason, recommend that all solvent rinses used be appropriate grade, such as pesticide or purge-and-trap grade quality. Finally, the deionized water is organic-free reagent water.

E.6.2.2 Procedure clarifications/exceptions.

E.6.2.2.1 Table E-3 refers to the general recommended procedures used to decontaminate sampling equipment. Depending upon site contaminants, degree of contamination, analytical protocols, and composition and type of sampling equipment used, the project chemist may determine to modify or eliminate various steps of the decontamination procedures outlined in Table E-3.

E.6.2.2.2 As noted previously, the detergent wash is used in conjunction with scrubbing for gross contamination removal, followed by the appropriate rinses. For cleaning of pumping equipment or devices with inaccessible internal mechanisms, suggest circulating/flushing the system with the applicable solutions in the following order. For sampling probes used for soil gas sampling procedures, decontaminate by removing visible soil and drawing ambient air through them. Alternatively, volatiles may be baked off the soil gas probe using a portable heater. Water and solvent rinses should not be used on soil gas sampling probes. Solvent rinses for water pumping equipment should be limited to a 10 percent dilution (volume/volume) of acetone or isopropyl alcohol in water. Tubing used with peristaltic pumps may be dedicated or may be flushed with hexane, followed by a distilled water rinse depending on contaminants noted onsite. All sampling equipment should be allowed to dry prior to the next use. For this reason it is important to have sufficient sampling devices onsite so that they may be alternated. This practice will allow a thorough drying of equipment without increasing sampling downtime. If sampling equipment is not used immediately, wrap within an inert material (i.e., aluminum foil) to avoid contact with potentially contaminating materials. Equipment that does not directly contact the sample, such as large drilling equipment, drill-rig components, power augers, etc. should be cleaned with a portable power washer or a steam-cleaning machine. Finally, depending upon the project, it may be appropriate to contain spent decontamination fluids and arrange for eventual disposal as investigation-derived wastes. These containers may also be used for the eventual disposition of the materials, and therefore must comply with any potentially applicable DOT regulations.

E.6.3 Sample contaminant sources and other potential problems.

E.6.3.1 Carryover and leaching. Contaminant carryover between samples and/or from leaching of the sampling device is very complex and requires special attention. Decisions concerning the appropriateness of the material composition of the device must account for these carryover or leaching potentials, and whether these contaminants are of concern on the project. Materials potentially encountered on projects and their associated common contaminants are listed in Table E-4.

E.6.3.2 Adsorption. Contaminant adsorption is another problem that must be considered when deciding on an applicable sampling device or the appropriate composition material. This phenomenon is more critical when sampling an aqueous or gaseous media, due to the capability of lower levels of contaminant detection and the fact that the fluid matrix is more susceptible to potential contaminant transfer. PVC and other plastics are known to sorb organics and to leach plasticizers and phthalate esters. Polypropylene and other thermoplastics have been shown to sorb organics and environmental mercury efficiently and should, therefore, be avoided in sampling devices, especially tubing. For these reasons, PTFE is commonly chosen over the PVC and plastics when working with organic or mercury contaminants. In addition, some pesticides and halogenated compounds preferentially adsorb to glass surfaces. For this reason, it is recommended that when aqueous samples are taken, the sample container NOT be rinsed prior to sample collection, and the same container be rinsed with the extraction solvent after the sample has been quantitatively transferred to an extraction apparatus. Inorganics (metals) adsorption to containers is dependent upon the specific metal element, the concentration, pH, contact time, complexing agents present, and container composition. This is believed to be nominal, and proper preservation of samples should prevent this. In selecting appropriate tubing to be used for aqueous sample acquisitions, it is important to decide applicable material composition and diameter based upon the contaminant and the purpose of the data. Adsorption is less likely to occur when there is a increase in tubing diameter.

Table E-4
Materials Potentially Encountered on Projects

Material	Commonly Related Contaminants
Glass	Silicon Boron
Rigid PVC (threaded joints)	Chloroform Vinyl chloride
Rigid PVC (cemented joints)	Methyl ethyl ketone Toluene Acetone Methylene chloride Benzene Tetrahydrofuran Ethyl acetate Cyclohexanone Vinyl chloride
PVC plastic tubing	Phthalate esters Vinyl chloride Low level (zinc, iron, antimony, and copper)
Soldered pipes	Lead Tin
Stainless steel	Chromium Iron Nickel Molybdenum
Brass	Copper Zinc Tin

Appendix F

Sample Documentation and Shipment Instructions

F.1 Documentation

F.1.1 Scope and application. This section describes procedures for maintaining sample control through proper sample documentation. When samples are collected for chemical or physical characteristics analysis, documentation such as sample labels, daily contractor quality control reports (QCR), chain-of-custody and sample analysis request forms, custody seals, and field logbooks need to be completed. The information presented in this section enables maintenance of sample integrity from time of sample collection through transportation and storage. It is this documentation that will verify that samples were handled properly.

F.1.2 Documentation. The following discussion outlines standard practices and procedures to be used when documenting a sampling episode. All project-specific documentation requirements must be presented in the sampling and analysis plan (SAP). This includes identification of procedures required for field documentation, sample labeling, and the maintenance of chain-of-custody. Applicable requirements are identified in the following sections. Proper completion of all documentation with indelible ink is necessary to support the use of these records in any potential enforcement actions that may result. Protocols for corrections to documentation should not obliterate data entries, but place a single line through incorrect entry, noting corrected information, recorder's initials, and date correction was performed. Maintaining sample integrity through proper documentation is essential. Following site activities, all project documentation becomes a part of the final evidence file. These records should be maintained for a certain period of retention time. The documentation retention time requirements of a project must be presented within the SAP and may be based on the use of the data, funding source, or regulatory authority.

F.1.2.1 Daily contractor quality control reports (QCR). During the field investigation or remedial action activities, daily contractor QCRs should be prepared daily, dated, signed by the project contractor quality control representative, and sent to USACE at a rate specified in the scope of work or specifications. With respect to geotechnical and chemical procedures, these reports should include weather information at the time of sampling, field instrument measurements, calibrations, identification of all field and control samples taken, departures from the approved SAP necessary, deviations from approved geotechnical procedures (such as well installation or drilling), any problems encountered, and instructions from Government personnel. Any deviations that may affect data quality objectives must be conveyed to U.S. Army Corps of Engineers (USACE) personnel (technical manager, project geologist, project chemist, etc.) immediately. The following should be attached to the daily contractor QCRs: quality assurance (QA) sample tables that match up primary, replicate (quality control (QC)/QA), and other field control samples (e.g., blanks), copies of chain-of-custody forms, field-generated analytical results, and any other project forms that are generated. Additional documentation requirements of the daily contractor QCRs are outlined in Engineer Regulation (ER) 415-1-302 and Corps of Engineers Guide Specification (CEGS) 01451.

F.1.2.2 Field logbooks. Sampling situations vary widely. No general rules can specify the exact information that must be entered in a field logbook for a particular site. However, the logbook should contain sufficient information to enable the sampling activity to be reconstructed without relying on the collector's memory. Project field logbooks should be bound and have numbered, water-resistant pages. Record the site name and project name and number on inside front cover of logbook. All pertinent information regarding the site and sampling procedures must be documented as near to real-time as possible. At the conclusion of each day, the person maintaining the logbook should sign and date the day's

documentation entries. Notations should be made in logbook fashion, noting the time and date of all entries. Information recorded in other project documents (e.g., boring logs, well installation/development logs, or drum logs) should not be repeated in the field logbook, except in summary form to avoid transcription errors. Logbooks should be kept in the field team member's possession or in a secure place during field work. Following site activities or if the logbook is completely filled, the logbook becomes a part of the project final evidence file as noted previously. The technical planning team may also elect to establish documentation requirements that follow a more uniform organization than a field logbook. These documentation requirements would include the use of project forms. This approach helps enhance consistency in the information recorded and streamlines the documenting process. Any forms proposed for use should be task specific and should incorporate appropriate topics from those identified as follows. All forms must be presented in the project SAP. The following are some suggested topics to include in the field logbook:

- Name and exact location of site of investigation or interest.
- Name and title of person maintaining logbook (author).
- Date and time of arrival and departure at site location.
- Purpose of site visit or sampling activity.
- Name and address of field contact. This may also include information on access agreements.
- Names and responsibilities of all persons on site.
- Names, affiliations, and purpose of all site visitors.
- Level of personal protective equipment worn at the site.
- Weather conditions on the day of sampling, and any additional environmental conditions or observations pertinent to field activities.
- Field instrumentation or equipment used, and purpose of use (i.e., health and safety screening, sample selection for laboratory analysis). Note source, quality, or lot numbers for any supplies or reagents (e.g., sample containers, preservatives, reagents, water for field blanks/field control samples, and decontamination procedures). Retain any certificates or information supplied with the equipment used.
- Type of waste, suspected waste concentrations if known, and sample matrices to be handled.
- Document the sample collection method and any sample handling procedures such as filtration, compositing, and executed preservation techniques used.
- Document the sample location. If a compositing scheme is used, clearly identify appropriate locations for all sample aliquots included within each composite sample. Prepare a dimensional sketch of the general surroundings of the sampling area (site), and/or support with other forms of documentation (i.e., photographic log). Sample identification numbers should correspond directly with sample locations.

- Identify sample numbers, volumes, and containers (number, size, type) used for each sample collected. Note the date and time of each sample, identify any associated QC samples, or any factors that may affect the quality.
- Record any field measurements, field screening/analytical results generated, calibration methods used, field results, and QC information.
- Identify decontamination procedures employed for sampling equipment.
- Document appropriate references to maps and photographic logs of the sampling site.
- Record information on scheduling modifications, change orders, sampling or drilling decisions/changes.
- Describe the number of shipping coolers packed, note chain-of-custody (COC) numbers or attach a copy of COC, and record the mode of transportation and applicable tracking numbers.
- Record name and address of all receiving laboratories.
- Maintain appropriate documentation for investigation-derived wastes. Note contents and volumes of waste generated, storage, and disposal methods used.

F.1.2.3 Documenting sampling points and locations. The exact locations of sampling points should be documented for purposes of generating an accurate representation of the site conditions using the data generated to date, defining data gaps, and identifying potential future data needs. A monument should be chosen at each site to act as a stationary reference point from which all sampling points can be measured using a compass and measuring tape. If a building or other stationary structure exists, its corner may act as this reference point. If no monument exists, it will be necessary to create one. A piece of wood, approximately 5 cm by 5 cm (2 in. by 2 in.), should be hammered into the ground to almost ground level, making it difficult to remove and thus assuring its permanence. The stake should then be marked with flagging tape or fluorescent paint. When applicable, sampling points associated with coordinates that are referenced to a position on the earth must comply with ER 1110-1-8156. ER 1110-1-8156 requires geospatial data to be documented using the Federal Geographic Data Committee's content standards for digital geospatial metadata. Geospatial data are nontactical data, referenced either directly or indirectly to a location and boundaries on the earth. Additional guidance on geospatial data systems may be found in EM 1110-1-2909. To establish a sampling point, the following procedure is recommended:

- Standing at the monument, facing the sampling point, use the compass hairlines to determine the degree of direction.
- Ensure that the line of sight runs from the monument, through both hairline needles on the compass, to the sampling point.
- When first establishing the sampling point, record the degree and direction reading from the compass in the field logbook, along with the distance measurement from the monument to the sampling point.

F.1.2.4 Photographic documentation. All sampling points should be documented on film. A film record of a sampling event allows positive identification of the sampling point. In some cases, a photograph

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of the actual sample collected may also be required. Photographs are the most accurate and convenient record of field personnel observations. Photographs taken to document sampling points should include two or more reference points to facilitate relocating the point at a later date. Keeping a record of photographs taken is crucial to their validity as a representation of an existing situation. Photographic documentation is invaluable if the sampling and subsequent analytical data end in litigation, enforcement, or cost recovery actions. In addition to photographs, video coverage of a sampling episode can be equally as valuable as or even more valuable than photographs because it can be used to prove that samples were taken properly as well as verify the location at which they were taken. Video coverage can be used as a record of site conditions and can give those who have not been onsite an idea of the circumstances. For each photograph taken, the following items should be noted in the field logbook:

- Date.
- Time.
- Photographer (signature).
- Name of site.
- General direction faced and description of the subject.
- Sequential number of the photograph and the roll number.
- Site photo map (see Figure F-1).

F.1.2.5 Sample documentation

F.1.2.5.1 Sample labels. Sample labels are required for properly identifying samples and evidence. All samples must be properly labeled with the label affixed to the container prior to transportation to the laboratory. It is also recommended that samples be photographed so that labels are clearly readable for later identification. Information on sample labels should include, but not be limited to, the following:

Project Code. An assigned contractor, project number, site name.

Station Number. A unique identifier assigned to a sampling point by the sampling team.

Sample Identification Number. Each sample, including field control samples, collected for a project should be assigned a unique number. This assigned number incorporates information on the sample type and date as noted in Section F.1.2.5.2.

Samplers. Each sampler's name and signature or initials.

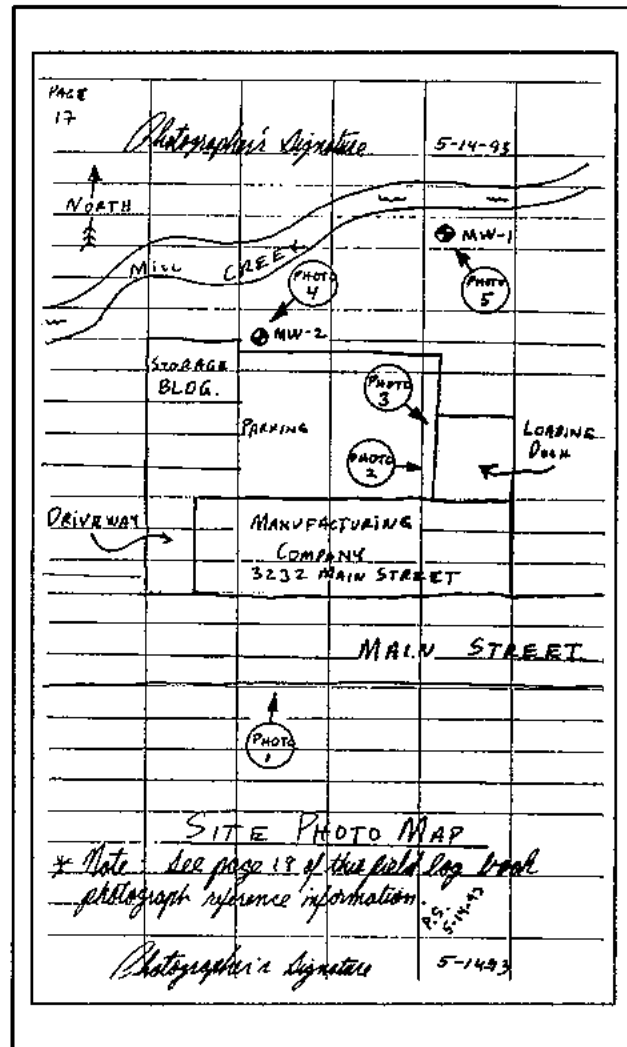


Figure F-1. Site photo map

Preservative. Whether a preservative is used and the type of preservative.

Analysis. The type of analysis requested.

Date/Time. Identify the date and time the sample was taken.

Type of Sample. The type of sample should be identified as discrete or composite.

F.1.2.5.2 Sample numbering. A sample numbering system should be used to identify each sample collected and submitted for analysis. The purpose of the numbering system is to assist in the tracking of samples and to facilitate retrieval of analytical results. The sample identification numbers for each sampling effort should be used on sample labels, sample tracking matrix forms, COC forms, field logbooks, and all other applicable documentation. A listing of all sample identification numbers should be recorded in the field logbook. The sampling numbering system may vary depending upon the number and type of samples that will be collected at the site. An example of a sample numbering system follows. Location and sample identification numbers should consist of the following designations to identify the location (AABBB-CC), sample sequence number, date (MMDDYY), and sample depth interval for soils (00-00):

- For soil: AABBB-CC/MMDDYY/00-00
- For water: AABBB-CC/MMDDYY
- For QC samples: AABBB-CC/MMDDYY

Example: SB001-01/081492/08-10 = Soil Boring SB001 Sample Number 1, sampled on August 14, 1992, from a sample depth interval of 8 to 10 ft (2.4 to 3 m). Duplicate samples should be numbered in sequential order. For example, a duplicate sample collected from this soil boring example would have a designation as follows: SB001-02/081492/08-10. Each sample collected must be assigned a unique sample number. Sample numbers should change when the media or location changes. Sample numbers should not change because different analyses are requested. For example, water samples collected at the same location, date, and time for volatile organics, semivolatile organics, and metals analyses would all have the same sample number, although the various sample aliquots would be collected in different containers.

F.1.2.5.3 Chain-of-custody (COC). COC procedures provide documentation of the handling of each sample from the time it is collected until it is destroyed. COC procedures are implemented so that a record of sample collection, transfer of samples between personnel, sample shipping, and receipt by the laboratory that will analyze the sample is maintained. Records concerning the cleaning of empty sample containers, container shipment from the laboratory to the site, and security of empty containers at the site should also be maintained. The COC record (Figure F-2) serves as a legal record of possession of the sample. The COC record is initiated with the acquisition of the sample. The COC record remains with the sample at all times and bears the name of the person (field investigator) assuming responsibility for the samples. The field investigator is tasked with ensuring secure and appropriate handling of the bottles and samples. To simplify the COC record and eliminate potential litigation problems, as few people as possible should handle the sample or physical evidence during the investigation. A sample is considered to be under custody if one or more of the following criteria are met:

[illegible]

Figure F-2. Chain-of-custody form

The sample is in the sampler's possession.

The sample is in the sampler's view after being in possession.

The sample was in the sampler's possession and then was locked up to prevent tampering.

The sample is in a designated secure area.

In addition to the COC record, there is also a COC (custody) seal. The COC seal (Figure F-3) is an adhesive seal placed in areas such that if a sealed container is opened, the seal would be broken. The COC seal ensures that no sample tampering occurred between the field and the laboratory analysis.

F.1.2.5.4 Transfer of custody and shipment. All sample sets should be accompanied by a COC record. When transferring possession of samples, the individual receiving the samples should sign, date, and note the time that he/she received the samples on the COC record. This COC record documents transfer of custody of samples from the field investigator to another person, other laboratories, or other organizational units. Samples must be properly packaged for shipment and delivered or shipped to the designated laboratory

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for analyses. Shipping containers must be secured by using nylon strapping tape and custody seals (Instruction F-2). The custody seals must be placed on the container so that it cannot be opened without breaking the seals. The seal must be signed and dated by the field investigator. When samples are split with a facility, state regulatory agency, or other government agency, the agency representative must sign the COC record, if present. All samples should be accompanied by the COC record. The USACE tracking number (e.g., laboratory information management system (LIMS) number) that is used in conjunction with the

Government QA sample shipment must be written on the COC record of the QA sample. The original and one copy of the record will be placed in a plastic bag taped to the inside lid of the secured shipping container. One copy of the record will be retained by the field investigator or project leader. The original record will be transmitted to the field investigator or project leader after samples are accepted by the laboratory. This copy will become a part of the project file. If sent by mail, the package should be registered with return receipt requested. If sent by common carrier, an air bill should be used. Receipts from post offices and air bills should be retained as part of the documentation of the COC. The air bill number or registered mail serial number should be recorded in the remarks section of the COC record.

CUSTODY SEAL _____ Date _____ Signature	CUSTODY SEAL _____ Date _____ Signature

Figure F-3. Chain-of-custody seal

F.1.2.5.5 Sample analysis request. To ensure that proper analysis is performed on the samples, additional paperwork may need to be filled out, as required by the laboratory performing the analysis. This form identifies samples by number, location, and time collected and allows the collector to indicate the desired analysis. This form should act as a supplement/confirmation to the COC record and laboratory contacts made prior to the sample event initiation.

F.1.3 QA/QC requirements.

F.1.3.1 Corrections to documentation. All original data recorded in field logbooks and on sample labels, COC records, and receipt-for-samples forms are written in waterproof ink. If an error is made on an accountable document, corrections should be made simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on a document should be corrected by the person who made the entry. All corrections must be initialed and dated.

F.1.3.2 Photographs. The photographer should review the photographs or slides when they return from developing and compare them with the photographic log to confirm that the log and photographs match.

F.1.4 Potential problems. Although most sample labels are made with water-resistant paper and are filled out using waterproof ink, inclement weather and general field conditions can affect the legibility of sample labels. It is recommended that after sample labels are filled out and affixed to the sample container, the label should be covered with wide clear tape. This will preserve the label and keep it from becoming illegible. In addition to label protection, COC and analysis request forms should be protected when samples are shipped in iced coolers. Typically, these forms should be placed inside a ziplock bag or similar waterproof protection and taped to the inside lid of the secured shipping container with the samples.

F. 2 Packaging and Shipping Procedures

F.2.1 Scope and application. This section describes procedures for properly packaging and shipping environmental and hazardous waste samples, as well as the shipment of preservatives used in the environmental sampling. Guidelines for proper container and preservative selection can be found in Appendix B. Personnel that are involved in packaging, shipping, and receipt of samples must be aware of Department of Transportation (DOT) regulations, know when to apply them, and know what procedures are needed to support this application. Personnel who ship samples considered a DOT hazardous material (HM) must be trained in accordance with the requirements set in 49 CFR 172.704. The following procedures identify packaging and shipping requirements for environmental and hazardous waste samples that are both DOT-regulated and nonregulated. Further information is presented for shipping carriers (i.e., FedEx, UPS) that use the International Air Transportation Association (IATA) regulations to govern domestic and international shipments. Shipping procedures for common preservatives and decontamination fluids are also addressed. Finally, it should be noted that DOT regulations also apply to the shipment of asbestos samples.

F.2.2 Procedures for shipping environmental samples. Environmental samples are defined as those samples collected from environmental matrices such as soil, groundwater, or sediments. The following sections identify packaging and shipping requirements for environmental samples that are unpreserved or preserved by acid/base/chemical addition. The following general procedures apply to the packaging of all environmental samples:

- Verify that the sample label is complete and adequately identifies the items described in Instruction F-1.
- Verify that each sample cap/lid is secured on the bottle, and place each sample in a plastic bag. For multiple volatile organic analysis (VOA) vials, all vials from each sample location should be placed in a small plastic bag at a minimum. Evidence tape or custody seals may be placed over the sample lid and container, or over the seal of the bag for additional security, if desired.
- Squeeze as much air as possible from the bag, and seal the bag. Trip blanks are packaged in the same manner as that for aqueous VOA samples.
- Prepare the shipping container for use. For a commercial cooler, this includes taping the drain plug shut inside and out, and lining the cooler with a large plastic garbage bag. Place approximately 7.5 cm (3 in.) of inert packing material in the bottom of the liner. Place vermiculite or perlite on the bottom if the materials are liquid. Alternative shipping containers may be used if approved by project technical personnel.
- Place the samples upright in the lined cooler or storage container in such a way that the samples will not touch each other during shipment. Add inert packing material as necessary to ensure separation of samples.
- With the exception of aqueous metals analyses, all environmental samples should be shipped to the laboratory on ice and chilled to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. If any of the shipped samples require cooling, place double bags of ice around the containers. Also include a 40-mL VOA vial filled with water for use as a temperature blank for the laboratory.

- Fill the cooler with packing material and tape the inner liner shut. NOTE: Do not use “environmentally friendly” peanuts made of starch to pack containers of liquids. These packing materials will dissolve when they get wet or moist.
- Place the paperwork (Instruction F-1) being sent to the laboratory inside a plastic bag and tape it to the inside of the cooler lid. Include a copy of the COC form in the paperwork sent to the laboratory. The sampler keeps one copy of the COC form. Include any additional paperwork to notify the laboratory of project information (laboratory notification checklist), or if a sample is suspected of containing any substance for which laboratory personnel should take safety precautions.
- Close the cooler and seal it with strapping tape.
- Place at least two custody seals on the outside of the cooler (one on the front and one on the back). More custody seals may be used at the discretion of the sampler.
- Prepare standard air bill paperwork for shipment of the samples to the laboratory. Personnel should be aware of carrier weight or other policy restrictions.

F.2.2.1 Unpreserved environmental samples. Environmental samples that are shipped unpreserved are not considered a hazardous material by DOT if they do not exhibit a DOT hazard class. This exempts them from DOT regulation during transportation to the laboratory. In general, this applies to soil/sediment and aqueous samples preserved by cooling. Follow the general procedures identified in Section F.2.2 for packaging and shipment of unpreserved environmental samples.

F.2.2.2 Preserved environmental samples. All samples that are preserved by the addition of chemicals are subjected to greater scrutiny when defining whether DOT regulations apply and the appropriate packaging and shipping requirements necessary. Care should be exercised when adding any chemicals to environmental samples for preservation purposes. Samples must be observed, noting any chemical reactions that take place, and following with any contingency measures needed to obtain a representative sample. Most importantly, add only the amount of preservative needed to achieve the required preservation criteria. Excessive preservation may make an otherwise unregulated sample subject to DOT hazardous materials regulations. On average, testing of water samples arriving at commercial laboratories has shown that between 30 and 50 percent of the samples are excessively preserved and may have been improperly packaged and shipped. Samples in this category may also be considered a Resource Conservation and Recovery Act (RCRA) characteristic or listed waste. However, an exclusion from manifesting and hazardous waste marking requirements exists under RCRA for shipping environmental samples to the laboratory. The RCRA exclusion can be found in 40 CFR 261.4(d). Materials that are Toxic Substances Control Act (TSCA) regulated (polychlorinated biphenyls (PCBs)) may be shipped under exclusions found in 40 CFR 761.65(I). However, these exemptions do not pertain to DOT regulations, and compliance with DOT regulation is still required. Field personnel should also realize that even though the DOT may allow for these items to be shipped by air, other international regulations governing air carriers (such as IATA/International Civil Aviation Organization (ICAO)) may further limit or forbid materials allowed by DOT. The shipper must also comply with all packaging regulations. These regulations will be found in 49 CFR 171.101 and 49 CFR 173. Packaging and shipping requirements for preserved environmental samples are determined based on whether the preserved samples exhibit the same physical or chemical characteristics that initially defined the preservative as a DOT hazardous material. Follow the guidance presented in Section F.2.2.2.1 and in Sections F.2.2 or F.2.3 to determine the appropriate shipping and packaging requirements to apply.

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F.2.2.2.1 Excepted preserved environmental samples. The DOT definition of a corrosive material is based on the destruction of intact animal skin. The DOT packing group (PG) associated with these samples determines the packaging and shipping procedures necessary, which are based on the time frame of observed tissue damage. Alternative testing to the animal testing has been developed and is accepted by DOT to support an application for exception from DOT classification and regulation. In the spring of 1997, USACE performed alternative testing to support the exception from the determination of acid/base preserved samples as a DOT corrosive classification. The testing showed that samples preserved in the manner described in Table F-1 and packaged as outlined in paragraph F.2.2 did not meet the definition of corrosive materials as prescribed by DOT under 49 CFR 173.136 (a)(1), 173.137 (a,b,c(1)). Based on this information, environmental samples meeting these criteria may be shipped as non-DOT regulated material following procedures outlined in Section F.2.2 under the USACE number DOT-E10904. Further information on this exception should be obtained from the USACE Hazardous, Toxic, Radioactive Waste - Center of Expertise (HTRW-CX) prior to its application or use. For consistency, the proper preparation of sample preservatives is outlined as follows for some common preservatives used in conjunction with environmental sampling:

Acid preservatives:

- (1) Hydrochloric acid 500 mL water + 2.0 mL 12N hydrochloric acid
- (2) Nitric acid 500 mL water + 2.0 mL 15.7N nitric acid
- (3) Sulfuric acid 1000 mL water + 1.0 mL 18M sulfuric acid

- Base preservatives:

Sodium hydroxide 500 mL water + 1.0 mL 30% sodium hydroxide

Table F-1 identifies the required pH ranges for sample preservation to meet standard U.S. Environmental Protection Agency methods, and to avoid meeting the definition for a particular DOT hazard classification and packing group. Samples preserved in the field should be verified for correct pH to assess the utilization of this exception. This may become problematic if the testing materials used (i.e., pH test strips) do not distinguish pH values to the required accuracy. Based on the range limits established, it is mandatory to use pH paper capable of a minimum of 0.5 pH unit resolution, such as the use of short-range pH paper. However, due to the proximity of several of these values, it is recommended a pH meter be used to allow resolution to 0.1 pH unit. Field personnel are cautioned that, based on specific acid type, if pH is adjusted below the acid range limit or above the basic range limit, preserved samples will be regulated by DOT as a hazardous material and will require proper shipping papers, marking, and labeling as identified in Section F.2.2.2.2.

Table F-1
Preserved Sample pH Ranges Needed for DOT Exemption

Preservative Used	Acceptable Sample pH Ranges for DOT Exemption Status ¹
Hydrochloric acid	pH = 1.43 to 2.00
Nitric acid	pH = 1.33 to 2.00
Sulfuric acid	pH = 1.31 to 2.00
Sodium hydroxide	pH = 12.00 to 12.58

¹ Per USACE exemption DOT-E10904

F.2.2.2.2 Acid/base preserved environmental samples. Environmental samples that have been overpreserved may meet the DOT definition of hazardous materials (i.e., corrosive liquid). When applicable, these materials must be shipped in proper DOT-approved containers, unless the shipper uses limited-quantity exceptions, or if the shipper has determined through testing that the material does not meet the definition of a DOT corrosive (Section F.2.2.2.1). DOT and IATA regulations should be reviewed to determine appropriate packaging and shipping requirements, and if a limited-quantity exemption exists. If a limited-quantity exemption does exist, the volume of hazardous material to be shipped is evaluated to determine if it exceeds this threshold limit. Refer to Table F-2 for information on the proper shipping name (PSN) and the limited quantities associated with some common types of acid preservation. When the total volumes of shipped material are less than the limited quantities noted, then the materials may be shipped as a limited quantity following the sample packaging and shipment procedures included in Section F.2.3, with "Limited Quantity" or "Ltd Qty." recorded on the shipping papers after the PSN. Table F-3 summarizes general requirements necessary to ship DOT-limited quantities. If the shipper does not meet these requirements, then the samples are considered fully regulated DOT hazardous material, and all DOT requirements as defined in 49 CFR 171-178 must be met.

Table F-2
PSN and Limited Quantities for Common Preservatives, Decontamination Fluids, and Potentially Hazardous Samples¹

Chemical Compound/Sample/ Material	PSN	Lmt Qty ²	Lmt Qty ³
Sulfuric acid >51%	Sulfuric Acid, with more than 51% sulfuric acid, 8, UN1830, PGII	1 liter	30 Liters
Sulfuric acid <51%	Sulfuric Acid, with not more than 51% sulfuric acid, 8, UN2796, PGII	1 liter	30 Liters
Nitric acid >70%	Nitric Acid, with more than 70% nitric acid, 8, UN2031, PGI	Forbidden	2.5 Liters
Nitric acid <70%	Nitric Acid, with less than 70% nitric acid, 8, UN2031, PGII	Forbidden	2.5 Liters
Nitric acid solution (10%) ⁴	Nitric Acid, other than red fuming with less than 20% nitric acid, 8, UN2301, PGII	1 liter	30 liters
Nitric acid solution (1%) ⁴	Nitric Acid, other than red fuming with less than 20% nitric acid, 8, UN2301, PGII	1 liter	30 liters
Nitric acid preserved samples	Corrosive Liquids, Acidic, Inorganic, NOS (Nitric Acid), 8, UN3264, PGIII	5 liters	60 liters
Hydrochloric acid	Hydrochloric Acid Solution, 8, UN1789, PGII	1 liter	30 liters
Hydrochloric acid preserved samples	Corrosive Liquids, Acidic, Inorganic, NOS (Hydrochloric Acid), 8, UN3264, PG III	5 liters	60 liters
Phosphoric acid	Phosphoric Acid, 8, UN1805, PGIII	5 liters	60 liters
Sodium hydroxide solution	Sodium Hydroxide Solution, 8, UN1824, PGII	1 liter	30 liters
Sodium hydroxide preserved sample	Corrosive Liquids, Basic, Inorganic, NOS (Sodium Hydroxide), 8, UN3266, PGIII	5 liters	60 liters
Isopropyl alcohol	Isopropyl alcohol or Isopropanol, 3, UN1219, PGII	5 liters	60 liters
Methanol	Methanol, 3, UN1230, PGII	1 liter	60 liters
Hexanes	Hexanes, 3, UN1208, PGII	5 liters	60 liters
Sodium bisulfate, aqu sol	Bisulfate, aqueous solution, 8, UN2837, PGII	1 Liter	30 liters
Fuel ID/Tank Samples	Flammable Liquids, NOS (fuels), 3, UN1993, PGIII.	60 liters	220 liters

¹ Personnel should be aware that the following represents only a few of the possible Proper Shipping Names (PSNs) available for shipping hazardous materials. Not all materials field personnel may have to ship are covered by these examples. Shippers are advised to review the DOT hazardous materials table prior to shipping.

² Passenger Aircraft/Railcar.

³ Cargo Aircraft Only.

⁴ Nitric acid solutions at 20% acid are recognized by the ICAO and IATA, and are addressed in 49 CFR 171.11.

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Table F-3
Limited Quantity Packaging and Shipping Paper Criteria

Parameter	Class 3	Class 6.1	Class 8	Class 9
Outer Package (max gross wt)	30 kg/66 lb	30 kg/66 lb	30 kg/66 lb	30 kg/66 lb
Outer Package Markings:				
1. PSN				
2. UN#				
3. Orientation Arrows - liquids				
4. Address				
5. RQ	()	()	()	()
6. Other Markings: Marine Pollutant, Cargo Air Craft, etc.	()	()	()	()
Label	Air: Flammable Liquid Other: excepted	Air: Poisonous Other: excepted	Air: Corrosive Other: excepted	Air: Class 9 Other: excepted
Inner Package				(Not PG specific)
Size Limit:				
1. PGI	0.5 L	N/A	N/A	4.0 L/5.0 kg
2. PGII	1.0 L	N/A	1.0 L/1.0 kg	
3. PGIII	5.0 L	4.0 L/5.0 kg	4.0 L/5.0 kg	
Shipping Paper Entries:				
1. Gross wt				
2. Number of packages				
3. Proper shipping description				
4. "Ltd Qty"				
5. Marine Pollutant	()	()	()	()
6. RQ	()	()	()	()
Note:				
Entry Required				
() Required if definition criteria are met				

F.2.2.2.3 Methanol preserved samples. Soil and sediment samples may require preservation with methanol if samples will be tested for volatile organics by the high-level method. In this case methanol is added neat to the sample and is, therefore, considered a hazardous material. DOT and IATA regulations should be reviewed to determine appropriate packaging and shipping requirements, and to determine if a limited-quantity exemption exists. If so, the volume of hazardous material to be shipped is evaluated to determine if it exceeds this threshold limit. Refer to Table F-2 for information on the PSN, and limited quantities associated with methanol. Additional information on limited quantities should be referenced from IATA regulations when applicable. Again, refer to Table F-3 for a summary of general requirements necessary to ship DOT-limited quantities. For instance if the total volume of methanol included within sample jars packaged in the shipping container does not exceed 1 L, then one may ship under the exception found in 49 CFR 173.150 (b)(2) for limited quantities. This is supported by the DOT Hazardous Materials Table, which identifies the methanol quantity limitation for passenger aircraft or railcar as 1 L (0.3 gal). When the total volumes of shipped material are less than the limited quantities noted, then the materials may be shipped as a limited quantity. "Limited Quantity" or "Ltd Qty." must be recorded on the shipping papers after the PSN if the exception is used. Sample packaging and shipment should follow procedures included in Section F.2.3. When greater than 1 L is included, sample packaging and shipment procedures noted within 49 CFR 172.701, Hazardous Materials Table, must be followed. Recommend packaging shipping containers to maintain the volume of methanol below the thresholds noted in Table F-2. Project personnel are also

encouraged to check with the shipping carrier used, to verify that additional, more stringent policy requirements do not exist for the shipment of flammable liquids such as methanol. Another option available under DOT is the small-quantity exception found in 49 CFR 173.4. Specifically, 49 CFR 173.4(a)(1)(i) states the maximum quantity of material per inner container is limited to 30 mL for authorized liquids, other than Division 6.1, Packing Group I materials (i.e., poisons). In other words, for Method 5035 (EPA/SW-846) preserved samples, if one has less than or equal to 30 mL of methanol or bisulfate aqueous solutions (sodium bisulfate) per inner (sample) container, this material is not subject to any other requirements of the hazardous materials regulations except those in 49 CFR 173.4. DOT hazard classes covered by this exception include Class 3, Division 4.1, Division 4.2 (PGII and PGIII), Division 4.3 (PGII and PGIII), Division 5.1, Division 5.2, Division 6.1, Class 7, Class 8, and Class 9. In addition to the 30-mL container limit, additional restrictions and requirements apply. Personnel taking this exception should review 49 CFR 173.4 carefully. Finally, no 49 CFR 173.21 (forbidden) materials may be packaged, the gross weight of the completed package cannot exceed 29 kg (64 lb), and the package cannot be opened or altered until it is no longer in commerce (transport). The shipper must certify conformance with the referenced sections by marking the outside of the package with the statement "*This package conforms to 49 CFR 173.4*" or alternatively until 1 October 2001 with the statement "*This package conforms to the conditions and limitations specified in 49 CFR 173.4*." Further, the shipper must indicate on the air waybill under nature and quantity of goods, "*Dangerous goods in Excepted Quantities*." The IATA also requires the application of an "Excepted Quantities" label. This label contains the certification language previously identified. Label entries include shipper signature, title, date, address, and indication of the hazard class and associated United Nations (UN) number.

F.2.2.2.4 Quantity limitations. One final restriction to note is that while 49 CFR 173.4 does not have a total net quantity limitation, IATA Dangerous Goods Regulations (DGR Section 2.7.5.2) does. For packing group II materials (i.e., methanol or sodium bisulfate) the total net quantity limit is 500 mL. This equates to 33 inner (sample) containers (i.e., VOA vials) containing up to 15 mL of preservative per outer package (cooler). When shipping DOT hazardous materials by air, shippers have additional restrictions that are identified in Columns 9A/9B of the 49 CFR 172.101 Hazardous Materials Table. Net quantity limits of methanol for passenger and cargo aircraft are 1 L and 60 L, respectively. The net quantity limits for sodium bisulfate solutions are 1 L and 30 L, respectively. Shippers should note that *these* quantities exceed the IATA small-quantity exception. Therefore, if the volume of preservative (methanol or sodium bisulfate solution) is kept less than 30 mL per inner (sample) container *and* total net quantity per outer package (cooler) is limited to 500 mL, then quantity limits given in DOT Hazardous Materials Regulations or IATA Dangerous Goods Regulations are not an issue provided packaging conforms with 49 CFR 173.4.

F.2.2.2.5 HTRW-CX assistance. The HTRW-CX has coordinated with the Logistics Support Activity Packaging, Storage, and Containerization Center at Tobyhanna Army Depot, Tobyhanna, PA, to develop a standard 49 CFR 173.4 tested and certified packaging. Materials needed to assemble these sample and shipping packages are readily available to field personnel from local hardware or retail stores. The protocol established is available for USACE personnel use by contacting HTRW-CX for additional information.

F.2.3 Procedures for shipping hazardous samples.

F.2.3.1 Hazardous samples are defined as those that are typically highly contaminated, such as oils, sludges, discarded products, and items that exhibit a hazard as defined by DOT, or if it is suspected that they may be explosive, reactive, poisonous, toxic, flammable, or corrosive. Samples with visual evidence of explosives content (e.g., TNT flakes) should be considered suspect and managed appropriately. Hazardous waste samples taken for chemical analyses are normally taken in small volumes with preservation limited to cooling. Packaging and shipping requirements for hazardous samples are typically determined based on

any known contaminants or characteristics of the samples. In several cases, field screening techniques may be used to identify the packaging requirements necessary. The shipment of these samples to the laboratory may also be considered exempt from regulation under RCRA/TSCA as previously described and as referenced from 40 CFR 261.4(d) and 40 CFR 761.65(I). However, these exemptions do not pertain to DOT or IATA regulations. DOT-defined hazardous material samples must be packaged and shipped in accordance with all applicable DOT regulations, including those establishing sample container types and specifications, marking, labeling, placarding requirements, and the preparation of associated shipping papers. In most cases, the shipper will be able to package and ship these samples under the limited-quantity requirements found in column 8A, Packaging Exceptions, of the Hazardous Materials Table (49 CFR 172.101). If no limited-quantity exceptions are found in column 8A, then field personnel should use the following guidelines to determine appropriate packaging and shipping requirements.

F.2.3.2 Initially, the shipper must determine the appropriate DOT hazard class. If the shipper is unable to determine the proper DOT hazard class, due to the unknown nature of the sample, the shipper must consult 49 CFR 171-177 to determine the proper hazard class and shipping name. The next step is to look at column 8A or 8B to determine the proper outer and (if required) inner nonbulk packaging requirements and any applicable exceptions. As it is safest to assume that the materials to be shipped do meet the definitions of a DOT hazard class, the outer container must be properly labeled and marked and the shipper must comply with all regulations concerning shipping papers and placarding. The cooler, or other outer package if considered an overpack (49 CFR 171.8 and 49 CFR 173.25), must be marked and labeled accordingly. For air shipment of samples that meet the definition of a DOT-hazardous material, the shipper must also use the quantity limitations found in column 9 of the Hazardous Materials Table (49 CFR 172.101). Further recommend that the transportation by air be designated as cargo aircraft. By specifying cargo aircraft, the shipper is permitted to ship larger volumes of material in a single outer container with less stringent regulatory requirements. The requirements for packaging, packing, and shipping for hazardous samples are outlined as follows. (Note: The following protocol should be used for the shipment of hazardous samples only if the shipper is taking a limited-quantity exception, unless the "paint can" is a UN specification container (i.e., 1A2, 1B2, etc). If the shipper is not taking a limited-quantity exception, UN performance-oriented packing requirements apply. Do not assume paint cans are UN specification packages unless they are marked in accordance with 49 CFR 178.503.)

- Ensure sample container label is complete, and adequately identifies the items prescribed in Instruction F-1.
- Verify each sample cap/lid is secured onto the bottle. Tape shut the lid onto sample containers, and place each sample in a plastic bag. Activated carbon may also be placed with the sample within the plastic bag to prevent cross-contamination.
- Place evidence tape or custody seals over the sample lid and container, or over the seal of the bag for additional security, if desired.
- Squeeze as much air as possible from the bag, and seal the bag.
- Place each bottle upright in a separate paint can. Fill the paint can with vermiculite, and affix the lid to the can. The lid must be sealed with metal clips or with filament or evidence tape; if clips are used, the manufacturer typically recommends six clips.
- Place DOT Orientation arrows on the can to indicate which end is up.

- Mark each with the proper DOT shipping name and identification number for the sample. These can be found referenced in the Hazardous Materials Table. The information may be placed on stickers or printed legibly. A liquid sample of an uncertain/unknown nature is shipped as a flammable liquid with the shipping name "FLAMMABLE LIQUID, N.O.S." and the identification number "UN1993." A solid sample of uncertain nature is shipped as a flammable solid with the shipping name "FLAMMABLE SOLID, N.O.S." and the identification number "UN1325." If the nature of the sample is known, 49 CFR 171-177 is consulted to determine the proper marking, labeling and packaging requirements. Always use DOT-approved outer containers to ship samples that meet or are suspected to meet the definitions of a hazardous material.
- Place the cans upright in a cooler that has had its drain plug taped shut inside and out, and has been lined with a garbage bag. Place vermiculite or perlite on the bottom if the materials are liquid.
- All hazardous samples should be shipped to the laboratory on ice and chilled to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$.
- Place additional inert packing material (styrofoam peanuts) in the cooler to partially cover the sample bottles. If samples are required to be shipped to the laboratory with ice, place bags of ice around the containers. The cooler must then be filled with packing material and the inner liner taped shut. NOTE: Do NOT use "environmentally friendly" peanuts made of starch to pack containers of liquids. These packing materials will dissolve when they get wet or moist.
- Place the paperwork going to the laboratory inside a plastic bag and tape it to the inside of the cooler lid. A copy of the COC form should be included in the paperwork sent to the laboratory. The sampler keeps one copy of the COC form. The laboratory should be notified if a sample is suspected of containing any substance for which laboratory personnel should take safety precautions.
- Close the cooler and seal with strapping tape. Place at least two custody seals on the outside of the cooler (one on the front and one on the back). More custody seals may be used at the discretion of the sampler.
- Place the following markings on the top of the cooler:
 - (1) Proper shipping name (49 CFR 172.301).
 - (2) DOT UN/North America identification number (49 CFR 172.301).
 - (3) Shipper/consignee's name and address (49 CFR 172.301).
- Place the following labels on top of the cooler (49 CFR 172.406(e)):
 - (1) Appropriate hazard class label (adjacent to PSN).
 - (2) "Cargo Aircraft Only" (as needed, per 49 CFR 172.101).
 - (3) Certification statement: "Inside (inner) packages comply with the prescribed specifications"
- Place orientation markings on two opposite vertical sides indicating "This Way Up" in addition to the markings and labels described in preceding item (49 CFR 172.312).

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- Use restricted-article air bills for shipment. The "Shipper Certification for Restricted Articles" section is filled out as follows:
 - (1) Number of packages or number of coolers
 - (2) Proper shipping name
 - (3) Classification
 - (4) Identification number
 - (5) Net quantity per package or per cooler
 - (6) Radioactive materials section (leave blank)
 - (7) Note passenger or cargo aircraft
 - (8) Name and title of shipper (printed)
 - (9) Emergency telephone contact number within 24 to 48 hr
 - (10) Shipper's signature

IATA Dangerous Goods Regulations list the hazard classes for many compounds. If the materials to be shipped cannot be found on the list, it may be necessary to use a more generic (not otherwise specified (NOS)) description. IATA regulations apply mainly to international shipment of hazardous materials by air. However a number of overnight domestic carriers (such as FedEx and UPS) also use IATA regulations to govern domestic shipments. Quantity limitations concerning hazardous materials shipments are usually the same as DOT; however, exceptions exist. IATA regulations must be reviewed if a domestic carrier requires IATA quantity limitations. Examples of PSNs that may be appropriate for samples are included in Table F-2.

F.2.4 Procedures for shipping preservatives and decontamination fluids. Preservatives and decontamination solvents used in environmental and hazardous waste sampling are often hazardous materials. These materials must also be stored and shipped in accordance with all applicable regulations. The preferred method for transporting preservatives to the site, many of which are DOT hazardous materials, is to order them from a chemical supply company and have that company ship the materials directly to the sampling site or base of operations. This reduces the liability and regulatory compliance issues that must be dealt with for field personnel. If project personnel must ship the materials defined as DOT-hazardous for use as preservatives or decontamination fluids, compliance with all applicable DOT regulations, including proper shipping containers, container markings, placarding, packaging, labeling, and shipping paper requirements is required. When Government personnel will transport preservatives and decontamination fluids to the field in a Government vehicle via highway only, the less stringent 49 CFR 173.6, Materials of Trade Exceptions, may apply. Further information on the exception can be obtained from the HTRW-CX. Procedures for shipping preservatives and decontamination fluids are outlined as follows:

- Determine the proper DOT shipping name (PSN) for the materials to be shipped. The PSN for hazardous materials will be found in 49 CFR 172.101, Hazardous Materials Table. The PSNs for the most common preservatives are given in Table F-2.

- Determine whether there is an exception for limited quantities for the material(s) to be shipped. Refer to column 8A in 49 CFR 172.101, Hazardous Materials Table, under the PSN for the specific material that needs to be shipped.
- If there is a limited-quantity exception and the materials to be shipped meet those quantity limitations for the transportation methods shown in column 9A/9B of the Hazardous Materials Table and comply with the proper packaging requirements as shown in column 8A, then the materials may be shipped as a limited quantity. "Limited Quantity" or "Ltd Qty." must be recorded on the shipping paper after the PSN if the exception is used. Some of the quantity limitations of the more common chemicals used as preservatives in environmental samples are given in Table F-2.
- If the material does not have an exception as a limited quantity, the next step is to determine the requirements to properly package the material under DOT regulations. Refer to 49 CFR 172.101, Column 8B. In this section (packaging authorizations for nonbulk packaging), a three-digit (***) number is present. To find the proper section for packaging authorizations, see 49 CFR 173.(***). For example, under Sulfuric Acid, the three-digit number found in column 8B is 202. So the shipper should look under 49 CFR 173.202 for the packaging authorizations for shipping sulfuric acid. The materials to be shipped **MUST** comply with the required packaging.
- Determine whether there are placarding requirements for the shipment. Refer to 49 CFR 172.500 for this information.
- Ship the materials following the criteria established.

F.2.5 Potential problems.

F.2.5.1 Field personnel should be aware that there are discrepancies for nitric acid in the shipping name tables for DOT and ICAO/IATA. IATA/ICAO allow the shipment of ≤ 20 percent nitric acid via passenger aircraft and allow these concentrations to be shipped as a limited quantity. DOT does not acknowledge this PSN entry, but does acknowledge ICAO technical instructions. Refer to 49 CFR 171.11 for additional details.

F.2.5.2 Note that excessive sample preservation is very likely to bring an environmental sample into the DOT hazardous materials regulatory realm. Depending on the specific inorganic acid used as a preservative, a difference of 0.5 pH unit (e.g., pH 1.0 versus pH 1.5) will likely trigger all DOT hazardous materials communication standards and regulations. The ranges noted in Table F-2 are provided to help field personnel make the appropriate decisions associated with the classification of preserved environmental samples for transportation.

F.2.5.3 Individual samples known to contain or are highly suspected of containing PCBs at greater than or equal to 0.45 kg (1 lb) or greater than or equal to 1 percent by weight are regulated in the air mode. In this instance DOT hazardous materials regulations are applicable. Further, PCBs are regulated as a marine pollutant, which requires additional notations on the shipping paper. Readers are referred to 49 CFR 172.203.

