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MCB CAMP LEJEUNE
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Site-Specific Work Plan
for
Preliminary Assessment/Site Inspection, D-6, 50-Foot Indoor Rifle and Pistol Range - UXO-01 (Former Building 451)

Marine Corps Base Camp Lejeune
Onslow County, North Carolina

Naval Facilities Engineering Command Mid-Atlantic

Contract Number N62472-03-D-0057
Contract Task Order 163

April 2009

SITE-SPECIFIC WORK PLAN
FOR
PRELIMINARY ASSESSMENT/SITE INSPECTION, D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE - UXO-01 (FORMER BUILDNG 451)

MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Mid-Atlantic
Marine Corps North Carolina IPT
6506 Hampton Boulevard
Norfolk, Virginia 23508

Submitted by:
Tetra Tech
234 Mall Boulevard, Suite 260
Kiung of Prussia, Pennsylvania 19406

CONTRACT NUMBER N62472-03-D-0057
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APRIL 2009

PREPARED UNDER THE SUPERVISION OF:

Richard Barringer / 4-27-09
RICK BARRINGER
PROJECT MANAGER
TETRA TECH
PITTSBURGH, PENNSYLVANIA

T.E. Johnston / 4-27-09
THOMAS JOHNSTON, PhD
QUALITY ASSURANCE MANAGER
TETRA TECH
PITTSBURGH, PENNSYLVANIA

4/30/09
ROBERT LOWDER
INSTALLATION RESTORATION PROGRAM MANAGER
MCB CAMP LEJEUNE

APPROVED FOR SUBMITTAL BY:

5-1-09
BRYAN BECK
NAVY TECHNICAL REPRESENTATIVE
NAVFAC MID-ATLANTIC

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ACRONYMS

°C	Degree Celsius
°F	Degree Fahrenheit
AEC	Areas of Environmental Concern
bgs	below ground surface
BMP	Best Management Practices
CAD	Computer-Aided Drafting
CAMA	Coastal Area Management Act
CD-ROM	Compact Disk-Read Only Memory
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMU	Concrete Masonry Unit
CSM	Conceptual Site Model
CTO	Contract Task Order
DMM	Discarded Military Munitions
DO	Dissolved oxygen
DPT	Direct-Push Technology
DQO	Data Quality Objectives
ESV	Ecological Screening Value
FBL	Fixed-Base Laboratory
FOL	Field Operations Leader
GIS	Geographical Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
HSM	Health and Safety Manager
ID	Inner diameter
IDW	Investigation Derived Waste
INRMP	Integrated Natural Resources Management Plan
IR	Installation Restoration
ITRC	Interstate Technology and Regulatory Council
MC	Munitions Constituent
MCB	Marine Corps Base
MEC	Munitions and Explosives of Concern

mg/kg	milligrams per kilogram
mL	milliliter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
msl	Mean sea level
NAVFAC	Naval Facilities Engineering Command
NCDENR	North Carolina Department of Environment and Natural Resources
NTR	Navy Technical Representative
NTU	Nephelometric turbidity unit
OE	Ordnance and Explosives
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PC	Personal Computer
PDF	Portable Document Format
PM	Project Manager
PPE	Personal Protective Equipment
PVC	Polyvinyl chloride
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QC	Quality Control
RBSL	Risk-Based Screening Level
RI	Remedial Investigation
RPM	Remedial Project Manager
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SSO	Site Safety Officer
SSWP	Site-Specific Work Plan
TAL	Target Analyte List
TBD	To Be Determined
Tetra Tech	Tetra Tech NUS, Inc.
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

USMC	United States Marine Corps
UXO	Unexploded Ordnance
WAR	Water and Air Research
XRF	X-Ray Fluorescence

Worksheet #2 -- SAP Identifying Information

Site Name/Number: D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451)
Operable Units: To be determined
Contractor Name: Tetra Tech NUS, Inc.
Contract Number: N62467-03-D-0057
Contract Title: Comprehensive Long-Term Environmental Action Navy
Work Assignment Number (optional): CTO 163

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (U.S. EPA, 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (2002)*.

2. Identify regulatory program: CERCLA

3. This SAP is a project-specific SAP.

4. List dates of scoping sessions that were held:

Scoping Session	Date
Meeting No. 1 – Site Visit	September 10 and 11, 2008

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
NA	

6. List organizational partners (stakeholders) and connection with lead organization:

USEPA Region 4; NCDENR; NAVFAC Mid-Atlantic; MCB Camp Lejeune

7. Lead organization
NAVFAC Mid-Atlantic

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

Worksheet #2: A complete UFP-SAP was not developed because the work is activity-funded.
Worksheet #9: Not applicable. Scope was issued by NAVFAC.

Worksheet #13: Not applicable. No secondary data was used in developing this Work Plan.

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	See cover page of SSWP
2	Table of Contents SAP Identifying Information	See Worksheet #2
3	Distribution List	See Worksheet #3
4	Project Personnel Sign-Off Sheet	See Worksheet #4
Project Organization		
5	Project Organizational Chart	See Worksheet #5 and Figure 2-1
6	Communication Pathways	See Section 2.0 of SSWP
7	Personnel Responsibilities and Qualifications Table	See Sections 2.1, 2.2 and 2.3 of SSWP
8	Special Personnel Training Requirements Table	See Section 2.4 of SSWP
Project Planning/Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	Not applicable
10	Problem Definition, Site History, and Background. Site Maps (historical and current)	See Appendix F of SSWP
11	Site-Specific Project Quality Objectives	See Appendix F of SSWP
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information, Secondary Data Criteria and Limitations Table	Not applicable
14	Summary of Project Tasks	See Sections 2.6 and 3.0 of SSWP
15	Reference Limits and Evaluation Table	See Table 3-3 of SSWP
16	Project Schedule/Timeline Table	See Table 2-2 of SSWP
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	See Section 3.0 of SSWP
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	See Section 3.0 and Table 3-1 of SSWP
19	Analytical Methods/SOP Requirements Table	See Appendix E of SSWP
20	Field Quality Control Sample Summary Table	See Table 4-1 of SSWP
21	Project Sampling SOP References Table, Sampling SOPs	See Appendix D of SSWP
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	See Section 4.3.1 and Appendix D of SSWP
Analytical Tasks		
23	Analytical SOPs, Analytical SOP References Table	See Appendix E of SSWP
24	Analytical Instrument Calibration Table	See Appendix E of SSWP

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	See Appendix E of SSWP
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving, and Disposal Sample Handling Flow Diagram	See Sections 4.2, 4.3 and Appendix D of SSWP
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	See Sections 4.2, 4.3, and Appendix D of SSWP
Quality Control (QC) Samples		
28	QC Samples Table, Screening/Confirmatory Analysis Decision Tree	See Appendix E of SSWP
Data Management Tasks		
29	Project Documents and Records Table	See Section 4.3 of SSWP
30	Analytical Services Table Analytical and Data Management SOPs	See Tables 3-1, 3-2 and Appendix E of SSWP
C. Assessment Oversight		
31	Planned Project Assessments Table, Audit Checklists	See Section 2.0 of SSWP
32	Assessment Findings and Corrective Action Responses Table	See Section 2.0 of SSWP
33	QA Management Reports Table	See Sections 1.2, 2.6.6, and 4.3 of SSWP
D. Data Review		
34	Verification (Step I) Process Table	See Section 2.0 of SSWP
35	Validation (Steps IIa and IIb) Process Table	See Sections 2.2, 4.5.1, and Appendix E of SSWP
36	Validation (Steps IIa and IIb) Summary Table	See Sections 2.2, 4.5.1, and Appendix E of SSWP
37	Usability Assessment	See Sections 2.2, 4.5.1, and Appendix E of SSWP

Worksheet #3 -- Distribution List

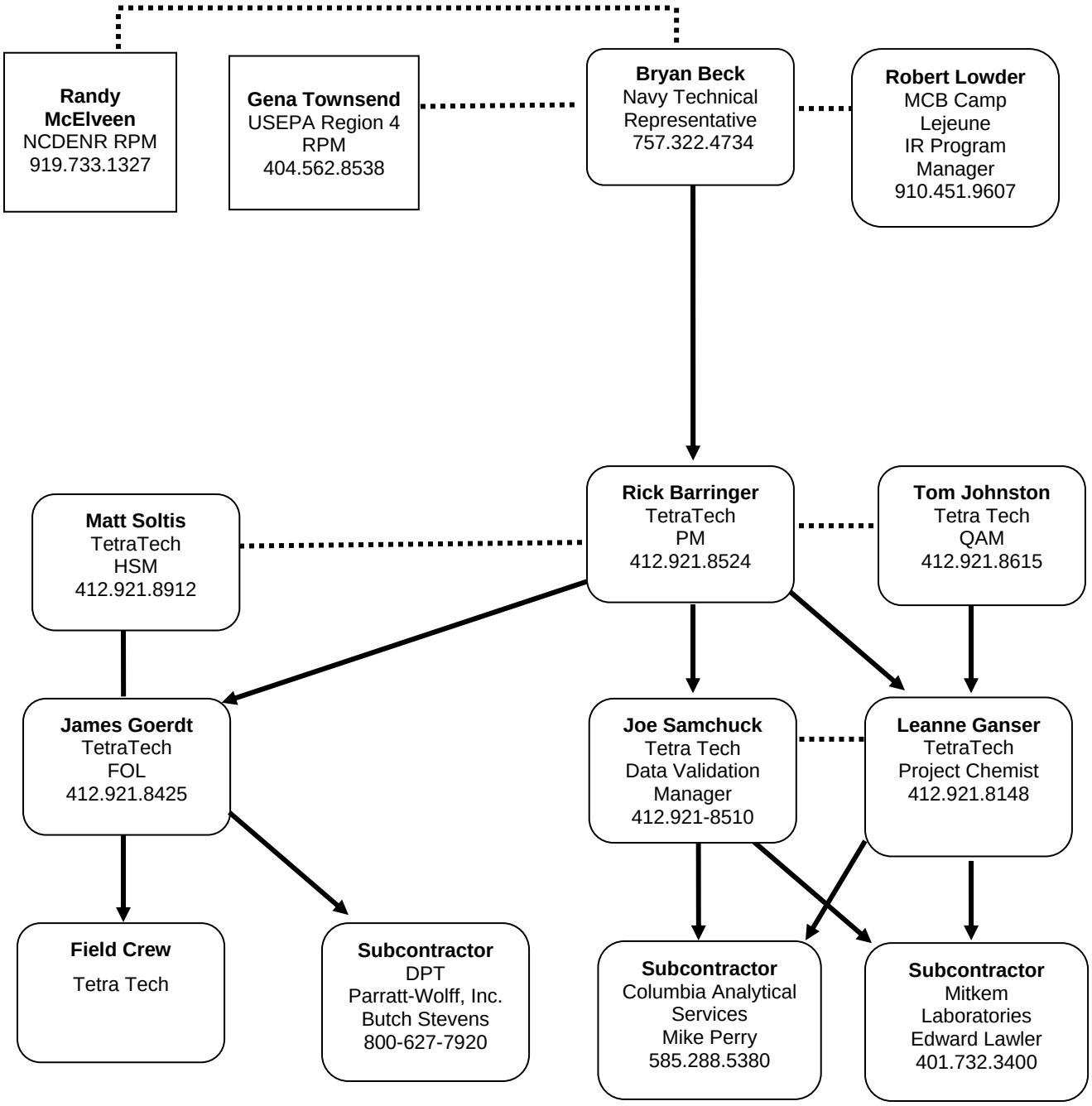
Name of SSWP Recipient	Title/Role	Organization	Telephone Number (Optional)	E-Mail or Mailing Address
Gena Townsend	USEPA Region 4 RPM	USEPA	404.562.8538	townsend.gena@epa.gov
Randy McElveen	NCDENR RPM	NCDENR	919.733.1327	randy.mcelveen@ncmail.net
Bryan Beck	Navy Technical Representative	NAVFAC Mid-Atlantic	757.322.4734	bryan.beck@navy.mil
Robert Lowder	MCB Camp Lejeune IR Program Manager	MCB Camp Lejeune	910.451.9607	robert.a.lowder@usmc.mil
John Trepanowski	Program Management	Tetra Tech	610.491.9688	john.trepanowski@tetratech.com
Matt Soltis	Health and Safety Manager	Tetra Tech	412.921.8912	matt.soltis@tetratech.com
Rick Barringer	PM	Tetra Tech	412.921.8524	rick.barringer@tetratech.com
James Goerdt	FOL	Tetra Tech	412.921.8425	james.goerdt@tetratech.com
Leanne Ganser	Project Chemist	Tetra Tech	412.921.8148	leanne.ganser@tetratech.com
Tom Johnston	QAM	Tetra Tech	412.921.8615	tom.johnston@tetratech.com
Edward Lawler	Laboratory PM	Mitkem Laboratories	401.732.3400	elawler@mitkem.com
Sharyn Lawler	Laboratory QAM	Mitkem Laboratories	401.732.3400	slawler@mitkem.com
Mike Perry	Laboratory Manager	Columbia Analytical Services, Inc.	585.288.5380	mperry@caslab.com

Worksheet #4 -- Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number (optional)	Signature/E-Mail Receipt	Work Plan Section Reviewed	Date Work Plan Read
Navy and Regulator Project Team Personnel					
Gena Townsend	USEPA Region 4 RPM	404.562.8538	townsend.gena@epa.gov		
Randy McElveen	NCDENR RPM	919.733.1327	randy.mcelveen@ncmail.net		
Bryan Beck	NAVFAC Mid-Atlantic Navy Technical Representative	757.322.4734	bryan.beck@navy.mil		
Robert Lowder	MCB Camp Lejeune IR Program Manager	910.451.9607	robert.a.lowder@usmc.mil		
TetraTech Project Team Personnel					
Rick Barringer	PM	412.921.8524	rick.barringer@tetratech.com		
James Goerdt	FOL	412.921.8425	james.goerdt@tetratech.com		
Leanne Ganser	Project Chemist	412.921.8148	leanne.ganser@tetratech.com		
Tom Johnston	QAM	412.921.8615	tom.johnston@tetratech.com		
Matt Soltis	Health and Safety Manager	412.921.8912	matt.soltis@tetratech.com		
Subcontractor Personnel					
Edward Lawler	Mitkem Laboratories	401.732.3400	elawler@mitkem.com		
Mike Perry	Columbia Analytical Services, Inc.	585.288.5380	mperry@caslab.com		

Worksheet #5 -- Project Organizational Chart

Lines of Authority ——— Lines of Communication ·····



1.0 INTRODUCTION

1.1 BACKGROUND AND PROJECT OBJECTIVES

Marine Corps Base (MCB) Camp Lejeune is located in the Atlantic Coastal Plain Physiographic Province in Onslow County, North Carolina, approximately 45 miles south of New Bern and 47 miles north of Wilmington (Figure 1-1). The base covers approximately 236 square miles and is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean.

The base is bordered by the City of Jacksonville, North Carolina, and State Route 24 to the north, the Atlantic shoreline to the south and east, and U.S. Route 17 to the west (not including the Greater Sandy Run Area of the base west of U.S. Route 17).

The topography of the base is generally flat and typical of the North Carolina Coastal Plain. Elevations on the base range from sea level to approximately 72 feet above mean sea level (msl). However, elevations on the majority of the base range from approximately 20 to 40 feet above msl.

Drainage at the base generally is toward the New River, except in areas near the coast, which drain through the Intracoastal Waterway. In developed areas, the natural drainage has been altered by asphalt cover, storm sewers, and drainage ditches. Approximately 70 percent of the base is situated in broad, flat, interstream areas. Drainage is poor in these areas and the soils are often wet (WAR, 1983). The United States Army Corps of Engineers (USACE) has mapped the limits of the 100-year floodplain at the base at 7 feet above msl in the upper reaches of the New River increasing downstream to 11 feet above msl near the coastal area (WAR, 1983).

The United States Marine Corps (USMC) has conducted small bore weapons training and marksmanship qualification activities at multiple ranges at MCB Camp Lejeune. Of particular significance to this project is the D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451) (D-6 Small Arms Range) that has since been demolished and removed from the site.

Construction of MCB Camp Lejeune began in 1941, and during World War II, the installation was used as a training area to prepare Marines for combat. MCB Camp Lejeune has served as a combat Marine training center during the Korean and Vietnam conflicts as well as the Gulf War and subsequent Middle Eastern activities.

To collect site-specific information on the D-6 Small Arms Range, a site visit was performed on September 10 and 11, 2008, by Tetra Tech NUS, Inc. (Tetra Tech) Personnel. This data collection effort considered the following five primary sources of information:

- Historical archives
- Personal interviews
- Installation data repositories (including the Administrative Record)
- Visual surveys
- Off-range data sources and repositories, such as local libraries and museums

As a result of the USMC's small arms weapons training activities at the D-6 Small Arms Range, there is the potential for Munitions Constituents (MC) (primarily lead) to be present in the environment at the site. Based on the known use of small arms at this range, the potential presence of Munitions and Explosives of Concern (MEC) including Discarded Military Munitions (DMM), Unexploded Ordnance (UXO), and MC in high enough concentrations to pose an explosive hazard is unlikely. An Explosives Safety Submission (ESS) Determination form was submitted for this former small arms range and is included in Appendix G of this Work Plan. The Marine Corps Systems Command indicated that an ESS is not required for the proposed PA/SI activities at this site and that anomaly avoidance is not required based on the location being used as a small arms range.

The D-6 Small Arms Range site covers an area of approximately 1-acre inside the main cantonment area (Compartment #31) on the eastern side of the New River, downstream of the Hadnot Point area of the base. The D-6 Small Arms Range site is located north of the intersection of I Street and Julian C. Smith Road (previously named River Road), as shown on Figure 1-2.

This Preliminary Assessment/Site Inspection (PA/SI) is being conducted to accomplish the following objectives:

- Identify historical activities at the D-6 Small Arms Range that may have resulted in environmental contamination with MC by researching archival records and interviewing current and former installation personnel.

- Evaluate the presence and nature of MC contamination that may exist at the D-6 Small Arms Range by conducting an investigation of soil, groundwater, and if present, sediment and surface water.

- Conduct ecological and human health risk screenings using analytical data collected at the D-6 Small Arms Range.

The USMC is following the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process for the investigation of this site. After the Preliminary Assessment (PA), the next step in the CERCLA process for the D-6 Small Arms Range at MCB Camp Lejeune is the PA/SI. The primary objective of the PA/SI is to determine if further response actions or a Remedial Investigation (RI) may be appropriate at the site. The PA/SI considers the background information (as compiled during the initial project phase) and collects supplemental site-specific environmental data to further define the nature and extent of MC at the site. Because the PA/SI is a secondary component of the CERCLA site evaluation process, it is not intended to be a full-scale study of the nature and extent of range-derived contamination hazards.

1.2 SITE-SPECIFIC WORK PLAN SCOPE AND ORGANIZATION

The following PA/SI activities are performed in accordance with the methods and procedures detailed in this Site-Specific Work Plan (SSWP) to accomplish the objectives described in Section 1.1:

Preliminary Assessment

- Conduct a detailed historical archive search for documents pertaining to the D-6 Small Arms Range and prior uses of the property.

- Interview current installation personnel, and attempt to identify and interview former military personnel, to obtain their accounts of activities that may have impacted the project area.

Site Inspection

- Conduct a field investigation for MC contamination by sampling and analyzing groundwater, soil, and if present, surface water and sediment.
- Prepare a PA/SI Report.

This SSWP is divided into sections providing information on the detailed approach, including procedures to be employed during the execution of the project. Appendices to the SSWP provide supporting documentation that details specific procedures for the execution of the project.

This SSWP is organized as follows:

- **Section 1.0, Introduction:**
  Provides general information about this SSWP, describes the D-6 Small Arms Range, summarizes the history of the site, and presents the project scope and objectives.

- **Section 2.0, Project Organization and Responsibilities:**
  Presents the overall project organization, along with key project personnel and their responsibilities.

- **Section 3.0, Sampling and Analysis Plan:**
  Identifies the technical approach, methods, and operational procedures that will be used to execute the field investigation activities, including mobilization and demobilization, utility clearance, vegetation clearing, temporary well installation, and sampling of environmental media.

- **Section 4.0, Quality Control Plan:**
  Provides details of the approach, methods, and operational procedures to be employed for quality control (QC) of the PA/SI at the D-6 Small Arms Range.

- **Section 5.0, Environmental Protection Plan:**
  Describes the approach, methods, and operational procedures to be employed to protect the natural environment during performance of all tasks at the D-6 Small Arms Range.

- **Section 6.0, References:**
  Lists the references cited in the preceding sections.

- **Appendix A, Archival Records Search Report:**
  Presents the results of the records search and personnel interviews that were conducted to identify historical activities that may have resulted in environmental contamination of the site area.

- **Appendix B, Site Photographs:**
  Provides photographs of the D-6 Small Arms Range taken during the site walk on September 10 and 11, 2008.

- **Appendix C, Health and Safety Plan:**
  Provides an interface with Tetra Tech's overall health and safety program.

- **Appendix D, Field Standard Operating Procedures:**
  Provides a comprehensive list of all Standard Operating Procedures (SOPs) to be used in the field during this PA/SI.

- **Appendix E, Fixed-Base Laboratory Analytical SOPs:**
  Provides a comprehensive list of all SOPs to be used by the fixed-base laboratory (FBL) during the analytical process.

- **Appendix F, Conceptual Site Model, Data Quality Objectives and Project Action Limits Criteria:**
  Provides the Conceptual Site Mode (CSM), associated Data Quality Objectives (DQOs), and the Project Action Limits Criteria for the PA/SI of the D-6 Small Arms Range.

- **Appendix G, Explosives Safety Submission Determination Request:**
  Provides the initial Explosives Safety Submission Determination form prepared for the Former Live Fire Range D-6, 50-foot Indoor Rifle and Pistol Range (UXO-1) and Marine Corps endorsements.

1.3 SITE LOCATION AND DESCRIPTION OF D-6 SMALL ARMS RANGE

The D-6 Small Arms Range site covers an area of approximately 1-acre. The firing range was entirely enclosed inside Building 451 and was used for small arms training and qualification testing for small bore weapons from approximately 1953 to mid-1997. Building 451 was formerly located on the northwestern side of I Street between Building 429 and Building 430 (see Figure 1-2).

The location of the D-6 Small Arms Range site is shown on Figure 1-2 and supported a 50-foot firing line and a 75 foot firing line inside the building structure. Figure 1-3 presents a 1998 aerial photograph showing the exact location of the former D-6 Small Arms Range. The building was then demolished in December of 1998 and as shown on the 1999 aerial photograph (Figure 1-4), the area disturbed by the building demolition and removal did not extend into the mature forested area surrounding the building demolition site.

1.3.1 Development and Construction of the D-6 Small Arms Range

Building 451 consisted of metal sheeting on a steel frame (Butler Building) and was constructed in November 1952. The original design blueprints dated April 25, 1952, indicate outside dimensions of 120 feet, 6 inches (oriented southwest to northeast) by 40 feet. Photographs and drawing details shown on the building demolition plan dated July 9, 1997, indicate that the building entrance was on the southeastern corner and the direction of small arms fire was to the northeast. This drawing indicates that the northeastern end of the building and approximately 86 feet along the southeastern and northwestern walls were lined with concrete masonry unit (CMU) walls inside the Butler Building sheet metal exterior wall. The CMU walls were typical cinder block construction, and inside Building 451 surrounding the range area, were 12 feet, 10 inches high. The indoor range at Building 451 was apparently eight firing lanes wide and accommodated target practice firing from distances of 50 and 75 feet from the targets. The 75-foot firing line is consistent with the outside dimensions of the building and the dimensions of the CMU wall lining the inside of the building wall along the firing range.

1.3.2 Bullet Trap Design for the D-6 Small Arms Range

The indoor range bullet trap system consisted of a series of four angled steel baffle plates suspended from the building's structural steel roof supports. The final baffle was a 13-foot-wide steel plate that extended across the width of the range and the covered area behind the targets. The steel baffle was oriented at a 45-degree downward angle from about 11 feet above the range floor to near the base of the downrange CMU wall. The leading edge of the final baffle was suspended above a 2-foot-high CMU wall about 10 feet in front of the CMU wall at the northeastern (target) end of the building. Behind the 2-foot wall approximately 8 to 16 inches of sand were placed over a 4-inch layer of gravel directly overlying the foundation slab. The sand layer thickened from the 2-foot CMU wall toward the rear (downrange) CMU wall where the final baffle plate was anchored. The sand would catch the expended bullets after they passed through the targets and were deflected by the final steel baffle plate into the bullet trap (sand pit). No records were discovered during the historical archive search relating to the handling or management of the expended bullets or bullet fragments in the Building 451 bullet trap sand.

1.3.3 Demolition and Removal of the D-6 Small Arms Range

Property records indicated that Building 451 was improved in 1985, and the building upgrades are believed to have been to the ventilation system, electrical supply, and building acoustics as detailed in Building 451 improvement plans dated June 20, 1983. The notes on the demolition plan indicate that building demolition included removal of wood-framed structures on the reinforced concrete foundation and slab including steel siding, CMU walls, partitions, and steel baffle plates. A note 4 also indicates that

the area was to be backfilled, raked, and seeded after building demolition and removal. This is relevant because non-native soil fill may have been brought to the site during this process, and any potential surface soil contamination may now be at depth below clean fill.

The Class 2 Disposal Record dated December 21, 1998, indicated that Building 451 was managed as property record number 204789. The disposal contract was recorded as FACLTR3DEC98, and the demolition/disposal for Building 451 was dated December 18, 1998.

1.3.4 General Information Compiled During the Site Visit

The following information was developed from interviews conducted and documentation reviewed during the data collection site visit on September 10 and 11, 2008. A series of interviews was conducted with multiple MCB Camp Lejeune personnel regarding the D-6 Small Arms Range. The sequence of site data collection efforts, including the interview of site personnel, collected information elements are summarized in Appendix A.1 of this report. The data collection effort included a review of the installation's data repositories, historical archives (vault records), the installation library, and other relevant environmental reports for the installation that provided most of the relevant information in terms of construction dates, general building design and dimensions, demolition design details, and dates for the demolition completion. This has been compiled and summarized in Appendix A.2 of this report. This general information is summarized in the following sections and verifies that the D-6 Small Arms Range was most likely operational in early 1953 and continued to be used as an indoor range for small-bore weapons training until about mid-1997 when the range building demolition plans were being developed. The more significant documents reviewed during the data collection effort are included in this report as Appendix A.3. A visual survey (digital photographic record) of the conditions at the site during the data collection site visit on September 10 and 11, 2008, is included in this report as Appendix B.

1.4 PRELIMINARY ASSESSMENT/SITE INSPECTION CONCEPTUAL SITE MODEL/DATA QUALITY OBJECTIVES

One component of the PA/SI is the refinement of the site-specific CSM as developed based on the information complied during the Historical Records Review report. The CSM describes the range and its environmental setting and was developed following guidance documents issued by the United States Environmental Protection Agency (USEPA) for hazardous waste sites and by USACE for Ordnance and Explosives (OE) sites. Additional guidance documents relevant to CSM development include USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (1988) and USACE's CSM Guidance for Development of Integrated Conceptual Site Models for Environmental OE

Sites (2003). A detailed CSM and the DQOs are presented in Appendix F. A brief summary of the problem definition is presented in this section.

The following is a summary of the problem definition:

- Environmental contamination may exist at the former D-6 Small Arms Range (approximately 1-acre) because the facility was an active small arms firing range from 1952 until about mid-1997. This indoor range features a 75-foot firing line and a 50-foot firing line for small bore weapons target training.

- Specific small arms ammunition types and materials used at the former D-6 Small Arms Range most likely included small arms and pistol ammunition (5.56mm, 7.62mm, .22-cal, and possibly other small arms ammunition).

- This indoor range was constructed with a standard deflection plate and sand pit bullet trap behind the targets at the northeastern end of the building. To reduce the potential for ricochet hazards in the bullet trap the sand pit was routinely maintained and the expended bullets were collected and removed.

- There was no information discovered in the installation archive describing how the bullet trap sands or the expended bullets recovered from the Building 451 sand pit were handled. It is presumed that standard range management and maintenance practices would periodically recover expended lead bullets and fragments from the sand pit and that recovered lead material was taken off-site for recycling.

- Known hazardous material noted on the Building 451 demolition plans included friable asbestos in cloth-wrapped pipes, transite panels in the restroom ceiling, and details on the locations and concentrations of lead-containing paint in or on building metal siding surfaces and the steel baffle plates. There was no mention in the demolition plan regarding expended lead bullets or the bullet trap sands that could contain particulate lead and bullet fragments. It is presumed that because this demolition activity was only completed ten years ago that the bullet trap sand and contents were removed by the Navy from Building 451 prior to demolition. It is also presumed that those materials were sent offsite to recycle the lead or support some other beneficial reuse.

- In the absence of documentation to conclusively indicate that bullet trap sands (containing expended lead bullets and lead fragments) were removed from Building 451 prior to demolition, a limited

environmental sampling program has been proposed for the former D-6 Small Arms Range area. If bullet-derived contamination is present at the site, it should be concentrated in the vicinity of the former indoor range bullet trap area, at the northeastern end of the former indoor range (approximately 62 feet southwest of Building 430).

- MC consisting of metals (primarily lead and, to a lesser extent, antimony, arsenic, copper, tin, and zinc) as well as perchlorate may be present in site soil, particularly surface soil (the 0- to 6-inch interval). Additional environmental media such as surface water and sediment in nearby drainage ditches leading from the former range may also be affected and these drainageways discharge to adjoining unnamed tributaries and eventually to the New River. Lead is assumed to be the primary MC metals of concern because it is the primary constituent in spent small arms munitions (typically 85 to 96 percent lead by weight) and because of the documented toxicity of lead to both human and ecological receptors. It is anticipated that other metals contamination will be spatially correlated with lead concentrations. MC, if present in surface soil, may have migrated to subsurface soil and subsequently infiltrated to underlying groundwater. These constituents may have also migrated to the adjoining surface water bodies via surface soil runoff or discharge of contaminated shallow groundwater to surface water. However, the nature and extent of the potential environmental contamination at the former D-6 Small Arms Range is not known at this time (no environmental sampling has been conducted to date).

- The CSM indicates that potentially complete exposure pathways for MC exist for human receptors under both current and hypothetical future land uses. However, potential human risks have not been characterized for receptors exposed to the potentially contaminated environmental media.

- Sampling of local surface soil, subsurface soil, drainage ditch sediments, and groundwater (and possibly drainage ditch surface water, if present) will support the laboratory analysis of these media for the MC constituents of concern. The comparison of these analytical data against relevant medium-specific regional screening levels will aid in characterizing whether there has been a release of MC to the environment from the former D-6 Small Arms Range.

1.5 CLIMATE

The climate at MCB Camp Lejeune is characterized by mild winters and hot humid summers. Winters are usually short and mild, with occasional and short-duration cold periods. Summers are long, hot, and humid. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53 degrees Fahrenheit (°F) in the winter months and 71 to 88 °F during the summer

months. Winds are generally south-southwesterly in the summer and north-northwesterly in the winter (WAR, 1983).

1.6 GEOLOGY AND HYDROGEOLOGY

According to Cardinell et al. (1993), three of the upper Tertiary formations (Yorktown, Eastover, and Pungo River) are not present in the vicinity of MCB Camp Lejeune. Cardinell et al. (1993) postulated that the New River may have eroded the Belgrade formation locally at MCB Camp Lejeune.

The uppermost undifferentiated Holocene and Pleistocene sediments consist of mostly fine loose to medium dense sands with a lesser amount of silt and clay and are present from land surface to depths of approximately 20 to 30 feet below ground surface (bgs). Thin discontinuous lenses of silt and clay may be regionally associated with the Belgrade Formation, which generally consists of mostly fine sands, silts, and clays with lesser amounts of shell fragments.

The upper portion of the River Bend Formation, which underlies the Quaternary sediments, is composed of sands, silts, shell and fossil fragments, and trace amounts of clay. The River Bend Formation overlies the Eocene Castle Hayne Formation, which consists of both poorly indurated and well-indurated biomicrite and biomicrudite limestone (Harris et al., 1991). The thickness of the Castle Hayne Formation ranges from 150 feet and over 450 feet at MCB Camp Lejeune (Cardinell et al., 1993).

TETRA TECH

Figure 1-1
General Location Map
Site-Specific Work Plan
MCB Camp Lejeune
Onslow County, North Carolina

80 40 0 80 Miles

Drawn By: K. MOORE 12/5/08
Checked By: J. GOERDT 1/16/08
Approved By:

Contract Number: 112G01716
CTO 163

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TETRA TECH

Figure 1-2
Site Location
D-6, 50-foot Indoor Rifle and Pistol Range
(Former Building 451, ASR #2.64)
MCB Camp Lejeune
Onslow County, North Carolina

Legend

Topographic Contour (2 ft)

Former Location of Demolished Building 451 (ASR #2.64)

Natural Color Digital Image
Dated February 2004 (0.15m/pixel resolution)

NOTE: Digital image provided by Camp Lejeune Installation Geospatial and Information Service (IGI&S), East Coast Regional GEOFidelis (Geospatial) Center.

100 50 0 100 Feet

Drawn By: K. MOORE 10/22/08
Checked By: J. GOERT 1/16/09
Approved By:

Project Number: 112G01716
CTO 0163

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TETRA TECH

Figure 1-3
1998 Aerial Photograph
D-6, 50-foot Indoor Rifle
and Pistol Range
(Former Building 451, ASR #2.64)
MCB Camp Lejeune
Onslow County, North Carolina

Legend

Topographic Contour (2 ft)

Former Location of Demolished Building 451 (ASR #2.64)

Natural Color Digital Image
Dated March 1998 (1m/pixel resolution)

NOTE: Digital image provided by Camp Lejeune Installation Geospatial and Information Service (IGI&S), East Coast Regional GEOFidelis (Geospatial) Center.

100 50 0 100 Feet

Drawn By: K. MOORE 10/22/08
Checked By: J. GOERT 1/16/09
Approved By:

Project Number: 112G01716
CTO 0163

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TETRA TECH

Figure 1-4
1999 Aerial Photograph
D-6, 50-foot Indoor Rifle
and Pistol Range
(Former Building 451, ASR #2.64)
MCB Camp Lejeune
Onslow County, North Carolina

Legend

Topographic Contour (2 ft)

Former Location of Demolished Building 451 (ASR #2.64)

Natural Color Digital Image
Dated May 1999 (0.15m/pixel resolution)

NOTE: Digital image provided by Camp Lejeune Installation Geospatial and Information Service (IGI&S), East Coast Regional GEOFidelis (Geospatial) Center.

100 50 0 100 Feet

Drawn By: K. MOORE 10/22/08
Checked By: J. GOERT 1/16/09
Approved By:

Project Number: 112G01716
CTO 0163

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2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section describes the project management, organization, and responsibilities of key personnel for this SSWP.

Tetra Tech, on behalf of Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, is responsible for the preparation of this SSWP and for oversight of the PA/SI to ensure that they are completed satisfactorily at the D-6 Small Arms Range.

The subcontracted FBLs for this PA/SI, Mitkem Laboratories and Columbia Analytical Services (perchlorate), are responsible for analyzing all samples in accordance with the analytical methods and additional requirements specified in this document. It also will be the responsibility of the FBL to properly dispose of any unused sample aliquots.

2.1 PROJECT ORGANIZATION

The key organizations involved in this project are NAVFAC Mid-Atlantic, MCB Camp Lejeune, the North Carolina Department of Environment and Natural Resources (NCDENR), USEPA, and Tetra Tech. Project execution will be conducted by Tetra Tech and its subcontractors; specific duties for Tetra Tech and its subcontractors are described in this section of the SSWP. It is anticipated that Tetra Tech will issue subcontracts for brush clearing, utility clearance, direct-push technology (DPT) soil sampling and temporary well installation, and laboratory analyses.

2.1.1 Project Personnel

The reporting relationship between key project personnel and the roles and responsibilities of key personnel are discussed below. Contact information for key project personnel is listed by organization in Table 2-1.

Management

Tetra Tech personnel will report directly to NAVFAC Mid-Atlantic and will maintain open channels of communication during field activities to facilitate resolution of problems as efficiently as possible. Personnel from MCB Camp Lejeune will be actively involved and will coordinate with Tetra Tech personnel as necessary. Responsibilities for program management, project management, field operations, and laboratory operations are discussed in the following sections, as appropriate. It is

intended that the individuals named will assume the designated responsibilities to the extent that the specific person is available to perform the stated activities.

USEPA Oversight

The USEPA Region 4 Remedial Project Manager (RPM), (Ms. Gena Townsend), will oversee the implementation of the PA/SI at the D-6 Small Arms Range site. She will also represent USEPA's interests and will provide input from this perspective and lend general historical and technical assistance to PA/SI field activities.

North Carolina Department of Environment and Natural Resources Oversight

The NCDENR representative, Mr. Randy McElveen, will act as the focal representative for North Carolina, providing management, technical direction, and oversight for the PA/SI activities.

Navy Technical Representative

The Navy Technical Representative (NTR), Mr. Bryan Beck, will act as the focal representative for the United States Navy, providing management, technical direction, and oversight for the PA/SI activities performed by Tetra Tech and their subcontractors. In matters such as facilitation of site access, oversight, etc., the NTR will be assisted by the MCB Camp Lejeune Installation Restoration (IR) Program Manager, Mr. Robert Lowder.

Tetra Tech Program Manager

The Tetra Tech NAVFAC Mid-Atlantic CLEAN Program Manager, Mr. John Trepanowski, provides operations, technical, and administrative leadership and oversees and supports quality policies. The Program Manager assigns Project Managers (PMs) and oversees their performance, ensures the availability of technical and support resources for program operations, and maintains consistency in procedures and projects among Contract Task Order (CTO) assignments. In these matters, the Program Manager is assisted by the Tetra Tech PM.

Tetra Tech Project Manager

The Tetra Tech PM, Mr. Rick Barringer, has overall responsibility for ensuring that the project meets USEPA objectives and Navy and Tetra Tech quality standards associated with investigation oversight, sample collection, sample analyses, and data interpretation to determine whether the PA/SI is completed

satisfactorily. The PM is responsible for the preparation and distribution of this SSWP. The PM will report to the NTR and is responsible for technical QC and project oversight. Additional responsibilities of the PM are as follows:

- Ensuring timely resolution of project-related technical, quality, and safety questions associated with Tetra Tech operations.
- Functioning as the primary Tetra Tech interface with the NTR, MCB Camp Lejeune IR Program Manager, Tetra Tech field and office personnel, and laboratory Point-of-Contacts (POCs).
- Ensuring that Tetra Tech health and safety issues related to this project are communicated effectively to all personnel and the FBL.
- Monitoring and evaluating all Tetra Tech subcontractor performance.
- Coordinating and overseeing work performed by Tetra Tech field and office technical staff (including data validation, data interpretation, and report preparation).
- Coordinating and overseeing maintenance of all Tetra Tech project records.
- Coordinating and overseeing review of Tetra Tech project deliverables.
- Preparing and issuing final Tetra Tech deliverables to the Navy.

Tetra Tech Project Chemist

The Tetra Tech Project Chemist, Ms. Leanne Ganser, has overall responsibility for ensuring that the project meets objectives from the standpoint of laboratory performance. The Project Chemist is responsible for the technical preparation of laboratory statements of work (SOWs) and work releases. The PM of the subcontracted laboratory conducting sample analyses will report to the Tetra Tech Project Chemist and the Project Chemist will report to the Tetra Tech PM. Additional responsibilities of the Project Chemist are as follows:

- Providing technical advice to the Tetra Tech team on matters of project chemistry.
- Monitoring and evaluating subcontractor FBL performance.

- Ensuring timely resolution of laboratory-related technical, quality, or other issues effecting project goals.
- Functioning as the primary interface between the subcontracted FBL and the Tetra Tech PM.
- Coordinating and overseeing work performed by the subcontracted FBL.
- Overseeing the completion of Tetra Tech data validation.
- Coordinating and overseeing review of laboratory deliverables.
- Recommending appropriate laboratory corrective actions.

Tetra Tech Health and Safety Manager

The Tetra Tech Health and Safety Manager (HSM), Mr. Matt Soltis, is responsible for the following:

- Providing technical advice to the Tetra Tech PM on matters of health and safety.
- Overseeing the development and review of the Health and Safety Plan (HASP).
- Conducting health and safety audits.
- Preparing health and safety reports for management.

Each field event will have the support of a Site Safety Officer (SSO) who will be assigned by the HSM.

2.2 QUALITY ASSURANCE

This section identifies the quality assurance (QA) responsibilities for the PA/SI. Responsibilities of USEPA, Tetra Tech, and the analytical laboratory are discussed.

2.2.1 North Carolina Department of Environment and Natural Resources and United States Environmental Protection Agency

Chemists at the NCDENR and USEPA are responsible for review and approval of chemistry aspects of this SSWP and for providing overall QA support and review. Additional responsibilities may include the following:

- Coordinating external performance and system audits of the contracted laboratory.
- Reviewing and evaluating analytical field and laboratory procedures.

2.2.2 Tetra Tech QA Manager

The Tetra Tech NAVFAC Atlantic Program Quality Assurance Manager (QAM), Dr. Tom Johnston, is responsible for overall QA for the Tetra Tech portion of the project and reports directly to the Tetra Tech Program Manager. He acts on behalf of the United States Navy for project QA. The QAM is responsible for the following:

- Developing, maintaining, and monitoring QA policies and procedures.
- Providing training to Tetra Tech staff in QA/QC policies and procedures.
- Conducting systems and performance audits to monitor compliance with environmental regulations, contractual requirements, SSWP requirements, and corporate policies and procedures.
- Auditing project records.
- Monitoring subcontractor quality controls and records.
- Assisting in the development of corrective action plans and ensuring correction of non-conformances reported in internal or external audits.
- Ensuring that this SSWP meets Tetra Tech and Navy requirements.
- Overseeing the responsibilities of the Tetra Tech Project QA/QC Advisor.
- Preparing QA reports for management.

2.2.3 Laboratory Responsibilities

The subcontracted FBLs for this PA/SI are responsible for analyzing all samples in accordance with the analytical methods and additional requirements specified in this SSWP. The subcontracted FBLs, Mitkem Laboratories and Columbia Analytical Services (perchlorate), are NCDENR approved laboratories. It will also be the analytical laboratories responsibilities to properly dispose of unused sample aliquots. Responsibilities of key laboratory personnel are outlined in the following paragraphs.

2.2.3.1 Laboratory Project Manager

The Laboratory PM will interface directly with the Tetra Tech Project Chemist, Tetra Tech PM, and Tetra Tech QAM and will perform the following tasks:

- Ensure that methods and project-specific requirements are properly communicated and understood by laboratory personnel.
- Ensure that all laboratory resources are available on an as-required basis.
- Ensure compliance with analytical and project QA requirements.
- Review data packages for completeness, clarity, and compliance with project requirements.
- Inform the Tetra Tech PM of project status and any sample receipt or analytical problems.
- Oversee the preparation of and approving final analytical reports before submittal to Tetra Tech.

2.2.3.2 Laboratory Operations Manager

Responsibilities of the Laboratory Operations Manager include the following:

- Supporting the QA program within the laboratory.
- Providing management overview of both production- and quality-related laboratory activities.
- Maintaining adequate staffing to meet project analytical and quality objectives.
- Approving all laboratory SOPs and QA documents.
- Supervising in-house chain-of-custody documentation.

2.2.3.3 Laboratory Quality Assurance Officer

The Laboratory QA Officer (QAO) will report directly to the Laboratory Operations Manager and will be independent of laboratory production management to ensure that laboratory quality performance is assessed without schedule and cost considerations. Responsibilities of the Laboratory QAO include the following:

- Defining appropriate laboratory QA procedures and monitoring overall laboratory QA.

- Stopping work if a condition adverse to the quality of work is encountered, if QA or QC procedures are not followed, or if analytical out-of-control events are encountered that have not been corrected.

- Approving and maintaining document control of all laboratory QA documents and SOPs.

- Performing and/or implementing internal system and performance audits and verifying completion of corrective actions cited in audits.

- Directing laboratory participation in laboratory accreditation and certification programs.

- Reviewing data packages and case narratives for completeness according to project requirements and analytical methods.

2.2.3.4 Laboratory Sample Custodian

The Laboratory Sample Custodian will report to the Laboratory Operations Manager. Responsibilities of the Laboratory Sample Custodian include the following:

- Receiving and inspecting incoming sample containers.

- Recording the conditions of incoming sample containers.

- Signing appropriate documents.

- Verifying chain-of-custody records.

- Notifying the Laboratory PM of sample receipt and inspection.

- Assigning a unique identification number and customer number and entering each into the sample receiving log.

- With the help of the Laboratory PM, initiating transfer of the samples to appropriate laboratory sections.

- Controlling and monitoring access/storage of samples and extracts.

2.2.3.5 Laboratory Technical Staff

The laboratory technical staff will be responsible for sample analyses based on the analytical methods and requirements specified in this SSWP.

2.3 FIELD INVESTIGATION

Tetra Tech will be responsible for all field sampling and field analysis activities related to ensuring that the SSWP is completed satisfactorily. The Tetra Tech field team will be organized according to the activities planned, and field team members will be selected based on the type and extent of effort required. All team members will be appropriately skilled and trained for the tasks they are assigned to perform. It is anticipated the field effort will be completed in one 5-day shift.

2.3.1 Field Operations Leader

The Tetra Tech Field Operations Leader (FOL) is responsible for coordinating all on-site personnel and for providing technical assistance, when required. The FOL has authority to complete the field work in the most efficient manner while adhering to the requirements of this SSWP and the associated HASP (Appendix C). The Tetra Tech FOL will ensure the availability and maintenance of all sampling materials and equipment pertinent to his/her function. The Tetra Tech FOL is responsible for completing all sampling, field, and chain-of-custody documentation, will assume custody of all samples sent to the analytical FBL, and will ensure the proper handling and shipping of samples. The Tetra Tech FOL will report directly to the Tetra Tech PM but will have authority to guide field operations to efficiently complete the scheduled work. Specific Tetra Tech FOL responsibilities include the following:

- Ensuring that all health and safety requirements unique to the PA/SI are implemented.
- Functioning as the on-site communications link between field staff members, the SSO, MCB Camp Lejeune IR Program Manager, and Tetra Tech PM.
- Alerting off-site FBL of any special health and safety hazards associated with environmental samples.
- Overseeing the mobilization and demobilization of all field equipment and subcontractors.
- Coordinating and managing the field technical staff.
- Adhering to work schedules provided by the Tetra Tech PM.
- Ensuring the proper maintenance of site logbooks, field logbooks, and field record keeping.

- Initiating Field Task Modification Requests (field change orders) when necessary.

- Identifying and resolving problems in the field, resolving difficulties via consultation with the MCB Camp Lejeune IR Program Manager, implementing and documenting corrective action procedures, and providing communication between the field team and project management.

2.3.2 Site QA/QC Advisor

The FOL (or designee) will act as the Site QA/QC Advisor and will be responsible for ensuring adherence to all QA/QC requirements as defined in this SSWP. Strict adherence to these procedures is critical to the collection of acceptable and representative data. The following is a summary of the Site QA/QC Advisor's responsibilities:

- Ensuring that field QC samples are collected at the proper frequencies.

- Ensuring that additional volumes of sample are supplied to the analytical laboratory at the proper frequency to accommodate laboratory QA/QC analyses.

- Ensuring that measuring and test equipment are calibrated, used, and maintained in accordance with applicable procedures and technical standards.

- Acting as liaison between site personnel, laboratory personnel, and the QAM.

- Managing bottleware shipments and overseeing field preservation.

- Preparing a daily log of all work performed.

2.3.3 Site Safety Officer

The duties of the designated Tetra Tech SSO are detailed in the Tetra Tech HASP (Appendix C). The SSO has stop-work authority, which can be executed upon the determination of an imminent safety hazard.

2.3.4 Technical Staff

The technical staff for this project will be drawn from a pool of qualified personnel. All of the designated team members will be experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

Field staff members are responsible for complying with field-related requirements as presented in this SSWP and the associated HASP.

2.4 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

All field personnel will have appropriate training to conduct the field activities to which they are assigned. Additionally, each site worker will be required to have completed a 40-hour course (and 8-hour refresher course, if applicable) in Health and Safety Training as described under Occupational Safety and Health Administration (OSHA), 29 Code of Federal Regulations (CFR) 1910.120(b)(4).

Users of the X-Ray fluorescence (XRF) instrument will be properly trained to correctly operate the instrument by a certified user of the instrument or by the instrument manufacturer.

2.5 PROJECT SCHEDULE

Table 2-2 presents the anticipated project schedule.

2.6 TECHNICAL APPROACH

2.6.1 Task 1: Project Planning

This task includes project management, meetings, SSWP preparation, and subcontractor procurement. Project management includes all work necessary for controlling the project budget and schedule. This includes monthly status reports and invoicing and all other administrative tasks required for project performance.

Subcontractor procurement is also included under this task. Anticipated subcontractor services include utility locating, brush clearing, DPT soil sampling and temporary well installation, and laboratory analyses.

2.6.2 Task 2: Data Evaluation/Archive Review

An archival records search was performed during preparation of this SSWP to identify previous site activities that may have environmentally impacted the investigation area. Results of the archival records search are presented in Appendix A.

2.6.3 Task 3: Site Inspection

All field investigation activities will be performed under this task. The scope of the field investigation and the technical approach are presented in Section 3.0. The primary field investigation activities include the following:

- Vegetation clearance
- Utility clearance
- Field work support
- Temporary well installation and abandonment
- Environmental sampling
- Collecting sample coordinates via Global Positioning System (GPS)

2.6.4 Task 4: Sample Management, Analysis, and Validation

This task includes management of environmental sample data from the time samples are collected until the validated data are completed and incorporated into the project reports. Details for this task are provided in Section 2.2.

2.6.5 Task 5: Geographical Information System

All field data will be collected in preparation for the creation of a geographical information system (GIS) tailored for the investigative needs of the D-6 Small Arms Range. All digital data will be created using a software platform that will allow it to be loaded directly into the GIS. The main purpose of the GIS is to facilitate review and analysis of the spatially related environmental investigative data.

Tetra Tech will also provide the D-6 Small Arms Range GIS data for uploading into the existing MCB Camp Lejeune GIS. These data will include ArcView project and shape files that best delineate the area on the basis of uses, site conditions, and other information gathered during the study.

2.6.6 Task 6: Reporting

A Draft PA/SI Report will be prepared to document the findings of the field investigation. The Draft PA/SI report will be submitted electronically for concurrent review by NAVFAC and MCB Camp Lejeune. Following receipt of review comments, Tetra Tech will issue a revised PA/SI Report to NAVFAC, MCB Camp Lejeune, USEPA and NCDENR for review. A Final PA/SI Report will be prepared that will address all comments received on the draft document. The report will provide a summary of site history, summarize all field activities, and present the results of the human health and ecological risk screenings.

The preliminary ecological risk screening will include a brief description of the ecosystems in the D-6 Small Arms Range area, a figure depicting the ecosystems, results of a comparison of maximum detected concentrations to ecological screening values (ESVs) in tabular form, and recommendations for further evaluation, if required. This preliminary ecological risk screening will not constitute a full Screening-Level Ecological Risk Assessment (SLERA). The human health risk screening will be conducted using data collected during the investigation. The data will be screened using the following criteria:

- Soil data will be compared to North Carolina Soil Screening Levels (SSLs) (NCDENR, 2005) and USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites - Residential Soil (ORNL, 2008).

- Groundwater data will be compared to North Carolina 2L Standards (NCDENR, 2005) and USEPA Regional Screening Values for Chemical Contaminants at Superfund Sites - Tap Water (ORNL, 2008).

- Surface water data, if collected, will be compared to North Carolina Surface Water Standards (NCDENR, 2007) and USEPA National Recommended Water Quality Criteria (USEPA, 2006).

- Sediment data, if collected, will be compared to Region 4 Ecological Sediment Screening Values (USEPA, 2001), and USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites - Residential Soil (ORNL, 2008).

The soil and groundwater data will also be compared to the MCB Camp Lejeune background soil and groundwater data from the *Final Base Background Soil Study Report* (Baker, 2001). Soil concentrations will be compared to two times the average soil background concentration, and groundwater concentrations will be compared to the arithmetic mean plus two standard deviations of the upper surficial aquifer groundwater background concentrations.

TABLE 2-1

KEY PROJECT PERSONNEL
NAMES, PHONE NUMBERS, AND ADDRESSES
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

PERSON/TITLE/ ORGANIZATION	ADDRESS	TELEPHONE
Gena Townsend Remedial Project Manager USEPA Region 4	USEPA Region 4 Atlanta Federal Center 61 Forsyth Street, S.W. Atlanta, Georgia 30303-8960	Phone: (404) 562-8538 FAX: (404) 562-8174
Randy McElveen Remedial Project Manager NCDENR	NCDENR Division of Waste Management 1646 Mail Service Center Raleigh, NC 27699-1646	Phone: (919) 508-8476 FAX: (919) 751-4061
Bryan Beck Navy Technical Representative US Navy NAVFAC Mid-Atlantic	NAVFAC Mid-Atlantic Marine Corps North Carolina IPT 6506 Hampton Boulevard Norfolk, Virginia 23508	Phone: (757) 322-4734 FAX: (757) 322-8280
Robert Lowder IR Program Manager MCB Camp Lejeune	MCB Camp Lejeune EQB/EMD/I&E Marine Corps Base Camp Lejeune, North Carolina 28542	Phone: (910) 451-9607 FAX: (910) 451-5997
John Trepanowski Program Manager Tetra Tech	Tetra Tech 234 Mall Boulevard, Suite 260 King of Prussia, PA 19406	Phone: (610) 491-9688 FAX: (610) 491-9645
Tom Johnston Quality Assurance Manager Tetra Tech	Tetra Tech 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8615 FAX: (412) 921-4040
Matt Soltis Health and Safety Manager Tetra Tech	Tetra Tech 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8912 FAX: (412) 921-4040
Rick Barringer Project Manager Tetra Tech	Tetra Tech 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8524 FAX: (412) 921-4040
James Goerdt Field Operations Leader Tetra Tech	Tetra Tech 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8425 FAX: (412) 921-4040
Leanne Ganser Project Chemist Tetra Tech	Tetra Tech 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745	Phone: (412) 921-8148 FAX: (412) 921-4040
Edward Lawler Laboratory Project Manager Mitkem Laboratories	Mitkem Laboratories 175 Metro Center Boulevard Warwick, Rhode Island 02886	Phone: (401) 732-3400 FAX: (401) 732-3499

TABLE 2-1

KEY PROJECT PERSONNEL
NAMES, PHONE NUMBERS, AND ADDRESSES
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

PERSON/TITLE/ ORGANIZATION	ADDRESS	TELEPHONE
Sharyn Lawler Laboratory Quality Assurance Manager Mitkem Laboratories	Mitkem Laboratories 175 Metro Center Boulevard Warwick, Rhode Island 02886	Phone: (401) 732-3400 FAX: (401) 732-3499
Mike Perry Laboratory Manager Columbia Analytical Services, Inc.	Columbia Analytical Services, Inc. 1 Mustard Street, Suite 250 Rochester, New York 14609	Phone: (585) 288-5380
Butch Stevens Vice President Parratt-Wolff, Inc.	Parratt-Wolff, Inc. 501 Millstone Drive Hillsborough, North Carolina 27278	Phone: (800) 627-7920 Fax: (919) 644-2817

TABLE 2-2

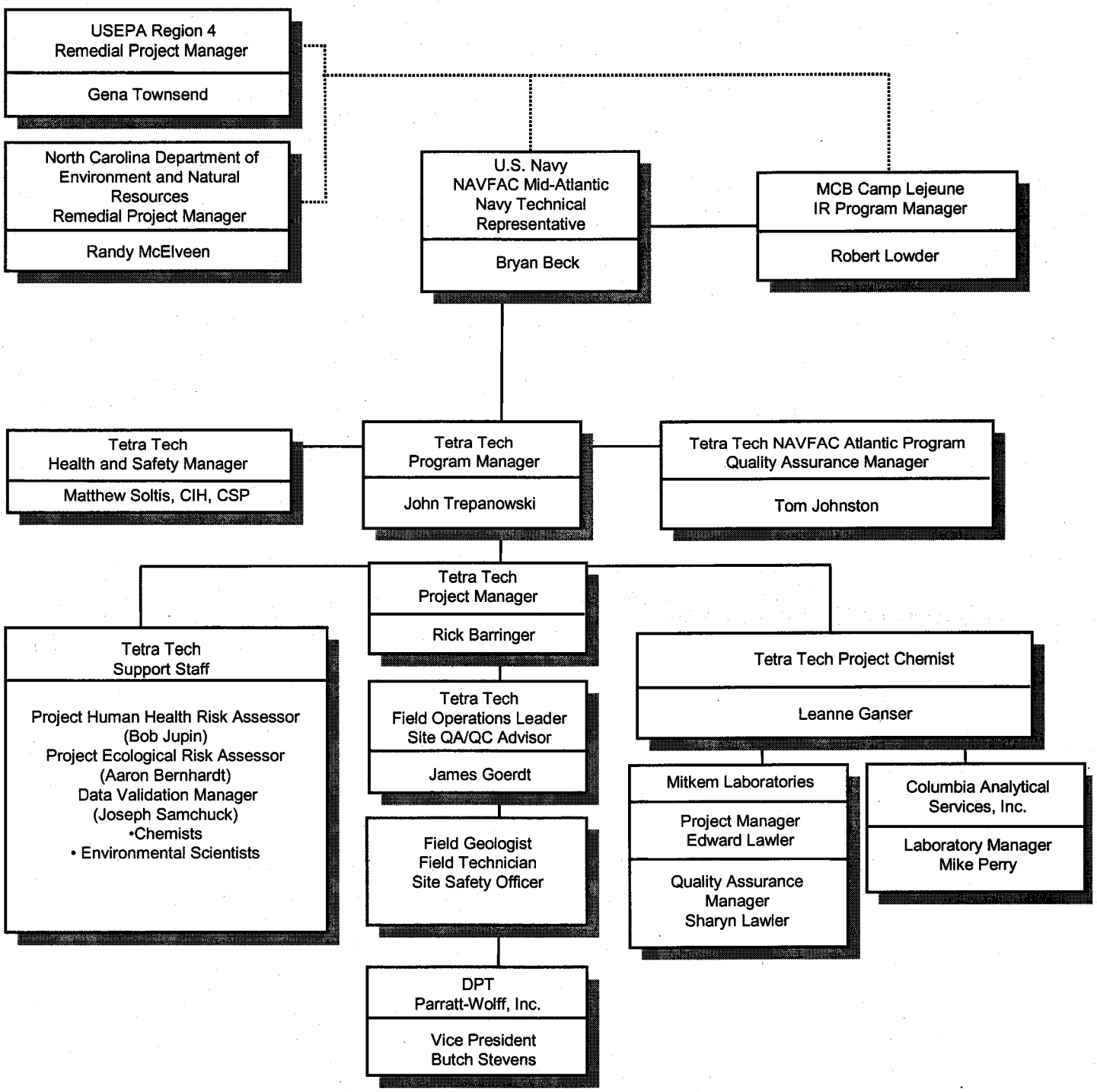
PROJECT SCHEDULE
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Activity	Organization	Start Date(1)	End Date(1)
Prepare Rough Draft SI Work Plan and Appendices	Tetra Tech	September 2008	December 2008
Submit Rough Draft SI Work Plan and Appendices	Tetra Tech	December 2008	December 2008
Navy Review	Navy	December 2008	January 2009
Prepare Draft SI Work Plan and Appendices	Tetra Tech	January 2009	January 2009
Submit Draft SI Work Plan and Appendices	Tetra Tech	January 2009	January 2009
Regulator Review	USEPA and NCDENR	February 2009	February 2009
Receive Comments/Comment Resolution	Tetra Tech	March 2009	March 2009
Prepare Final SI Work Plan and Appendices	Tetra Tech	March 2009	March 2009
Submit Final SI Work Plan and Appendices	Tetra Tech	March 2009	April 2009
Mobilization and Field Investigation	Tetra Tech	May 2009	May 2009
Complete Field Investigation and Demobilization	Tetra Tech	May 2009	May 2009
Laboratory Analysis	MitKem Laboratories and Columbia Analytical Services, Inc.	May 2009	June 2009
Data Validation	Tetra Tech	May 2009	June 2009
Database Entry	Tetra Tech	May 2009	June 2009
Prepare Draft SI Report	Tetra Tech	May 2009	June 2009
Submit Draft SI Report	Tetra Tech	July 15, 2009	July 15, 2009
Navy/Regulator Review	Navy / USEPA / NCDENR	July 15, 2009	August 15, 2009
Receive Comments/Comment Resolution	Tetra Tech	August 15, 2009	August 15, 2009
Prepare Final SI Report	Tetra Tech	August 15, 2009	August 31, 2009
Submit Final SI Report	Tetra Tech	August 31, 2009	August 31, 2009

1 Actual date shown where applicable, otherwise anticipated month shown.

FIGURE 2-1

PROJECT ORGANIZATION CHART FOR MCB CAMP LEJEUNE
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDNG 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA



3.0 SAMPLING AND ANALYSIS PLAN

3.1 OVERALL APPROACH

The primary objective for this PA/SI is to evaluate the presence and nature of MC contamination that may exist within the approximately 1-acre investigation area of the D-6 Small Arms Range. Potential site contaminants include primarily lead (and to a lesser extent, antimony, arsenic, copper, tin, and zinc) and perchlorate, which may leach from spent bullets and residues of materials used in bullet primer and igniter formulations (ITRC, 2003).

Because historical use of the D-6 Small Arms Range was limited to small arms fire, MEC avoidance procedures will not be practiced unless MEC is identified during the investigation. All field activities will be conducted in accordance with the SOPs provided in Appendix D. Any bullet fragments collected as part of samples will be removed from the matrix during the processing of the sample in accordance with SOP-14 so that only metals that have leached into the soil will be analyzed.

All soil samples collected will undergo screening in the field utilizing a handheld X-ray fluorescence analyzer (XRF). The USEPA Region 4 lead screening levels are 400 milligrams per kilogram (mg/kg) for residential and 800 mg/kg for industrial sites. To allow for a margin of error typically found in utilizing field analyses, Tetra Tech will use a decision criteria of 300 mg/kg for lead in determining whether a discrete sample location should undergo further analysis. Upon validation, FBL lead concentrations will be compared to the associated field XRF lead concentrations through a correlation plot. Additional information regarding this comparison can be found in Section 4.4.

The field investigation will accomplish the above objective through the following activities:

- The approximate 1-acre investigation area will be subdivided into (4) ¼ acre grids (Figure 3-1).
- Collection of five discrete surface soil samples (0 to 6 inches bgs) utilizing a hand auger from each of the four ¼-acre grids within the approximate 1-acre site. All 20 discrete samples will undergo field XRF analysis for lead.
- Any discrete sample location exhibiting an XRF lead concentration greater than 300 mg/kg will then be selected for composite sampling within that location for FBL analysis.

- Up to 16 composite sample locations may be selected for FBL analysis.

- If all discrete samples exhibit XRF lead concentrations less than 300 mg/kg, two locations within each of the four sample grids will be selected for composite sampling and undergo both XRF and FBL analysis. These locations will be biased towards locations with the highest discrete XRF lead concentrations.

- Placement of one subsurface soil boring within each of the four ¼-acre grids in the approximate 1-acre investigation area utilizing DPT. An additional four subsurface borings will be placed within the approximate 1-acre investigation areas in locations where surface soil samples contained elevated concentrations of lead (based on XRF data). If no elevated lead concentrations are detected in surface soil samples, then these four subsurface borings may be biased to characterize the general location of the former indoor range bullet trap (northeastern end of the building). The borings will be sampled in 2-foot increments from the surface to the local water table. If numerous surface soil sample locations have XRF lead concentrations greater than the decision criterion of 300 mg/kg, up to 12 additional composite surface soil samples may be collected to help identify contamination boundaries at the site.

- Collection of four groundwater samples from temporary groundwater wells installed within the surficial aquifer at four subsurface soil sample locations utilizing DPT. Groundwater samples will be collected from the four subsurface soil sample locations exhibiting the highest lead concentrations based on the XRF screening.

- If present, collection of surface water and sediment samples from three locations. If water is present, one surface water sample will be collected immediately upstream of the site, one surface water sample will be collected within the site, and the third surface water sample will be collected immediately downstream of the site. The three sediment samples will be co-located with the surface water samples.

The field investigation activities are detailed below.

3.2 SITE PREPARATION AND RESTORATION

The following subsections describe the procedures associated with site preparation, including mobilization of personnel and equipment and preparation for environmental investigation activities.

3.2.1 Mobilization

Mobilization will include identifying, briefing, and mobilizing staff and securing and deploying equipment.

General mobilization activities will include the following:

- Identify/procure, package, ship, and inventory project equipment including hand tools, sampling supplies, and vegetation clearance equipment.
- Coordinate with MCB Camp Lejeune, Base Range Control, police, hospital, and fire department, as appropriate.
- Coordinate communications and other logistical support.
- Test and inspect equipment.
- Conduct site-specific training on the SSWP and HASP.
- Verify that all forms and project documentation are in order and that project team members understand their responsibilities regarding completing project reporting requirements.

Kickoff/Safety Meeting

During mobilization, a kickoff and site safety meeting will be conducted that will include a review of this SSWP and a review and acknowledgment of the HASP by all site personnel. Additional meetings will occur, as needed, as new personnel, visitors, and/or subcontractors arrive at the site.

3.2.2 Buried Utility Clearance

All buried utilities will be cleared within the approximate 1-acre investigation site prior to initiation of sampling activities. Figure 3-2 presents all known utility locations.

3.2.3 Boundary and Sample Locations

A GPS unit with sub-meter accuracy will be utilized in accordance with SOP-11. The utilization of the GPS at the D-6 Small Arms Range will consist of two phases:

- Phase 1 - Prior to sampling activities, a site boundary survey will be conducted during which known GPS coordinates (site boundaries) will be marked with the GPS. The site boundaries will reflect those shown on Figure 3-1.

- Phase 2 - Upon completion of environmental sampling activities, all sample location coordinates will be collected with the GPS unit.

3.2.4 Vegetation Clearing

Vegetation less than 3-inches in diameter may be removed from an estimated ½-acre of the approximate 1-acre investigation area, as needed, to allow site access for sampling teams and DPT equipment. Vegetation clearing will be accomplished using a combination of non-intrusive mechanical and manual methods. Trees greater than 3 inches in diameter will not be removed unless absolutely necessary.

Tetra Tech will coordinate with Camp Lejeune's Environmental Management Division office to identify federally protected species or archeological sites that may be encountered during vegetation clearing activities. Federally listed plant species will be identified and left in place in accordance with the Environmental Protection Plan (see Section 5.0).

3.2.5 Site Restoration and Demobilization

Site Restoration

Damage caused by equipment or other site activities (e.g., deep ruts) will be repaired and seeded as necessary to prevent erosion.

Demobilization

Full demobilization will occur when the project is completed and appropriate QA/QC checks have been performed. The following will occur prior to demobilization:

- Chain-of-custody records will be reviewed to ensure that all field and QC samples were collected as planned and were submitted for appropriate analyses.

- Site restoration will be verified.

- All field equipment will be inspected, cleaned, packaged, and shipped back to the appropriate location.

3.3 GEOSPATIAL INFORMATION AND ELECTRONIC SUBMITTALS

This subsection describes the methods, equipment, and accuracy requirements for conducting site mapping and identifies the requirements for electronic submittal of documents, mapping, and GIS data.

All geospatial data will conform to the computer-aided drafting (CAD)/GIS Technology Center Spatial Data Standards for Facilities Infrastructure and Environment and will be provided in metric units.

3.3.1 Figures

The locations, identifications, and coordinates of all control points recovered and/or established at the site will be plotted on one or more site figures. Each control point will be identified on figures by its name and number and final adjusted coordinates.

Each figure will include a legend showing the standard symbols used for the mapping, a north arrow, and a title block.

3.3.2 Computer Files and Digital Data Sets

All final document files, including reports, figures, and tables, will be submitted in electronic format. These files will be compatible with Microsoft Office 97 or later formats and in portable document format (PDF) on compact disk-read only memory (CD-ROM).

3.4 FIELD SAMPLING PLAN

All samples collected during this field investigation will be given a unique identifying sample ID in accordance with SOP-02. The nomenclature format will be similar to other sample numbers utilized at MCB Camp Lejeune. This sample designation format will be followed throughout the project. Required deviations to this format in response to field conditions will be documented in the logbook.

Before samples are packaged for shipment to the FBL, sample labels will be checked to ensure that all information on the labels is complete and correct in accordance with SOP-01.

Field tests used to assess the chemical properties of site soil include the use of an XRF to identify soil containing concentrated amounts of heavy metals (lead). XRF field analysis will be performed in accordance with SOP-14.

Field Operations

To assess the presence and nature of MC contamination that may exist at the approximate 1-acre investigation site, the project team will investigate soil, surficial groundwater, and if applicable within the investigation site, surface water and sediment. This will include collecting surface soil samples via hand auger, subsurface soil samples via DPT, and groundwater samples from temporary wells. If surface water features are present, surface water and sediment samples will also be collected. QA/QC samples will be collected per Section 4.1.

Composite Surface Soil Sampling

Based on field XRF lead concentrations at the discrete surface soil sample locations, up to 16 composite surface soil samples are proposed for collection within the approximate 1-acre investigation area utilizing a stainless-steel hand auger. Each composite sample will be comprised of seven sample aliquots utilizing the seven-point wheel approach. The composite sample locations will be collected at discrete sample locations having XRF lead concentrations exceeding 300 mg/kg. Surface soil samples will be collected from 0 to 6 inches bgs, and will be analyzed as indicated in Table 3-1.

If sandy or loose soils are encountered, the sampler may utilize a disposable plastic liner tube fitted with an eggshell catcher to prevent sample loss from the hand auger bucket. The auger will be pushed or turned through the soil to the desired depth and the recovered core will either be extruded into a stainless-steel bowl or large re-sealable plastic bag for homogenization or directly into the appropriate sample jar.

The hand auger bucket will be decontaminated in the field between each sample location in accordance with SOP-04. Details regarding the labeling and collection of soil samples collected utilizing a hand auger are included in SOPs-02 and -05, respectively. Soil sample analytical information is presented in Table 3-1, and containers to be used for each sample aliquot are listed in Table 3-2. After the samples are containerized, labeled, and bagged (see SOPs-01, -03, and -12), they will be placed in a cooler containing ice until they can be packaged and prepared for shipment (Section 4.2).

All sample locations will be backfilled with the remaining removed soil and if necessary, topped off with bentonite pellets and hydrated to return the boring surface to the surrounding ground surface. All investigation-derived waste (IDW) will be handled in accordance with SOP-10. When a boring has been sampled and backfilled, it will be identified by a temporary brightly colored pin flag labeled using a waterproof marker with a unique soil boring number corresponding to the sample location. The pin flag will allow the sample location to be logged via GPS. All sample locations will be logged with the GPS on the same day they are marked to avoid the pin flags being disturbed over night. Prior to final demobilization, all pin flags will be removed from the investigation area.

Direct-Push Subsurface Soil Sampling

One subsurface soil boring will be placed within each of the ¼-acre sample grids. An additional four subsurface soil borings will be placed in locations where surface soil samples contained elevated concentrations of lead (based on XRF). If no elevated lead concentrations are detected in surface soil samples, then these additional four subsurface borings may be biased to characterize the general location of the former indoor range bullet trap (northeastern end of the building). Samples will be collected from these borings in 2-foot increments from the current surface grade down to groundwater at the site. Estimated range to groundwater at the site is 5 to 15 feet bgs.

The proposed subsurface boring sample locations will be drilled utilizing DPT in accordance with SOP-06 located in Appendix D of this SSWP. The DPT drilling method will utilize an open-core barrel sampling device. Each DPT sample chamber will contain a disposable acetate liner, and each boring will be completed in accordance with SOP-06. Decontamination procedures will be in accordance with SOP-04. All subsurface soil sample will initially be screened in the field via XRF, with a subset of those samples shipped to the FBL for analysis in accordance with the parameters listed on Table 3-1.

DPT Temporary Well Installation and Sampling

A temporary monitoring well will be installed in four boreholes used for subsurface soil sample collection. The temporary wells will be installed in the subsurface soil borings exhibiting the highest XRF lead screening concentration within each of the four ¼-acre sampling grids. Each well will consist of a 1-inch inner diameter (ID) polyvinyl chloride (PVC) casing and screen. The wells will be installed in accordance with SOP-06.

Discrete groundwater samples will be collected from each temporary well using dedicated polyethylene tubing and a peristaltic pump in accordance with SOP-09 and analyzed by the FBL in accordance with the

parameters listed on Table 3-1. For water samples exhibiting greater than 10 nephelometric turbidity units (NTUs), a dissolved water sample will also be collected using a 0.45 micron in-line filter.

Water sampling, water level measurement, and sample preparation equipment brought on site will be decontaminated in accordance with SOP-04 prior to and after each use. During cleaning and decontamination operations, the substitution of higher grade water for tap water is permitted and need not be noted as a variation. Personnel wearing Level D personal protective equipment (PPE) will decontaminate equipment in accordance with the site-specific HASP.

If modifications of sample locations are necessary due to utilities or accessibility issues, the revised sample location(s) will be located as near as possible to the original proposed locations.

Water Level Measurements

Water levels in each of the four temporary wells will be measured with a water level indicator prior to and after well sampling activities. The depth from the top of the 1-inch PVC casing to water level will be recorded to the nearest 0.01 foot. The length of the temporary well casing above ground surface will be noted on the groundwater sampling log sheet.

Soil Boring and Temporary Monitoring Well Abandonment

DPT borings and temporary monitoring wells will be abandoned upon completion of sampling activities. The objective of abandoning a boring or temporary monitoring well is to prevent surface water runoff or impacted groundwater from migrating to the boring. Soil borings and temporary wells will be abandoned in accordance with SOP-06.

Surface Water and Sediment Sampling

Surface water was not observed at the site during the site reconnaissance. However, if surface water is encountered during site clearing, three co-located surface water and sediment samples will be collected in accordance with SOP-07 (surface water) and SOP-08 (sediment) and analyzed by the FBL for the parameters shown on Table 3-1. If possible, one sample will be collected immediately upstream of the site, one collected within the site, and the third collected immediately downstream of the site. Surface water and sediment samples will be collected from downstream to upstream to avoid cross-contamination by sediment disturbance and suspension. For water samples exhibiting greater than 10 nephelometric turbidity units (NTUs), a dissolved water sample will also be collected using a 0.45 micron in-line filter.

Field Tests

Water quality parameters to be measured during field activities include pH, specific conductance, dissolved oxygen (DO), temperature, and turbidity. Measurement of these parameters at groundwater and surface water sample locations will be performed in accordance with SOP-13.

Investigation-Derived Waste

It is anticipated that a minimum amount of IDW will be generated during this PA/SI. All IDW will be handled in accordance with SOP-10 and the following subsections.

Soil

The only soil IDW generated during this PA/SI will be the minimal amount generated during installation of the four soil borings (estimated at less than one-tenth of a 55-gallon drum). The soil will undergo field XRF analysis for lead. It is assumed that all soil IDW will be non-hazardous and will be bagged and disposed at the base landfill prior to demobilization from the site. Off-site disposal will be arranged at an appropriate facility if the soil cannot be disposed at the base landfill.

Water

The only water IDW generated during this PA/SI will be the minimal amount needed for equipment decontamination. This wastewater is not anticipated to contain any free product and will be collected in portable containers and disposed on base at the wastewater treatment plant at Lot 203 prior to demobilization from the site. Prior to beginning field activities, Tetra Tech will contact the wastewater treatment plant operator regarding disposal of the decontamination water.

Other Debris

Examples of other IDW that may be generated at the site include plastic sheeting, PPE, and disposable sampling equipment. This non-hazardous debris will be collected in black, non-translucent trash bags that will be secured and disposed in a dumpster on the Base.

TABLE 3-1

LISTING OF SAMPLES AND LABORATORY ANALYSES
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Sample Location	Sample ID	Metals		Perchlorate
		Field XRF (Lead Only)	SW-846 3050B/6020A (TAL Metals)	SW-846 Method 6850
SURFACE SOIL				
MMRP64-SB001	MMRP64-SS001D-0001	1	---	---
	MMRP64-SS001C-0001	TBD(2)	TBD(3)	---
MMRP64-SB002	MMRP64-SS002D-0001	1	---	---
	MMRP64-SS002C-0001	TBD(2)	TBD(3)	---
MMRP64-SB003	MMRP64-SS003D-0001	1	---	---
	MMRP64-SS003C-0001	TBD(2)	TBD(3)	---
MMRP64-SB004	MMRP64-SS004D-0001	1	---	---
	MMRP64-SS004C-0001	TBD(2)	TBD(3)	---
MMRP64-SB005	MMRP64-SS005D-0001	1	---	---
	MMRP64-SS005C-0001	TBD(2)	TBD(3)	---
MMRP64-SB006	MMRP64-SS006D-0001	1	---	---
	MMRP64-SS006C-0001	TBD(2)	TBD(3)	---
MMRP64-SB007	MMRP64-SS007D-0001	1	---	---
	MMRP64-SS007C-0001	TBD(2)	TBD(3)	---
MMRP64-SB008	MMRP64-SS008D-0001	1	---	---
	MMRP64-SS008C-0001	TBD(2)	TBD(3)	---
MMRP64-SB009	MMRP64-SS009D-0001	1	---	---
	MMRP64-SS009C-0001	TBD(2)	TBD(3)	---
MMRP64-SB010	MMRP64-SS010D-0001	1	---	---
	MMRP64-SS010C-0001	TBD(2)	TBD(3)	---
MMRP64-SB011	MMRP64-SS011D-0001	1	---	---
	MMRP64-SS011C-0001	TBD(2)	TBD(3)	---
MMRP64-SB012	MMRP64-SS012D-0001	1	---	---
	MMRP64-SS012C-0001	TBD(2)	TBD(3)	---
MMRP64-SB013	MMRP64-SS013D-0001	1	---	---
	MMRP64-SS013C-0001	TBD(2)	TBD(3)	---
MMRP64-SB014	MMRP64-SS014D-0001	1	---	---
	MMRP64-SS014C-0001	TBD(2)	TBD(3)	---
MMRP64-SB015	MMRP64-SS015D-0001	1	---	---
	MMRP64-SS015C-0001	TBD(2)	TBD(3)	---
MMRP64-SB016	MMRP64-SS016D-0001	1	---	---
	MMRP64-SS016C-0001	TBD(2)	TBD(3)	---
MMRP64-SB017	MMRP64-SS017D-0001	1	---	---
	MMRP64-SS017C-0001	TBD(2)	TBD(3)	---
MMRP64-SB018	MMRP64-SS018D-0001	1	---	---
	MMRP64-SS018C-0001	TBD(2)	TBD(3)	---
MMRP64-SB019	MMRP64-SS019D-0001	1	---	---
	MMRP64-SS019C-0001	TBD(2)	TBD(3)	---
MMRP64-SB020	MMRP64-SS020D-0001	1	---	---
	MMRP64-SS020C-0001	TBD(2)	TBD(3)	---
Total Surface Soil Samples		**TBD(2)**	**TBD(3)**	**0**

TABLE 3-1

LISTING OF SAMPLES AND LABORATORY ANALYSES
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Sample Location	Sample ID	Metals		Perchlorate
		Field XRF (Lead Only)	SW-846 3050B/6020A (TAL Metals)	SW-846 Method 6850
SUBSURFACE SOIL				
MMRP64-SB001	MMRP64-SB001D-0002	1	TBD[4]	---
	MMRP64-SB001D-0204	1	TBD[4]	---
	MMRP64-SB001D-0406	1	TBD[4]	---
	MMRP64-SB001D-XXXX	1	TBD[4]	---
MMRP64-SB002	MMRP64-SB002D-0002	1	TBD[4]	---
	MMRP64-SB002D-0204	1	TBD[4]	---
	MMRP64-SB002D-0406	1	TBD[4]	---
	MMRP64-SB002D-XXXX	1	TBD[4]	---
MMRP64-SB003	MMRP64-SB003D-0002	1	TBD[4]	---
	MMRP64-SB003D-0204	1	TBD[4]	---
	MMRP64-SB003D-0406	1	TBD[4]	---
	MMRP64-SB003D-XXXX	1	TBD[4]	---
MMRP64-SB004	MMRP64-SB004D-0002	1	TBD[4]	---
	MMRP64-SB004D-0204	1	TBD[4]	---
	MMRP64-SB004D-0406	1	TBD[4]	---
	MMRP64-SB004D-XXXX	1	TBD[4]	---
MMRP64-SB005	MMRP64-SB005D-0002	1	TBD[4]	---
	MMRP64-SB005D-0204	1	TBD[4]	---
	MMRP64-SB005D-0406	1	TBD[4]	---
	MMRP64-SB005D-XXXX	1	TBD[4]	---
MMRP64-SB006	MMRP64-SB006D-0002	1	TBD[4]	---
	MMRP64-SB006D-0204	1	TBD[4]	---
	MMRP64-SB006D-0406	1	TBD[4]	---
	MMRP64-SB006D-XXXX	1	TBD[4]	---
MMRP64-SB007	MMRP64-SB007D-0002	1	TBD[4]	---
	MMRP64-SB007D-0204	1	TBD[4]	---
	MMRP64-SB007D-0406	1	TBD[4]	---
	MMRP64-SB007D-XXXX	1	TBD[4]	---
MMRP64-SB008	MMRP64-SB008D-0002	1	TBD[4]	---
	MMRP64-SB008D-0204	1	TBD[4]	---
	MMRP64-SB008D-0406	1	TBD[4]	---
	MMRP64-SB008D-XXXX	1	TBD[4]	---
Total Subsurface Soil Samples		**32**	**8**	**0**
GROUNDWATER				
MMRP64-TW001	MMRP64-TW001	NA	X	X
	MMRP64-TW001-F[5]	NA	X	---
MMRP64-TW002	MMRP64-TW002	NA	X	X
	MMRP64-TW002-F[5]	NA	X	---
MMRP64-TW003	MMRP64-TW003	NA	X	X
	MMRP64-TW003-F[5]	NA	X	---
MMRP64-TW004	MMRP64-TW004	NA	X	X
	MMRP64-TW004-F[5]	NA	X	---
Total Groundwater Samples		**NA**	**8**	**4**

TABLE 3-1

LISTING OF SAMPLES AND LABORATORY ANALYSES
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Sample Location	Sample ID	Metals		Perchlorate
		Field XRF (Lead Only)	SW-846 3050B/6020A (TAL Metals)	SW-846 Method 6850
SURFACE WATER[6]				
MMRP64-SW001	MMRP64-SW001	NA	X	X
	MMRP64-SW001-F[5]	NA	X	---
MMRP64-SW002	MMRP64-SW002	NA	X	X
	MMRP64-SW002-F[5]	NA	X	---
MMRP64-SW003	MMRP64-SW003	NA	X	X
	MMRP64-SW003-F[5]	NA	X	---
Total Surface Water Samples		**NA**	**6**	**3**
SEDIMENT[6]				
MMRP64-SD001	MMRP64-SD001-0006	NA	X	---
MMRP64-SD002	MMRP64-SD002-0006	NA	X	---
MMRP64-SD003	MMRP64-SD003-0006	NA	X	---
Total Sediment Samples		**NA**	**3**	**0**

C = Composite sample
D = Discrete sample
F = Field filtered
NA = Not applicable
NTU = Nephelometric Turbidity Unit
SB = Subsurface soil
SD = Sediment
SS = Surface soil
SW = Surface water
TAL = Target Analyte List
TBD = To be determined
TW = Temporary well
USEPA = United States Environmental Protection Agency
XRF = X-Ray fluorescence

--- = No FBL analysis.
X = Sample to be analyzed at FBL.
XXXX = Sample depth to be determined in the field based on groundwater level.

1 = Discrete sample to be analyzed in the field.

2 = Up to 16 sample locations will be selected for composite sample collection. All composite samples will also undergo field XRF analysis to allow correlation of field and fixed-base laboratory results.

3 = For sample locations with XRF lead concentrations greater than 300 mg/kg, a composite sample comprised of seven aliquots will be collected at that location for FBL analysis. If all XRF concentrations are less than 300 mg/kg, two composite samples from each sample grid will be collected for analysis at the FBL.

4 = Up to eight subsurface soil samples will be selected for FBL analysis to allow for a correllation between field XRF and FBL data.

5 = Groundwater or surface water samples with turbidities greater than 10 NTUs will undergo field filtering for dissolved metals analysis.

6 = Surface water and sediment samples to be collected if surface water exists within the investigation area.

NOTE: Field sampling SOPs are presented in Appendix D.

TABLE 3-2

SUMMARY OF SAMPLE ANALYSES, CONTAINER TYPES AND VOLUMES, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Medium	Analysis	Method	Sample Container	Container Volume	Preservation	Maximum Holding Time[(1)]
Soil/Sediment	TAL Metals	SW-846 3050B/6020A	Wide-mouth jar, Teflon-lined plastic cap	One 4 ounce	Cool to 4°C, dark	180 days to analysis
Groundwater/ Surface Water	Perchlorate	SW-846 6850	Poly bottle	One 1-liter	Cool to 4°C, dark	Extraction within 28 days; analysis within 40 days of extraction.
	TAL Metals (Total and Dissolved)	SW-846 3050B/6020A	Poly bottle	One 1-liter	Cool to 4°C, dark, HNO_3 to pH <2	180 days to analysis

1 All holding times are from date of collection.

°C = Degrees Celsius.
TAL = Target Analyte List.
USEPA = United States Environmental Protection Agency.
HNO_3 = Nitric Acid.

TABLE 3-3

PROJECT ACTION LIMITS
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Matrix: Soil
Analytical Group: Select Metals

Analyte	CAS Number	Project Action Limit (1,2) (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory (3)	
					Quantitation Limit (mg/kg)	Method Detection Limit (mg/kg)
Antimony	7440-36-0	5.42	NC SSL	1	1	0.15
Arsenic	7440-38-2	26.2	NC SSL	1	1	0.14
Copper	7440-50-8	704	NC SSL	1.5	1.5	0.094
Lead	7439-92-1	270	NC SSL	0.5	0.5	0.037
Nickel	7440-02-0	56.4	NC SSL	2.5	2.5	0.012
Tin	7439-92-1	47000	ORNL RSL	10	10	1
Zinc	7440-06-66	550	NC SSL	2.5	2.5	0.052

1. North Carolina Soil Screening Levels were used to determine the PAL, if no North Carolina criteria were available, then Oak Ridge Regional Screening Levels (Residential Direct Contact) were used to determine the PAL.
2. References: NC SSL = North Carolina Hazardous Waste Section Soil Screening Level Concentrations (NCDENR, 2005). ORNL RSL = Oak Ridge National Laboratory Regional Screening Levels for Chemical Contaminants at Superfund Sites, September 12, 2008.
3. Mitkem Laboratories will be performing work for this project.

TABLE 3-3

PROJECT ACTION LIMITS
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Matrix: Sediment
Analytical Group: Select Metals

Analyte	CAS Number	Project Action Limit (1,2) (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (mg/kg)	Laboratory (3)	
					Quantitation Limit (mg/kg)	Method Detection Limit (mg/kg)
Antimony	7440-36-0	2	Reg 4	1	1	0.15
Arsenic	7440-38-2	7.24	Reg 4	1	1	0.14
Copper	7440-50-8	18.7	Reg 4	1.5	1.5	0.094
Lead	7439-92-1	30.2	Reg 4	0.5	0.5	0.037
Nickel	7440-02-0	15.9	Reg 4	2.5	2.5	0.012
Tin	7439-92-1	47000	ORNL RSL	10	10	1
Zinc	7440-06-66	124	Reg 4	2.5	2.5	0.052

1. Region 4 Ecological Sediment Screening Values were used to determine the PAL, if no Region 4 criteria were available, then Oak Ridge Regional Screening Levels (Residential Direct Contact) were used to determine the PAL.
2. References: Reg 4 = Supplemental Guidance to RAGS: Region 4 Bulletin, Ecological Risk Assessment, November, 2001. ORNL RSL = Oak Ridge National Laboratory Regional Screening Levels for Chemical Contaminants at Superfund Sites, September 12, 2008.
3. Mitkem Laboratories will be performing work for this project.

TABLE 3-3

PROJECT ACTION LIMITS
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Matrix: Groundwater
Analytical Group: Select Metals

Analyte	CAS Number	Project Action Limit [1,2] (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory [3]	
					Quantitation Limit (µg/L)	Method Detection Limit (µg/L)
Antimony	**7440-36-0**	**15**	**ORNL RSL**	**15**	**20**	**4.4**
Arsenic	7440-38-2	50	NC Groundwater	20	20	2.5
Copper	7440-50-8	1000	NC Groundwater	30	30	1.7
Lead	7439-92-1	15	NC Groundwater	10	10	1.2
Nickel	7440-02-0	100	NC Groundwater	50	50	0.22
Tin	7439-92-1	22000	ORNL RSL	200	200	12
Zinc	7440-06-66	1050	NC Groundwater	50	50	3.3

Matrix: Groundwater
Analytical Group: Perchlorate

Analyte	CAS Number	Project Action Limit [2] (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory [4]	
					Quantitation Limit (µg/L)	Method Detection Limit (µg/L)
Perchlorate	14797-73-0	15	EPA Health Advisory	0.20	0.20	0.080

1. North Carolina Groundwater Standards (NC DENR 2L Standards) were used to determine the PAL, if no North Carolina criteria were available, then Oak Ridge Regional Screening Levels (Tap Water) were used to determine the PAL.
2. References: NC Groundwater = Classification and Water Quality Standards Applicable to the Groundwaters of North Carolina (NC DENR 2L Standards, amended 2006). ORNL RSL = Oak Ridge National Laboratory Regional Screening Levels for Chemical Contaminants at Superfund Sites, September 12, 2008. EPA Health Advisory – EPA Drinking Water Health Advisory, January 2009.
3. Mitkem Laboratories will be performing work for this project.
4. Columbia Analytical Services, a subcontractor to Mitkem Laboratories will be performing perchlorate analysis for this project.

Note: Bolded rows indicate that the PAL is in between the QL and MDL.

TABLE 3-3

PROJECT ACTION LIMITS
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Matrix: Surface Water
Analytical Group: Select Metals

Analyte	CAS Number	Project Action Limit (1,2) (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory (3)	
					Quantitation Limit (µg/L)	Method Detection Limit (µg/L)
Antimony	7440-36-0	NA	NA	20	20	4.4
Arsenic	7440-38-2	50	NC Surface Water	20	20	2.5
Copper	**7440-50-8**	**7**	**NC Surface Water**	**7**	**30**	**1.7**
Lead	7439-92-1	25	NC Surface Water	10	10	1.2
Nickel	7440-02-0	88	NC Surface Water	50	50	0.22
Tin	7439-92-1	NA	NA	200	200	12
Zinc	7440-06-66	50	NC Surface Water	50	50	3.3

Matrix: Surface water
Analytical Group: Perchlorate

Analyte	CAS Number	Project Action Limit (1,2) (µg/L)	Project Action Limit Reference	Project Quantitation Limit Goal (µg/L)	Laboratory (4)	
					Quantitation Limit (µg/L)	Method Detection Limit (µg/L)
Perchlorate	14797-73-0	NA	NA	0.20	0.20	0.080

1. North Carolina Surface Water Standards were used to determine the PAL, if no North Carolina criteria were available, then USEPA Water Quality Criteria were used to determine the PAL.
2. References: NC Surface Water = "Redbook" Surface Waters and Wetlands Standards. Freshwater Aquatic Life Standards – Class C Freshwater (NCDENR, 2007). USEPA Water Quality Criteria = National Recommended Water Quality Criteria. Chronic Freshwater Standards for Aquatic Life (USEPA, 2006).
3. Mitkem Laboratories will be performing work for this project.
4. Columbia Analytical Services, a subcontractor to Mitkem Laboratories will be performing perchlorate analysis for this project.

Note: Bolded rows indicate that the PAL is in between the QL and MDL.

TETRA TECH

Figure 3-1
Proposed Soil Sample Locations
D-6, 50-foot Indoor Rifle
and Pistol Range
(Former Building 451, ASR #2.64)
MCB Camp Lejeune
Onslow County, North Carolina

Legend

- Proposed Sample Location
- Sample Boundary
- Topographic Contour (2 ft)
- Former Location of Demolished Building 451 (ASR #2.64)

Natural Color Digital Image
Dated February 2004 (0.15m/pixel resolution)

NOTE: Digital image provided by Camp Lejeune Installation Geospatial and Information Service (IGI&S), East Coast Regional GEOFidelis (Geospatial) Center.

30 15 0 30 Feet

Drawn By: K. MOORE 10/22/08
Checked By: J. GOERT 1/16/09
Approved By:

Project Number: 112G01716
CTO 0163

P:\GIS\CAMP_LEJEUNE\MXD\INDOOR_FIRING_RANGE.MXD 12/16/08 KM

TETRA TECH

Figure 3-2
Utility Locations
D-6, 50-foot Indoor Rifle
and Pistol Range
(Former Building 451, ASR #2.64)
MCB Camp Lejeune
Onslow County, North Carolina

Legend

- 2" Water Main
- 2" Gate Valve & Box
- Exisiting 30" RCP Sanitary Sewer
- 6" TC Sanitary Sewer
- Underground Electric Cable
- Nonmetallic Sheathed Cable Power Line
- Former Location of Demolished Building 451 (ASR #2.64)

Natural Color Digital Image
Dated February 2004 (0.15m/pixel resolution)

NOTES:
1. Digital image provided by Camp Lejeune Installation Geospatial and Information Service (IGI&S), East Coast Regional GEOFidelis (Geospatial) Center.
2. Utility locations based on 1952 site and utility plan for original Building 451 blueprint.
3. Underground electric service conductors were to be removed during building demolition. Conduit may remain as indicated.

40 20 0 40 Feet

Drawn By: K. MOORE 10/22/08
Checked By: J. GOERT 1/16/09
Approved By:

Project Number: 112G01716
CTO 0163

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4.0 QUALITY CONTROL PLAN

4.1 QUALITY CONTROL SAMPLES

This section focuses on the overall QC standards applicable to the D-6 Small Arms Range site inspection.

Field QC samples collected as part of the PA/SI at the D-6 Small Arms Range include field duplicates, equipment rinsate blanks, source blanks, and matrix spike/matrix spike duplicates (MS/MSDs). All field QC samples collected during the site investigation will be submitted to the FBL for analysis. Table 4-1 presents the types and numbers of required field QC samples to be collected during the field investigation. Table 4-1 provides an overview of QC sample collection and analysis frequencies. Field QC sample requirements for field duplicates, rinsate blanks, source blanks, MS/MSDs, and temperature control blanks for this project are described below.

Field Duplicates: Field duplicates are obtained during a single act of sampling and are used to assess the overall precision of the sampling and analysis program. Duplicate samples will be collected at a rate of one for every 10 samples of each type of environmental medium. All duplicate samples will be analyzed by the FBL for the same parameters as their environmental sample counterparts. Field duplicates are given unique sample IDs in accordance with SOP-02 and are “blind” to the FBL.

Equipment Rinsate Blanks: Equipment rinsate blanks (or rinsate blanks) will be obtained under representative field conditions by running analyte-free water through sample collection equipment after decontamination and placing it in the appropriate sample containers for analysis. Equipment rinsate blanks will be collected for non-dedicated equipment. Rinsate blanks are given unique sample IDs in accordance with SOP-02.

Source Water Blanks: A source water blank will be collected for each source of water used for decontamination purposes. Source water blanks are given unique sample IDs in accordance with SOP-02.

MS/MSD: MS/MSD samples are designed to evaluate potential matrix interferences, accuracy, and precision. Three aliquots of a single sample – one native and two spiked with the same concentration of MS compounds – are analyzed. MS/MSD samples are given the same sample ID as their environmental sample counterpart.

Temperature Blanks: A single 40 milliliter (mL) vial of water will accompany each cooler of samples shipped to the FBL. The temperature blank is used by the FBL to determine if samples arrive at the laboratory under proper temperature conditions (i.e., 4°C +/- 2°C). Temperature blanks are not given any type of sample ID.

4.2 SAMPLE HANDLING, PACKAGING, AND SHIPPING

4.2.1 Sample Preservation

Preservation requirements for each of the parameters of interest are provided in Table 3-2. All samples will be promptly chilled with ice to 4 °C ± 2°C and packaged in an insulated cooler. Samples will not be frozen. Sample preservation must occur in the field immediately after sample collection. The containers supplied by the FBL will contain any applicable preservative. QA/QC samples will be collected in the same type of containers as the field samples. The preservatives and holding times for the analyses to be conducted for the D-6 Small Arms Range PA/SI are shown in Table 3-2.

4.2.2 Sample Labeling

Before samples are packaged, the sample labels will be checked to ensure that all information on the labels is complete and correct (see SOP-01) and that it matches the information on the sample collection log sheets and the chain-of-custody form.

4.2.3 Sample Packaging

Each sample container shipped to the laboratory in an insulated cooler will first be placed in a Ziploc bag to prevent cross-contamination and leakage. If necessary, each Ziploc bag will be wrapped in bubblewrap to prevent breakage and cross-contamination. Only shipping containers that meet all applicable state and federal standards for safe shipment will be used. Cube ice will be placed in and around the samples in sufficient quantity to ensure that the samples remain chilled (4°C ± 2°C) during transport to the FBL.

SOP-12 provides a detailed description of sample handling, packaging, and shipping procedures required for this project. The FOL will be responsible for ensuring the completion of the following forms:

- Sample labels
- Chain-of-custody forms
- Custody seals for coolers

- Shipping labels for coolers
- Express mail air bills

4.2.4 Sample Shipping

Shipping containers (i.e., coolers) will be sealed with nylon strapping tape in at least two places, and custody seals will be signed, dated, and affixed in a manner that will allow the receiver to quickly identify any tampering that may have occurred during transport to the laboratory (see SOPs -01 and -03).

Shipment will be made by a public courier at the next scheduled pickup following completion of sample collection. Copies of the air bills should be retained by the FOL for tracking purposes, if needed, and for communications with the laboratory. Air bills will be retained for the permanent record file.

4.2.5 Sample Custody

A chain-of-custody form will be maintained for all samples collected during the investigation, including field analyses and FBL analyses. Custody of the samples must be maintained and documented at all times in accordance with SOP-03, beginning with the collection of samples in the field and continuing through analysis of samples at the FBL.

4.3 RECORD KEEPING

Standard forms, field notebooks, and a field logbook will be used to record all sample collection activities, field measurements, observations concerning site conditions, and other project-related information. Additional field records include sample log sheets, daily activity records, field instrument calibration log sheets, and others. More details regarding record keeping are included in SOP-03.

At the completion of field activities, the FOL will submit to the Tetra Tech PM all field records, data, field notebooks, logbooks, chain-of-custody forms, sample log sheets, daily activity logs, and other records concerning the project, including all the forms and log sheets listed above. The FOL will check these records for legibility and completeness before submitting them to the Tetra Tech PM. These forms, data, and field notes will become part of the permanent project record.

All field XRF data will initially be electronically logged in the XRF unit's Compaq IPAQ Pocket personal computer (PC). The IPAQ will then be used to download the data into an Excel spreadsheet at the end of each day.

During this investigation, the following three types of data, as discussed below will be generated: field logbooks, laboratory data, and investigation results.

Field Logbooks

Bound weatherproof field notebooks will be maintained by the FOL. All information related to sampling and other field activities will be recorded in the field notebooks. This information will include, but is not limited to, sampling time, weather conditions, unusual events, field measurements, descriptions of photographs, and a summary of each day's activities.

The field team will document all field activities, including any visits to the site by regulatory personnel or their contractors. The logbook will also be used to document, explain, and justify all deviations from the approved SSWP. Its pages will be water-resistant and will be consecutively numbered.

Indelible ink, preferably black, will be used to record entries in the field logbook. Each page will be dated and signed by the individual making the entry. The field logbook will provide a summary of the field activities. The sampling team will record in the field logbook sampling information, physical and geological information, and any field measurements (e.g., pH, temperature) taken during sampling.

A copy of all field logbook entries and chain-of-custody records will be made available to NAVFAC upon request.

Laboratory Data

Upon their arrival at the FBL, the samples will be cross-referenced against the accompanying chain-of-custody records. All sample labels will be checked against the chain-of-custody form, and any mislabeling will be identified, investigated, and corrected prior to sample login at the FBL when possible. The samples will be logged in at every storage area and work station required by the designated analyses.

Raw data will be entered by the analysts in bound laboratory notebooks. A separate book will be maintained for each analytical procedure. All calculations will be entered into designated laboratory notebooks with a sufficient amount of data to compute without reference to other documents. A tracking form will be used to show that at least 10 percent of all calculations have been checked by the analyst and the laboratory QA supervisor from the raw data to the final value stages prior to reporting the results

for a group of samples. This tracking form, as well as all logs and calculations, will be made available for any QA audit conducted during the investigation.

Instrument calibration logs and internal QC procedures will be documented in accordance with the analytical method in use. Documentation of these activities will be made available during QA audits. The FBL analytical SOPs can be found in Appendix E of this SSWP.

Copies of all the analytical data reports, including the QC data, will be maintained by Tetra Tech in the main project file.

Investigation Results

The results of the investigation will be presented in tabular and graphical formats, as well as descriptive and interpretive text. The raw data will be included in a tabular format in appendices of the subsequent investigation report. The following data, as appropriate, will be presented in tables:

- Water level elevations
- Sampling location coordinates (GPS)
- Comparative data between study areas and background areas

Graphs or figures will be used to depict the following, as appropriate:

- Layout and topography
- Sampling locations
- Site boundary
- Stratigraphy and water level elevations
- Horizontal and vertical extent of contamination

4.3.1 Equipment Calibration Logs

An equipment calibration log sheet will be used to record each time an instrument is calibrated, recalibrated, or checked against a standard or background. All field equipment will be calibrated at the beginning of each day using appropriate calibrations solutions or gases. Field instruments will be calibrated in accordance with the manufacturers' procedures, and the XRF will be calibrated using National Institute of Standards and Technology traceable samples with low, moderate, and high concentrations of lead.

The procedures and standards to be used for instrument calibration are discussed in SOP-12 and SOP-13.

4.3.2 Sample Collection Logs

All sample log sheets will be completed in accordance with SOP-03.

4.3.3 Chain-of-Custody Forms

A chain-of-custody will be maintained for all FBL samples collected during the PA/SI. These forms are a record of the people having custody of the samples from the time the samples are collected to the time they are analyzed and disposed (see SOP-03). For samples being shipped for analyses at a FBL, the completed field chain-of-custody document will be placed in a sealed plastic envelope and taped to the top inside lid of the shipping container before it is shipped. For any samples temporarily maintained on-site, the completed chain-of-custody will remain on site with those samples. A copy of each chain-of-custody document will be retained by the FOL.

4.3.4 Shipping Forms/Air Bills

Copies of all forms and/or air bills related to the shipment of coolers will be retained by the FOL to trace the shipment, if necessary, and to communicate with the receiving laboratory.

4.3.5 Permanent Record File

This project will require the administration of a central project file. The data and records management protocols will provide adequate controls and retention of all materials related to the project. Record control will include receipt from external sources, transmittals, transfer to storage, and indication of record status. Record retention will include receipt at storage areas, indexing, filing, storage, maintenance, and retrieval.

4.3.6 Record Control

All incoming materials related to the project, including sketches, correspondence, authorizations, and logs, will be forwarded to the PM or designated assistant and then placed in the project file. Project personnel will work from copies of these documents. All records will be legible and easily identifiable. Examples of the types of records that will be maintained in the project file are as follows:

- Field documents
- Correspondences
- Photographs
- Laboratory data
- Reports
- Procurement agreements

4.3.7 Record Status

To prevent the inadvertent use of obsolete or superseded project-related procedures, the project team members will be responsible for reporting changes in protocol to the Tetra Tech PM. The PM will then inform other members of the project team and the Project QA/QC Advisor of these changes.

Revisions to procedures will be subject to the same level of review and approval as the original document. The revised document will be distributed to all holders of the original document and will be discussed with project personnel. Outdated procedures will be marked “void.” One copy of a document marked “void,” along with the reason(s) for marking the document “void” will be maintained in the project file. In addition, the date a document is marked “void” will be recorded.

4.3.8 Record Storage

All project-related information will be maintained by Tetra Tech for the duration specified by contract N62472-03-D-0057. Designated personnel will assure that incoming records are legible and in suitable condition for storage. Record storage will be performed in two stages: storage during and immediately following the project, and permanent storage of records directly related to the project.

Tetra Tech will use storage facilities providing a suitable environment that will minimize deterioration or damage and prevent loss. Records will be secured in steel file cabinets labeled with the appropriate project identification. Tetra Tech will use Microsoft Excel for data storage. Data will be maintained on CD-ROM and backed up each time a file is edited. Upon presentation of data to MCB Camp Lejeune, a backup of that version will be permanently stored in the central filing location.

At the completion of the project, the PM or his appointed document custodian will be responsible for the project file inventory. All material from the project file, including drawings, project-related QA documents,

and electronic project documentation and verification records will be maintained by Tetra Tech for the duration specified by contract N62472-03-D-0057.

At the termination of the CLEAN III program, all project files, laboratory data, and reports will be archived and returned to the Navy according to Navy guidance.

4.4 FIELD DATA REDUCTION AND COMPARISONS

Upon validation, laboratory lead concentrations will be compared to field XRF lead concentrations through a correlation plot. The field data will be plotted against the laboratory data, and a linear least-squares fit will be applied to generate an estimate of the "best" line through the data. If the data set exhibits more than one region where there appears to be a linear fit to the data but the regions have different slopes, the data may be subdivided into separate regions for fitting. No more than three separate regions of the correlation will be fit in this manner, and as few regions as possible will be used to adequately represent a linear fit. If a correlation coefficient (commonly denoted as "*r*") of 0.65 or greater is obtained for the PA/SI, the fit will be considered adequate to translate field XRF results to the equivalent laboratory lead concentrations. A correlation coefficient less than 0.65 will be considered unacceptable for making this translation. An ideal correlation coefficient would be 1.0.

The use of subdivisions of the overall concentration ranges to represent a best linear fit will be most important for concentrations in the range of about 250 to 550 mg/kg because the 400 mg/kg risk screening value for lead is within this range.

Assuming that a satisfactory correlation coefficient is obtained, the field XRF data will be translated into equivalent laboratory concentrations, which will then be used for estimating the spatial distribution and magnitude of lead contamination in surface soil. The 250 to 550 mg/kg concentration range will be the most critical range for these translations because it spans the 400 mg/kg concentration representing the risk-based screening level (RBSL) for lead. Because the 250 to 550 mg/kg range is most critical for decision making, a poor correlation at concentrations less than 1,000 mg/kg will be considered more serious than a poor correlation obtained for greater concentrations.

4.5 LABORATORY DATA REDUCTION AND REPORTING

Laboratory data reduction will be conducted in accordance with the FBL SOPs which are provided in Appendix E. The reported data will follow the requirements of the laboratory specification. Electronic

data will be reported in accordance with current Tetra Tech electronic data deliverable requirements and will be presented in the laboratory specification.

4.5.1 Data Validation

One hundred percent, full data validation will be performed on analysis from the FBL. For metals analysis, SW-846, 6020A method specific criteria will be used, for perchlorate, SW-846 6850 method specific criteria will be used. The logic outlined in USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review EPA-540/R-99-008, October 1999 will be used to apply qualifiers.

Data Usability Assessment

The usability of the data collected during the PA/SI directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum. The results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics.

Completeness

- For each matrix that was scheduled to be sampled, the FOL acting on behalf of the project team will prepare a table listing planned samples/analyses to collected samples/analyses. If deviations from the scheduled sample collection or analyses are identified, the Tetra Tech PM and risk assessor will determine whether the deviations compromise the ability to meet project objectives. If they do, the Tetra Tech PM will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

Precision

- The Project Chemist acting on behalf of the project team will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified previously in this SSWP. This will also include a comparison of field and laboratory precision with the expectation that field duplicate results will be no less precise than laboratory duplicate results. If the goals are not met, or data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report.

Accuracy

- The Project Chemist acting on behalf of the project team will determine whether the accuracy/bias goals were met for project data. This will be accomplished by comparing percent recoveries and surrogate compounds to accuracy goals of the analytical laboratory once the laboratory is identified. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, MS, and LCS. If the goals are not met, limitations on the use of the data will be described in the project report. The bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report.

Representativeness

- A Project Scientist acting on behalf of the project team will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and processed for analysis in accordance with this SSWP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless the professional judgment of the Project Scientist indicates that a quantitative analysis is required.

Comparability

- The Project Chemist acting on behalf of the project team will determine whether the data generated as part of this project are sufficiently comparable to historical site data generated by different methods and for samples collected using different procedures and under different site conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless the professional judgment of the Project Chemist indicates that such quantitative analysis is required.

Sensitivity

- The Project Chemist acting on behalf of the project team will determine whether project sensitivity goals are achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data

will be described. The Project Chemist will enlist the help of the project risk assessor to evaluate deviations from planned sensitivity goals.

Project Assumptions and Data Outliers

- The Tetra Tech PM and designated team members will evaluate whether project assumptions were valid. This will typically be a qualitative evaluation but may be supported by quantitative evaluations. The type of evaluation depends on the assumption being tested. Quantitative assumptions include assumptions related to data distributions (e.g., normal versus log-normal) and estimates of data variability. Potential outliers will be removed if a review of the associated documentation indicates that the results have an assignable cause the renders them inconsistent with the remainder of the data. During this evaluation, the team will consider whether outliers could be indications of unanticipated site conditions.

Evaluative procedures used to assess overall measurement error associated with the project:

After the completion of data validation (data validation procedures presented previously), the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The project team members identified by the PM will assess whether the data collectively support the attainment of project objectives. They will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated for by other data. Although rejected data will generally not be used, there may be reason to use them in a weight-of-evidence argument, especially when the supplement have not been rejected. If rejected data are used, their use will be supported by technically defensible rationales.

For statistical comparisons and mathematical manipulations, non-detected values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the ranges of concentrations. However, the average of original and duplicate samples will be used to represent the concentration at a particular sampled location.

Personnel responsible for performing the usability assessment:

The Tetra Tech PM, Project Chemist, FOL, and Project Scientist will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Navy, USEPA, and NCDERN. The review will take place either during a face-to-face meeting or teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will only be documented in the project report and reviewed during the normal document review cycle.

Description of the documentation generated during the usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). Written documentation will support the non-compliance estimated or rejected data results. The project report will identify and describe the data usability limitations and recommend resampling or other corrective actions, if necessary.

4.6 GPS

The location of every sample location will be marked with a temporary pin flag, and a boring hole number or sample ID will be marked on the flag.

All sample data coordinates will be collected via a GPS unit with sub-meter accuracy. For composite samples, the surveyed location will be the approximate center of the pattern formed by individual aliquot collection locations. It will be understood that this location represents an area larger than discrete locations typically associated with a single boring.

4.7 EQUIPMENT DECONTAMINATION

All reusable equipment used to collect samples will be decontaminated in accordance with SOP-04.

4.8 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

It is anticipated that this investigation will generate the following four types of potentially contaminated residues or IDW:

- PPE.
- Equipment decontamination fluids.
- Waste cuttings from soil boring activities.
- Miscellaneous debris (gloves, paper towels, etc.).

Additional information regarding the handling of IDW is described in SOP-10.

4.9 SAFETY

The health and safety activities described in the following sections will ensure that field activities are performed at a high level of safety.

4.9.1 Health and Safety Plan

The HASP has been prepared to describe specific health and safety requirements, concerns, and information related to these site activities. This document will be read and understood by each person working at the site. Each worker or visitor to the site must sign an acknowledgment that he or she has read and understands the HASP.

4.9.2 Health and Safety Training

All workers involved with the PA/SI will have successfully completed the OSHA-mandated 40-hour health and safety training and the follow-up annual 8-hour refresher courses when appropriate.

Tetra Tech and subcontractor personnel will supply OSHA documentation to the FOL before beginning work. Personnel who do not comply with this requirement must receive verbal approval to work from Tetra Tech corporate health and safety personnel.

4.9.3 Medical Approval and Personal Protective Clothing and Equipment

Workers at the site must be part of a medical monitoring program and must be medically approved to perform their duties without physical limitations. Protective clothing and equipment, as specified in the HASP, will be worn while performing site activities.

4.9.4 Safety Meetings

Safety meetings will be held among on-site workers at the beginning of field activities and whenever it is deemed appropriate by the SSO. The SSO will discuss safety issues related to activities being performed and will make site workers aware of any new conditions that could potentially affect health or safety.

4.10 ORGANIZATION AND LOGISTICS OF FIELD INVESTIGATIONS

4.10.1 Personnel

The duties, responsibilities, and lines of command for each person working on the project are described in Section 2.0 and displayed on Figure 2-1. Personnel working on the project will be familiar with their roles and responsibilities. In addition, they will be familiar with the mechanisms and procedures for coordinating tasks, improving communications, and reporting incidences or irregularities. The FOL is responsible for coordinating all on-site personnel and activities (Section 2.3.1). The SSO is responsible for health and safety monitoring and ensuring that the HASP is adhered to during all field activities (Section 2.3.3). The SSO has the authority to stop work if an imminent safety hazard is encountered.

4.10.2 Subcontractors

The FOL will direct all subcontractor activities on site, and the Project Chemist will direct the activities of the FBL.

4.10.3 Mobilization and Demobilization

Following approval of this SSWP, Tetra Tech will begin mobilization activities. All field team members will review the SSWP and HASP prior to mobilizing to the field. In addition, a field team orientation meeting will be held to familiarize personnel with the scope of the field activities. Items to be presented during that meeting include the following:

- Identification of this SSWP, the HASP (Appendix C), and applicable field SOPs (Appendix D).
- Site-specific safety concerns and requirements.
- Project objectives.
- Sampling designs and strategies for soil, groundwater, surface water, and sediment.
- Site-specific particulars of field operations (e.g., locations of utilities, physical access to sampling locations, communication mechanisms, lines of authority and responsibility, scheduling requirements, sample shipping concerns, etc.).

- Laboratory and other subcontractor coordination.
- Site access requirements.
- Travel requirements.

The FOL will coordinate the mobilization activities for this project. The equipment required for the field activities will be mobilized from the Tetra Tech Pittsburgh office or third-party vendor(s). The FOL and crew will demobilize from the site upon completion of the field operations and either transport field equipment back to the Tetra Tech Pittsburgh office or ship it back to the appropriate vendor. All work areas will be thoroughly checked, and trash will be removed and disposed properly.

TABLE 4-1

SAMPLE COLLECTION FREQUENCIES
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
SITE-SPECIFIC WORK PLAN
MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Analysis	Sample Matrix	Field Samples	Field Duplicates[2]	Rinsate Blanks[3]	Source Blanks[4]	MS/MSDs[5]
Surface Soil						
TAL Metals	Solid	28[6]	3	2	1	2
Direct Push Subsurface Soil						
TAL Metals	Solid	8	1	1	1	1
Temporary Well Groundwater						
Perchlorate	Aqueous	4	1	1	1	1
TAL Metals		4	1	1	1	1
Dissolved Metals[1]		4	1	1	1	1
Sediment						
TAL Metals	Solid	3	1	---	---	1
Surface Water						
Perchlorate	Aqueous	3	1	1	1	1
TAL Metals		3	1	1	1	1
Dissolved Metals[1]		3	1	1	1	1

MS/MSD = Matrix spike/matrix spike duplicate
NA = Not applicable
NTU = Nephelometric Turbidity Unit
TAL = Target analyte list

1 Aqueous samples for dissolved metals analysis will only be collected if turbidities are greater than 10 NTUs.
2 Field duplicates will be collected at a frequency of one per 10 environmental samples.
3 Rinsate blanks will be collected at a frequency of one per sampling device or instrument. These amounts are estimates and may vary. Sediment samples are typically collected with disposable plastic trowels.
4 Source blanks will be collected at a frequency of one per source of water used on site. These amounts are estimates and may vary.
5 MS/MSD samples are collected for all organic and inorganic parameters at a frequency of one per 20 field samples.
6 The total number of surface soil samples includes up to 12 discretionary samples that may or may not be collected. The number of QC samples will be changed if required based on the number of discretionary samples collected.

5.0 ENVIRONMENTAL PROTECTION PLAN

5.1 REGIONAL ECOLOGY SUMMARY

MCB Camp Lejeune is located within the New River Watershed. The New River is a slow moving and placid river that was dedicated as a National Scenic River in 1976. The topography along this coastal region is generally flat to gently rolling, which slopes from an altitude of 63 feet above msl to sea level. Approximately 59 percent of the New River Watershed is forested, with croplands and pastures making up 35 percent, and the remaining area being considered urban.

This portion of the North Carolina coast is a diverse region containing over 30 miles of sandy beaches that make up a continuously altering coastline. Many areas of the North Carolina coastline are highly erodable due to the sandy substrate and violent currents. These sandy coastlines transition into a region of pines (*Pinus sp*.), scrub oaks (*Quercus sp*.), sweetgum (*Liquidambar styraciflua*), and dogwood (*Cornus sp*.). Bermuda grass (*Cynodon dactylon*) is the primary undergrowth species of the area. These areas are interspersed with bottomland hardwood forests that were once more prevalent in this region. These forest types are dominated by bald cypress (*Taxodium distichum*) and swamp tupelo (*Nyssa sylvatica var. biflora*), with Atlantic white cedar (*Chamaecyparis thyoides*) being common on organic substrates underlain by sand. Croplands are also common in this area and are predominantly corn, cotton, peanuts, and tobacco.

The climate in Onslow County, North Carolina, is characterized by short mild winters and long, hot, humid summers. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33°F to 53°F in the winter months and 71°F to 88°F during the summer months.

5.2 ENDANGERED/THREATENED SPECIES WITHIN THE PROJECT SITE

Many protected species have been sighted at the vicinity of MCB Camp Lejeune, such as the American alligator, green sea turtle, loggerhead sea turtle, piping plover, red-cockaded woodpecker, bald eagle, seabeach amaranth, and rough-leaf loosestrife (USMC, 2006). These species are listed as threatened, endangered, or of special concern by the United Sates Fish and Wildlife Service (USFWS) under the Endangered Species Act of 1973, as amended.

MCB Camp Lejeune has active programs in place to protect the three federally protected avian species (American bald eagle, piping plover, and red cockaded woodpecker) that are known to occur on the base.

The D-6 Small Arms Range is not within the vicinity of any of the red cockaded woodpecker management areas, and suitable habitat for the piping plover does not exist at the D-6 Small Arms Range.

A bald eagle's nest is documented at MCB Camp Lejeune, located at the junction of Sneads Creek and the New River, 9.26 miles from the D-6 Small Arms Range. Three protective buffers that restrict ground and air-use activities have been established at approximately 750, 1,000, and 1,500 feet from the nest site. The D-6 Small Arms Range is not within any of these buffer zones. Non-nesting eagles may use the D-6 Small Arms Range for foraging habitat; however, the proposed work is not expected to impact any special habitat where eagles congregate.

The D-6 Small Arms Range is approximately 14.6 miles from the Atlantic Coast. The federally protected marine species (e.g., green sea turtle, leatherback sea turtle, loggerhead sea turtle, West Indian manatee) listed in Table 5-1 are unlikely to inhabit the D-6 Small Arms Range. The eastern cougar is the only federally listed mammal species that could occur in Onslow County. The only extant population of eastern cougar is located in south Florida, and the species has not been observed in North Carolina in over 50 years. Suitable habitat for the eastern cougar does not exist at the D-6 Small Arms Range, and the level of human activity in the area would tend to make the species avoid the area. Because the eastern cougar has not been verified in the area in more than 50 years and there is human activity in proximity to the D-6 Small Arms Range, it is very unlikely that the eastern cougar would occur on the site, and no impacts are expected.

Two of the four federally listed plant species have been identified on the base, rough-leaved loosestrife and seabeach amaranth. Approximately 22 rough-leaved loosestrife sites are found on Camp Lejeune, with 76 acres buffered and marked to protect this species. Rough-leaved loosestrife sites are visited annually to visually inspect for changes in extent and apparent health. Approximately half of the rough-leaved loosestrife sites occur within protected red-cockaded woodpecker sites, obviating the need for marking each of these sites individually. The other sites, mostly falling within the Greater Sandy Run Area, are marked with white paint around a perimeter that extends 100 feet from the outermost individuals. None of these sites are located at or adjacent to the D-6 Small Arms Range site.

Seabeach amaranth is an annual that has been described as a dune-builder because it frequently occupies areas seaward of primary dunes, often growing closer to the high tide line than any other coastal plant. As such, this plant is generally found along Onslow Beach and thus is not located at or adjacent to the D-6 Small Arms Range site.

Environmental reviews completed in preparation for the Integrated Natural Resources Management Plan (INRMP) determined that several of these species are not expected to exist at the site. No adverse impacts to listed species are expected to result from the proposed work within the investigation area at the D-6 Small Arms Range.

5.3 WETLANDS WITHIN THE PROJECT SITE

Jurisdictional wetland areas are known to be located within the D-6 Small Arms Range site and within the area of investigation. In addition to the jurisdictional wetlands, additional wetlands in the southwestern corner of the D-6 Small Arms Range site are apparent and clearly located in the vicinity of the investigation area. To install temporary monitoring wells and to collect environmental samples, vegetation removal will be necessary. Work will not be performed in wetland areas. No significant soil disturbance is anticipated from planned site work as described in this SSWP. No wetlands at or downstream of the D-6 Small Arms Range site are expected to be impacted by the project. The size of the area of investigation is less than the threshold for requiring a storm water pollution prevention plan. However, if the potential for runoff to jurisdictional wetlands exists, appropriate protection measures will be put in place.

5.4 CULTURAL AND ARCHAEOLOGICAL RESOURCES WITHIN THE PROJECT SITE

The environmental sampling activities proposed to support this SSWP involve a limited degree of intrusive activity. The probability that any significant cultural or archeological resources will be impacted by the field investigation is low. Consultation with the base archaeologist confirmed that no cultural or archaeological resources have been identified within the area of investigation. If any unmapped cultural or archaeological materials or resources are discovered within the project investigation area, the base archaeologist will be notified to provide guidance on performing further work in the area.

5.5 WATER RESOURCES WITHIN THE PROJECT SITE

The area of investigation does not encompass nor is it bordered by surface water bodies. No water resources are expected to be impacted by the project. If clearing of vegetation is required in areas adjacent to a water body, appropriate silt barriers or other best management practices (BMP) will be put in place to prevent sediment from migrating to the water body.

5.6 COASTAL ZONES WITHIN THE PROJECT SITE

Onslow County is subject to the rules and policies of the North Carolina Coastal Resources Commission, which administers the Coastal Area Management Act (CAMA). The CAMA requires permits for development in Areas of Environmental Concern (AECs) if they meet all of the following conditions:

- In one of the 20 counties covered by CAMA.
- Considered "development" under CAMA.
- In or affects an AEC established by the Coastal Resources Commission.
- Does not qualify for an exemption.

"Development" includes activities such as dredging or filling coastal wetlands or waters and construction of marinas, piers, docks, bulkheads, oceanfront structures, and roads. The investigation at the D-6 Small Arms Range will include surface investigations and the collection of subsurface soil and groundwater samples using DPT. These activities do not fit the definition of “development” under CAMA; therefore, a CAMA permit is not necessary for this project.

5.7 VEGETATION TO BE REMOVED WITHIN THE PROJECT SITE

Vegetation removal is anticipated in association with the field activities described in this SSWP. Vegetation will be removed to access sampling locations. It is estimated that approximately 100 percent of vegetation less than 3 inches in diameter will be cut over less than 1 acre of the project site. Only understory vegetation up to 3 inches in diameter will be cut as part of the investigation. Consultation with the base wildlife biologist confirms that no threatened or endangered species have been located within the project area.

5.8 EXISTING WASTE DISPOSAL SITES WITHIN THE PROJECT SITE

No known waste disposal sites are present in the area of investigation. Available documentation for the D-6 Small Arms Range indicates that the building structure was demolished in December 1998, and the demolition specifications state that all building materials were to be removed from the site. At this point, it is not known where the building demolition debris from former Building 451 was taken or disposed. It has been presumed that the bullet trap sand was removed prior to building demolition, but no documentation has been found to substantiate that presumption.

5.9 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

No applicable or relevant and appropriate requirements have been determined to be required for the proposed work.

5.10 DETAILED PROCEDURES AND METHODS TO PROTECT AND/OR MITIGATE THE RESOURCES/SITES IDENTIFIED

During the proposed work, a general survey of the project area will be conducted by the field personnel to identify obvious environmental concerns. The PM will provide instructions to field personnel regarding the protection of on-site environmental resources. Such protective measures will include, but are not limited to, the following:

- If federally protected plants are identified in the project area, the specimens will be flagged for easy relocation and verification.

- If cultural or archaeological material or resources are discovered in the project area, a qualified archaeologist will be notified to provide guidance on performing further work in the area.

- The PM will seek the guidance of a qualified ecologist to determine appropriate mitigation measures in the event that the performed work activities impact an environmental resource.

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APPENDIX A

Archival Records Search Report

D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)

MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Prepared for:
Department of the Navy
Naval Facilities Engineering Command Mid-Atlantic

Prepared by:
Tetra Tech
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NUMBER N62467-03-D-0057
CONTRACT TASK ORDER 163

APRIL 2009

APPENDIX A-1

SITE BACKGROUND INFORMATION
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
(ARCHIVE SEARCH REPORT #2.64), BUILDING 451
CAMP LEJEUNE CANTONMENT, NORTH CAROLINA

(from Normalized Database/Defense Site Environmental Reporting and Tracking System)

MCB Lejeune Cantonment 50-ft Indoor Range (D-6 50-ft indoor rifle and pistol range) is located at Building 451 in the area of I Street. Area is cleared. Potentially contaminated media are soil and groundwater. This range is identified as a .22 cal. indoor range located in Building 451.

The range appeared on a 1954 base map and is identified in Base Order 11102.B, dated 5 May 1960. The description of the range remained the same in BO P11102.1G, dated 6 February 1970, and in BO P11102.1K, dated 1 December 1986. Range fan information is extracted from range maps and one or more of the following documents: Training Regulations 140-5, dated 20 November 1931; AR 750-10, dated 22 May 1939; AR 750-10, dated 14 February 1942; AR 750-10, dated 22 January 1944; TM 9-855, dated 17 August 1944; TM 9-855, dated November 1951; Training Circular 25-1, dated 4 August 1978; Training Circular 25-8, dated 25 February 1992; MCO P3570.1A, dated 15 November 1983; MCO P3570.2, dated 5 January 1977, w/change 1, dated 1 June 1983; and Archive Search Report, USACoE, 2001. A site walk was performed by the IR/MMRP Program Manager for Camp Lejeune and evidence of range activities was found.

The Environmental Management office on Camp Lejeune initially identified the range. Also, the range was identified in the Archive Search Report (ASR 2.64) prepared for Camp Lejeune by the Corps of Engineers and finalized in 2001.

This range entered the CERCLA process (IRP) as a preliminary assessment. No CERCLA phases have been completed at the site, and the next phase is a PA/SI.

The estimated dates of range use are from 1954 – 2002. DERA-MRP funds will be used to fund this activity. This site is considered a range and was recommended for closure. See letter 5090 BEMD, dated 17 SEP 2002 “MILITARY RANGE INVENTORY COMMENTS FOR MARINE CORPS BASE (MCB), CAMP LEJEUNE AND MARINE CORPS AIR STATION, NEW RIVER.” The Normalized Database/Defense Site Environmental Reporting and Tracking System (NORM/DSERTS) form dated 19 April 2002 completed for this indoor small arms indoor range indicates that there is unexploded ordnance at the range. This statement is inconsistent with the typical information for a small arms range.

APPENDIX A-2

FIELD NOTES AND INTERVIEW FINDINGS
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
CAMP LEJEUNE, NORTH CAROLINA

September 10, 2008

0745 Met with Mr. Bob Lowder, Env. Eng. (910) 451-9607 at his office. Mr. Lowder provided names of individuals who might be available to assist us with information gathering: Mr. Duane Richardson (Range Control – Bldg. 54) and Ms. Linda Futrell at the base records vault (mapping) Bldg 1005.

0820 Met with Mr. Duane Richardson at Range Control (Building 54). Mr. Richardson said he actually trained within Building 451 in the 1970's. He also stated that small caliber was used within the building and it had a V-shaped bullet trap. He was not aware of any UXO ever used at the building. He also indicated that building usage for small bore (.22-caliber) target training was pretty low. Mr. Richardson identified Mr. Steve LeConto as the Base's Facilities Utilization Manager (910-451-4600) and Master Gunnery Sergeant (MGySgt) Charles Dailey (910-451-4600) as potential information sources on building specifications and usage.

0845 Stopped by location of former Building 451. The only visible element that appears to confirm the location of the Building 451 is a partial sidewalk that originated near the curb on I Street and lead back toward the former building area. Several large pine trees noted in the area may assist in determining the exact location of the former building.

0900 Base Library. Public Services Research Librarian Ms. Linda Hopkins provided (by e-mail) a general document on the history of MCB Camp Lejeune: *Semper Fidelis—A Brief history of Onslow County, North Carolina and Marine Corps Base Camp Lejeune*, Lewis Berger Group, Inc., Camp Lejeune Publications Department, North Carolina, 2002.

0925 Building 1005 (Mapping). Spoke with Kenneth at the front desk who took us back to meet with Ms. Shelly Parulis. Ms. Parulis did not have specific information on Building 451, but introduced us to Ms. Linda Futrell who turned out to be very helpful. Once we explained the purpose of our visit, Ms. Futrell was able to provide us with the Building 451 original design blue prints (PW Drawing Numbers 8493 through 8501) dated 25 April 1952. She also discovered an additional drawing dated 20 June 1983 (PW Drawing Number 14534) that indicated planned improvements to Building 451, primarily related to construction and installation of new mechanical equipment rooms to support improved facility ventilation and exhaust systems, improved acoustical treatment of interior walls and ceilings, and improved building lighting and electrical systems. Ms Futrell also provided us with a demolition date recorded for Building 451 as 14 December 1998. Ms. Futrell located the demolition plan (NAVFAC Drawing 4360682, Sheet 6 of 31) dated 9 July 1997 that shows the general layout of the Building 451 immediately before demolition. Black and white photographs of Building 451 were included on the drawing and appear to indicate that the mechanical equipment rooms for ventilation equipment added to the original metal building (in 1984) had already been removed.

1045 Returned to the Base Library. Reviewed base newspaper (*The Globe*) on micro fiche to determine if there were any items reported in the articles related to the demolition of the former Building 451. No information was discovered at the library.

1345 Met again with Bob Lowder at his office and discussed our findings as well as the eventual field sampling task. Bob indicated he should be able to provide trailer space on base from other contractors for our use. Bob had sent us a few GIS maps; however, they were low resolution images and would not support site map development. He indicated if we needed aerials from the GIS Department, a formal request via e-mail would be required.

September 11, 2008

0805 Met with Bob Lowder at his office. Mr. Lowder accompanied us to the location of former Building 451. We completed a site walk and took several photos. The adjacent building southwest of the former Building 451 location is Building 429, which is used as a storage warehouse. To the northeast of the former Building 451 location is Building 430, the Individual Simulated Marksman Facility.

The large pine trees in the area helped to determine the general location of the former building. Surface drainage in the area is to the southwest. A small drainage ditch lies just to the northwest of the site and discharges into the New River. Mr. Lowder indicated that groundwater is usually encountered at 4 to 8 feet below ground surface.

0905 Returned to Mr. Lowder's office. He indicated DRMO may have records on the demolition and disposal of the former building. He also gave us contact names for the GIS Department for possible aerial photograph coverage: Debbie Moffitt, Mike Becker, and Mike Lee (Manager).

0920 Stopped by GIS. No one was currently available to meet with us. Left our contact number and reason for our visit and asked that they call when available. Proceeded to the DRMO Hazardous Waste 90-day accumulation facility.

0935 Arrived at DRMO (Building 490) and spoke with Ms. Nancy Clemmer. She indicated that they did not have any records at that location. She sent us to speak with Mr. Bill Thomas on Lewis Road (Building 906).

0945 Met with Mr. Thomas who informed us that they do not keep any records on range residue and was not aware of anyone on base who would have any such type of information. DRMO does not take any lead residue from range traps, nor do they maintain any of the ranges on base. Mr. Thomas suggested that the Range Managers may have documentation on specific bullet trap cleaning and range waste management activities.

1030 Stopped back at GIS (Building 11) and met with Ms. Debbie Moffitt. She was able to pull up aerials from 1938, 1956, 1998 and 1999. The building was determined to be demolished in December 1998. The aerials from 1998 and 1999 provided good area detail in real color showing the actual building (1998) and then showing the former building location after the demolition had been completed (1999). She stated that we would have to request these aerials formally through our POC, Mr. Bob Lowder.

1055 Returned to the Range Control Office and met again with Duane Richardson. He was not aware of any range clean-up that routinely occurred at any of the ranges. Left a phone message for Steve LeConto regarding any knowledge he might have concerning the former Building 451.

1135 Stopped at Building 12 to contact Mr. LeConto. We were informed that he was on leave until September 24. We met with MGySgt. Charles Daily, the Base Facilities Manager. He was not able to directly provide any additional information regarding Building 451. However, MGySgt. Charles Daily did escort us down to meet with Mr. Fred Estes who works with Mr. LeConto. At that time Mr. Estes was not in his office. It was approaching lunch time and a brief break was taken with the intention of returning to Mr. Estes' office after lunch.

1310 Stopped back at Mr. Estes' office. Mr. Estes was able to provide us with a copy of the Class 2 Property Record (#204789) that included the construction/acquisition date for Building 451 as 01 November 1952. The property record also indicated that Building 451 was improved in 1985 and those building improvements may be the ventilation, electric, and acoustic upgrades that were detailed in the 20 June 1983 (PW Drawing Number 14534) plans. Mr. Estes also provided us with a copy of the Class 2 Disposal Record (#204789) that included the recorded date of disposal by demolition for Building 451 as 18 December 1998.

APPENDIX A-3

SUMMARY OF INFORMATION COLLECTED FOR THE D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451) CAMP LEJEUNE, NORTH CAROLINA

Building 451 consisted of metal sheeting on steel frame (Butler Building) constructed on 01 November 1952. The original design blueprints dated 25 April 1952 indicated outside building dimensions of 120 feet 6-inches long by 40-feet wide. Photographs and drawing details shown on the building demolition plan dated 09 July 1997 indicate the building entrance was on the southwestern wall and the direction of small arms fire was to the northeast. This drawing shows the northeastern end of the building and approximately 86 feet along the southeastern and northwestern walls were lined with concrete masonry unit (CMU) walls inside the Butler Building sheet metal exterior wall. The CMU walls were typical cinder block construction. The CMU walls inside Building 451 surrounding the range area were 12 feet 10-inches high. The indoor range at Building 451 was apparently eight firing lanes wide and accommodated target practice firing from a 50-foot distance and a 75-foot firing distance from the targets. The 75-foot firing line is consistent with the outside dimensions of the building and the dimensions of the CMU wall lining the inside of building wall along the firing range.

The range bullet trap system consisted of a series of four angled steel plate baffle plates suspended from the building's structural steel roof supports. The final baffle was a 13-foot wide steel plate that extended across the width of the range and covered the area behind the targets. The steel baffle was oriented at a 45 degree downward angle from about 11-feet above the range floor to near the base of the downrange CMU wall. The leading edge of the final baffle was suspended above a two-foot high CMU wall about ten feet in front of the CMU wall at the northeastern (target) end of the building. Behind the two-foot wall about 8 to 16 inches of sand were placed over a four-inch layer of gravel directly overlying the foundation slab. The sand layer thickened from the 2-foot CMU wall toward the rear (downrange) CMU wall where the final baffle plate was anchored. The sand would catch the expended bullets once they passed through the targets and were deflected by the final steel baffle plate into the sand bullet trap. No records were discovered to document the handling or management of the expended bullets or bullet fragments that accumulated in the Building 451 indoor range bullet trap.

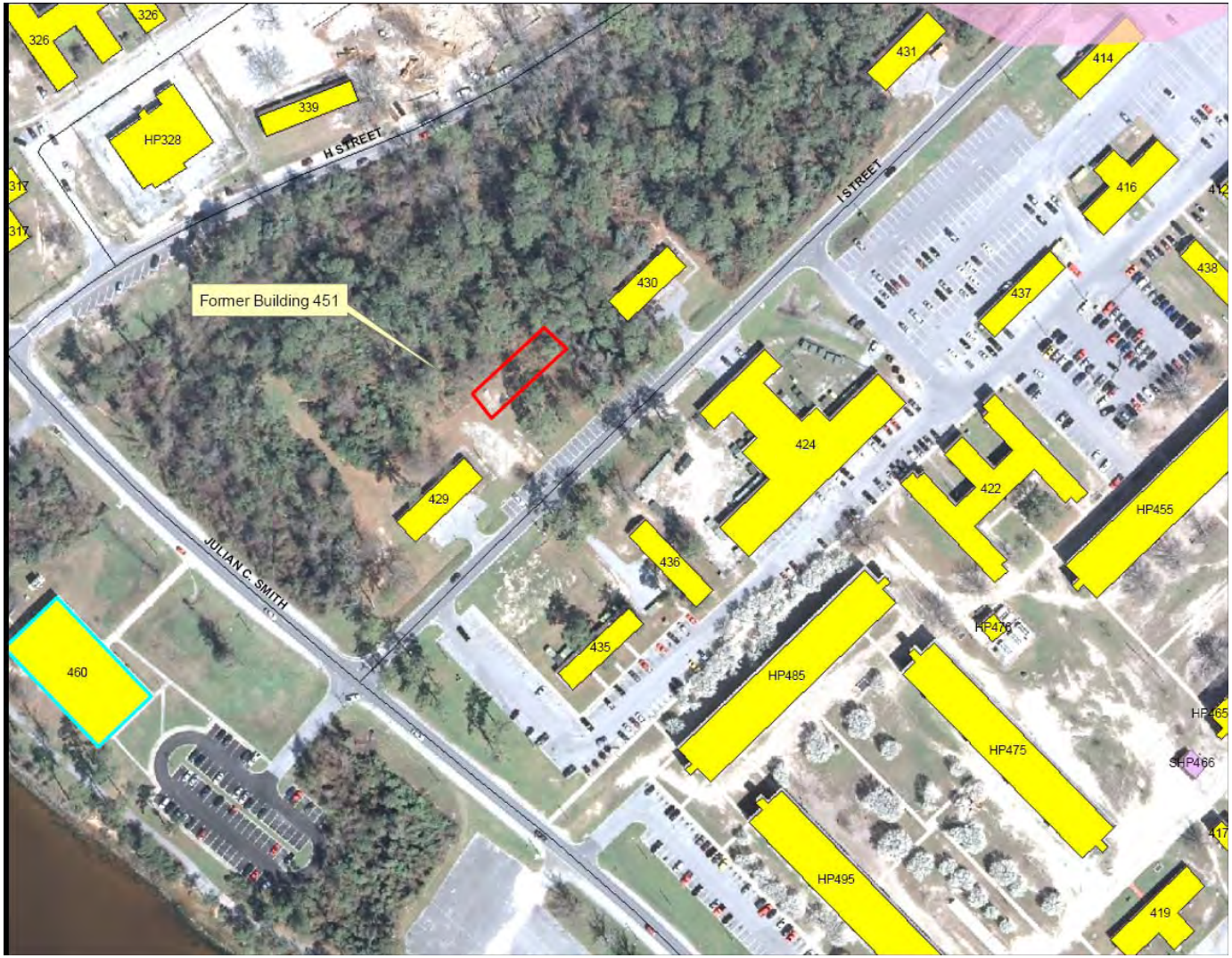
Property records indicated that Building 451 was improved in 1985 and those building upgrades may have included the ventilation system, electrical supply, and building acoustics as detailed in Building 451 improvement plans dated 20 June 1983. The demolition plan indicated that building demolition included removal of wood framed structures on the reinforced concrete foundation and slab including steel siding, CMU walls, partitions, and steel baffle plates. The plan (Note 4) indicated the area was to be backfilled, raked, and seeded after building demolition/removal. This indicates that non-native fill may have been brought to the site and potential surface soil MC contamination from the range may now be at depth below clean fill.

The Class 2 Disposal Record dated 21 December 1998 indicated Building 451 was managed as property record number 204789. The disposal contract was recorded as FACLTR3DEC98, and the demolition/disposal for Building 451 was dated 18 December 1998.

APPENDIX A-4

PRIMARY MAPS AND DOCUMENTS
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)
ONSLOW COUNTY, NORTH CAROLINA

D-6 50-ft Indoor Rifle and Pistol Range, (ASR 2.64), Former Building 451, Camp Lejeune Cantonment



Location map of D-6, 59-Foot Indoor Rifle and Pistol Range (Former Building 451) at MCB Camp Lejeune, provided by Camp Lejeune personnel.

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SITE PHOTOGRAPHS

Photo B-1: View to the northeast as seen from the location of the former D-6 Small Arms Range

Photo B-2: View to the southwest as seen from the location of the former D-6 Small Arms Range

Photo B-3: Sidewalk leading from I Street to the location of former D-6 Small Arms Range

Photo B-4: Sidewalk leading away from the location of former D-6 Small Arms Range out to I Street

Photo B-5: Overgrown vegetation at northern end of investigation area

Photo B-6: Overgrown vegetation at northern end of investigation area

Photo B-7: Picture showing typical height of under story growth at northeastern side of the investigation area

Photo B-8: Typical soil found at the investigation area

APPENDIX C

HEALTH AND SAFETY PLAN

Health and Safety Plan

for

Site Inspection Activities at the D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451)

Marine Corps Base Camp Lejeune
Onslow County, North Carolina

Naval Facilities Engineering Command Mid-Atlantic

Contract No. N62472-03-D-0057

Contract Task Order 163

April 2009

HEALTH AND SAFETY PLAN
FOR
SITE INSPECTION ACTIVITIES
AT THE
D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)

MARINE CORPS BASE CAMP LEJEUNE
ONSLOW COUNTY, NORTH CAROLINA

Submitted to:
Naval Facilities Engineering Command Mid-Atlantic
9742 Maryland Avenue
Norfolk, Virginia 23511-3095

Submitted by:
Tetra Tech NUS, Inc.
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NO. N62472-03-D-0057
CONTRACT TASK ORDER 0163

APRIL 2009

PREPARED UNDER THE SUPERVISION OF:

RICK BARRINGER
PROJECT MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

MATTHEW M. SOLTIS, CIH, CSP
CLEAN HEALTH & SAFETY MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

The objective of this Health and Safety Plan (HASP) is to provide the safety and health requirements, restrictions, practices, and procedures for Tetra Tech NUS, Inc. (TtNUS) personnel participating in site inspection field activities at the D-6, 50-Foot Indoor Rifle and Pistol Range, Marine Corps Base Camp Lejeune, Onslow County, North Carolina.

This HASP is to be used in conjunction with the TtNUS Health and Safety Guidance Manual. The Guidance Manual provides detailed information pertaining to hazard recognition and control, and TtNUS standard operating procedures (SOPs). This HASP and the contents of the Guidance Manual were developed to comply with the requirements stipulated in 29 Code of Federal Regulations (CFR) 1910.120 [Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Standard]. Both documents must be present at the site to satisfy these requirements.

This HASP has been written to support proposed tasks and techniques associated with the scope of work as presented in Section 4.0. It has been developed using the latest available information regarding known or suspected chemical contaminants and potential physical hazards associated with the proposed work at the site. Should the proposed work site conditions and/or suspected hazards change, or if new information becomes available, this document will be modified. Changes to the HASP will be made with the approval of the TtNUS Site Safety Officer (SSO) and the TtNUS Health and Safety Manager (HSM). Requests for modifications to the HASP will be directed to the SSO who will determine whether to make the changes. The SSO will notify the Project Manager (PM), who will notify the affected personnel of changes.

1.1 AUTHORITY

This work is authorized under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract, administered through the Naval Facilities Engineering Command Mid-Atlantic, as defined under Contract No. N62472-03-D-0057, Contract Task Order (CTO) 0163.

1.2 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibilities for site safety and health for TtNUS employees conducting the hand augering, sampling, and other supporting field activities under this field effort. All personnel assigned to participate in the field work have the primary responsibility for performing all of their work tasks in a manner that is consistent with the TtNUS Health and Safety Policy, the health and safety training that they have received, the contents of this HASP, and in an overall manner that protects their personal

safety and health and that of their co-workers. The following persons are the primary point of contact and have the primary responsibility for observing and implementing this HASP and for overall on-site health and safety.

- The TtNUS PM is responsible for the overall direction and implementation of health and safety for this work.

- The TtNUS Field Operations Leader (FOL) is responsible for implementation of this HASP. The FOL manages field activities, executes the Work Plan, and enforces safety procedures as applicable to the Work Plan. Specifically, the FOL will:

  - Verify training and medical status of on-site personnel in relation to site activities.
  - Assist and represent TtNUS with emergency services (if needed)
  - Provide elements of site-specific training for on-site personnel.

- The TtNUS SSO or his/her representative supports the FOL concerning the aspects of health and safety including, but not limited to:

  - Coordinating health and safety activities.
  - Selecting, applying, inspecting, and maintaining personal protective equipment (PPE).
  - Establishing work zones and control points.
  - Implementing air monitoring procedures.
  - Implementing hazard communication, respiratory protection, and other associated safety and health programs.
  - Coordinating emergency services.
  - Providing elements of site-specific training.

- Compliance with these requirements is monitored by the Project Health and Safety Officer (PHSO) and is coordinated through the HSM.

1.3 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: D-6, 50-Foot Indoor Rifle and Pistol Range - Camp Lejeune **Address:** Onslow County, NC

NAVFAC MID-ATLANTIC Engineer in Charge: Mr. Bryan K. Beck, P.E **Phone:**(757) 322-4734

Site Contact: Mr. Robert Lowder, Marine Corps Base Camp Lejeune IR Program Manager

Phone Number: (910) 451-9607

Site Address: I Street (between building 429 and building 430) Marine Corps Base Camp Lejeune – Onslow County, NC

Purpose of Site Visit: Site Inspection-Field Activities

Proposed Start-up Date: April 2009 until completion

Project Team:

Richard A. Barringer, CPG, CHMM, REM	Project Manager (PM)
James Goerdt	Field Operations Leader (FOL)
Matthew M. Soltis, CIH, CSP	Health and Safety Manager (HSM)
Jennifer Choich, PhD	Project Health and Safety Officer (PHSO)
TBD	Site Safety Officer (SSO)

Prepared by: Jennifer Choich, PhD

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an emergency. In the event of an emergency, the field team will primarily evacuate and assemble to an area unaffected by the emergency and notify the appropriate local emergency response personnel/agencies. TtNUS personnel are not authorized to participate in any emergency response activities. Workers who are ill or who have suffered a non-serious injury may be transported by site personnel to nearby medical facilities, provided that such transport does not aggravate or further endanger the welfare of the injured or ill person. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of site operations, which ensures adequate emergency response time. The Navy Remedial Project Manager will be notified if outside response agencies are contacted.

TtNUS personnel may participate in minor event response and emergency prevention activities such as:

- Initial fire-fighting support and prevention
- Initial spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provision of initial medical support for injury or illness requiring only first-aid level support
- Provision of site control and security measures as necessary

2.2 EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, emergencies resulting from chemical, physical, or fire hazards are the types of emergencies that could be encountered during site activities. To minimize or eliminate the potential for these emergency situations, pre-emergency planning activities will include the following (which are the responsibility of the SSO and/or the FOL):

- Coordinating with the base fire protection and emergency services prior to commencement of work to ensure that TtNUS emergency action activities are compatible with existing emergency response procedures.

- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:

  - Chemical Inventory (of chemicals used on site), with Material Safety Data Sheets (MSDS).
  - On-site personnel medical records (Medical Data Sheets).
  - A logbook identifying personnel on site each day.
  - Hospital route maps with directions (these should also be placed in each site vehicle).
  - Emergency Notification - phone numbers.

The TtNUS FOL will be responsible for the following tasks:

- Identifying a chain of command for emergency action.

- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.

- Periodically performing practice drills to ensure site workers are familiar with incidental response measures.

- Providing the necessary equipment to safely accomplish identified tasks.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

Emergency situations that may be encountered during site activities will generally be recognized by visual observation. Visual observation will also play a role in detecting potential exposure events to some chemical hazards. To adequately recognize chemical exposures, site personnel must have a clear knowledge of signs and symptoms of exposure associated with the principle site contaminants of concern as presented in this HASP. Tasks to be performed at the site, potential hazards associated with those tasks, and the recommended control methods are discussed in detail in Sections 5.0 and 6.0. Additionally, early recognition of hazards will be supported by daily site surveys to eliminate any situation predisposed to an emergency. The FOL and/or the SSO will be responsible for performing surveys of work areas prior to initiating site operations and periodically while operations are being conducted. Survey findings are documented by the FOL and/or the SSO in the Site Health and Safety logbook; however, site personnel will be responsible for reporting hazardous situations. Where potential hazards

exist, TtNUS will initiate control measures to prevent adverse effects to human health and the environment.

The above actions will provide early recognition for potential emergency situations, and allow TtNUS to initiate necessary control measures. However, if the FOL and the SSO determine that control measures are not sufficient to eliminate the hazard, TtNUS will withdraw from the site and notify the appropriate response agencies listed in Table 2-1.

2.3.2 Prevention

TtNUS and subcontractor personnel will minimize the potential for emergencies by following the Health and Safety Guidance Manual and ensuring compliance with the HASP and applicable OSHA regulations. Daily site surveys of work areas by the FOL and/or the SSO, prior to the commencement of that day's activities, will also assist in prevention of illness/injuries when hazards are recognized early and control measures initiated.

2.4 EVACUATION ROUTES, PROCEDURES, AND PLACES OF REFUGE

An evacuation will be initiated whenever recommended hazard controls are insufficient to protect the health, safety, or welfare of site workers. Specific examples of conditions that may initiate an evacuation include, but are not limited to the following: severe weather conditions, fire or explosion, monitoring instrumentation readings that indicate levels of contamination are greater than instituted action levels, and evidence of personnel overexposure to potential site contaminants.

In the event of an emergency requiring evacuation, personnel will immediately stop activities and report to the designated safe place of refuge unless doing so would pose additional risks. When evacuation to the primary place of refuge is not possible, personnel will proceed to a designated alternate location and remain until further notification from the TtNUS FOL. Safe places of refuge will be identified prior to the commencement of site activities by the SSO and will be conveyed to personnel as part of the pre-activities training session. This information will be reiterated during daily safety meetings. Whenever possible, the safe place of refuge will also serve as the telephone communications point for that area. During an evacuation, personnel will remain at the refuge location until directed otherwise by the TtNUS FOL or the on-site Incident Commander of the Emergency Response Team. The FOL or the SSO will perform a head count at this location to account for and to confirm the location of site personnel. Emergency response personnel will be immediately notified of any unaccounted personnel. The SSO will document the names of personnel on site (on a daily basis) in the site Health and Safety Logbook. This information will be utilized to perform the head count in the event of an emergency.

Evacuation procedures will be discussed during the pre-activities training session, prior to the initiation of project tasks. Evacuation routes from the site and safe places of refuge are dependent upon the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) may dictate evacuation routes. As a result, assembly points will be selected and communicated to the workers relative to the site location where work is being performed. Evacuation should always take place in an upwind direction from the site.

2.5 EMERGENCY CONTACTS

Prior to initiating field activities, personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. Table 2-1 provides a list of emergency contacts and their associated telephone numbers. This table must be posted where it is readily available to site personnel. Facility maps should also be posted showing potential evacuation routes and designated meeting areas.

As soon as possible, Marine Corps Base Camp Lejeune IR Program Manager, Robert Lowder, will be informed of any incident or accident that requires medical attention.

Any pertinent information regarding allergies to medications or other special conditions will be provided to medical services personnel. This information is listed on Medical Data Sheets filed on site (See Attachment I). If an exposure to hazardous materials has occurred, provide hazard information from Table 6-1 to medical service personnel.

TABLE 2-1
EMERGENCY CONTACTS

MCB CAMP LEJEUNE, NORTH CAROLINA

CONTACT	PHONE NUMBER
EMERGENCY (Police, Fire, and Ambulance Services)	**911**
Craven Regional Medical Center 1110 Huff Dr, Jacksonville, NC 28546	(910) 353-0714
Naval Hospital Camp Lejeune 100 Brewster Blvd Camp Lejeune, NC 28547	(910) 450-HELP (4357)
Chemtrec	(800) 424-9300
National Response Center	(800) 424-8802
North Carolina One-Call Center	811
Marine Corps Base Camp Lejeune IR Program Manager, Robert A. Lowder	(910) 451-9607
NAVFAC Mid-Atlantic Engineer In Charge, Mr. Bryan K. Beck, P.E	(757) 322-4734
Project Health and Safety Officer; Jennifer Choich, PhD	(412) 921-8083
TtNUS, Task Order Manager Rick Barringer	(412) 921-8524
TtNUS, Health and Safety Manager Matthew M. Soltis, CIH, CSP	(412) 921-8912

2.6 EMERGENCY ROUTE TO HOSPITAL

Life-threatening medical emergencies will be handled by the Naval Hospital Camp Lejeune. Others will be referred to the Craven Regional Medical Center. Maps to these two facilities are provided in Figure 2-1.

FIGURE 2-1

DIRECTIONS AND MAPS TO HOSPITALS

Naval Hospital Camp Lejeune
100 Brewster Blvd
Camp Lejeune, NC 28547
(910) 450-4300

Total Time: 13 minutesTotal Distance: 4.63 miles

1.	Start out going NORTHEAST on I ST toward H ST. (point A on map)	0.2 mi
2.	I ST becomes unnamed road.	0.1 mi
3.	Turn LEFT onto MAIN SERVICE RD.	0.1 mi
4.	Turn LEFT onto HOLCOMB BLVD.	0.1 mi
5.	Turn LEFT onto MAIN SERVICE RD.	1.4 mi
6.	MAIN SERVICE RD becomes SETH WILLIAMS BLVD.	0.5 mi
7.	Turn RIGHT onto STONE ST.	2.2 mi
8.	Turn RIGHT onto BREWSTER BLVD.	0.0 mi
9.	End at 100 Brewster Blvd Camp Lejeune, NC 28547-2538 (point B on map)	

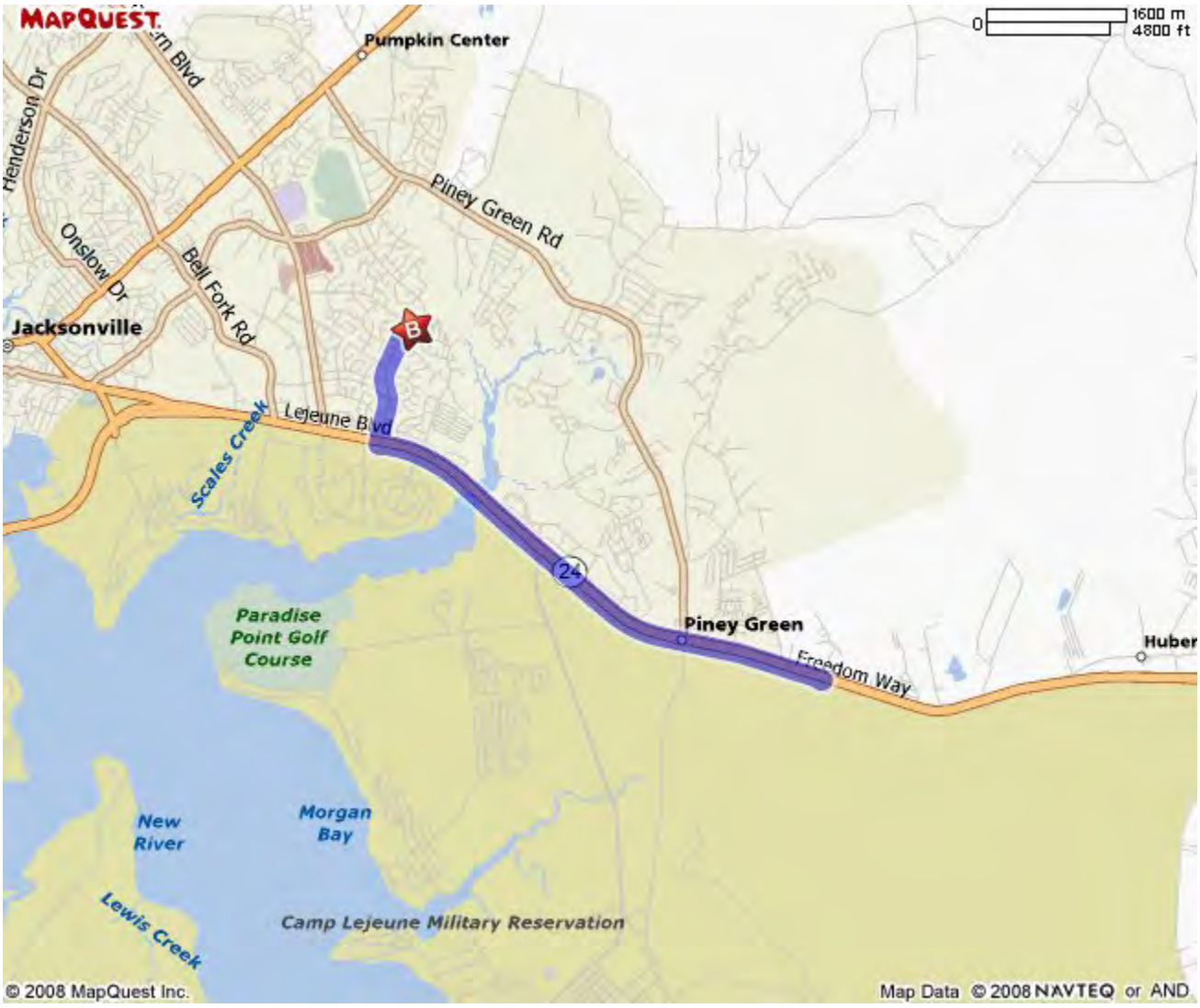
100 Brewster Blvd, Camp Lejeune, NC 28547-2538

Craven Regional Medical Center
1110 Huff Dr, Jacksonville, NC 28546
(910) 353-0714

Total Time: 9 minutesTotal Distance: 5.87 miles

1.	Go out of the base onto FREEDOM WAY/NC-24 W.	0.0 mi
2.	Turn LEFT onto NC-24 W.	4.7 mi
3.	Turn RIGHT onto PINE VALLEY RD.	1.1 mi
4.	Turn RIGHT onto HUFF DR.	0.0 mi
5.	End at 1110 Huff Dr Jacksonville, NC 28546 (point B on map)	

Craven Regional Medical Ctr: 1110 Huff Dr, Jacksonville, NC 28546, (910) 353-0714



2.7 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

TtNUS personnel will be working in close proximity to each other at Camp Lejeune and other work sites associated with the installation of wells and sampling activities. As a result, hand signals, voice commands, and line of site communication will be sufficient to alert site personnel of an emergency.

If an emergency warranting evacuation occurs, the following procedures are to be initiated:

- Initiate the evacuation via hand signals, voice commands, or line of site communication.
- Report to the designated refuge point where the FOL will account for all personnel.
- Once non-essential personnel are evacuated, appropriate response procedures will be enacted to control the situation.
- Describe to the FOL (FOL will serve as the Incident Coordinator) pertinent incident details.

In the event that site personnel cannot mitigate the hazardous situation, the FOL and SSO will enact emergency notification procedures to secure additional assistance in the following manner:

Dial 911 and call other pertinent emergency contacts listed in Table 2-1 and report the incident. Give the emergency operator the location of the emergency, the type of emergency, the number of injured, and a brief description of the incident. Stay on the phone and follow the instructions given by the operator. The operator will then notify and dispatch the proper emergency response agencies.

2.8 PPE AND EMERGENCY EQUIPMENT

A first-aid kit, eye wash units (or bottles of disposable eyewash solution), and fire extinguishers (strategically placed) will be maintained on site and shall be immediately available for use in the event of an emergency. This equipment will be located in the field office as well as in each site vehicle. At least one first aid kit supplied with equipment to protect against bloodborne pathogens will also be available on site. Personnel identified within the field crew with bloodborne pathogen and first-aid training will be the only personnel permitted to offer first-aid assistance.

2.9 DECONTAMINATION PROCEDURES / EMERGENCY MEDICAL TREATMENT

During any site evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. Decontamination will be postponed if the incident warrants immediate evacuation. However, it is unlikely that an evacuation would occur which would require workers to evacuate the site without first performing the necessary decontamination procedures.

TtNUS personnel will perform rescue operations for emergency situations and may provide initial medical support for injury/illnesses requiring only "Basic First-Aid" level support, and only within the limits of training obtained by site personnel. Basic First-Aid is considered treatment that can be rendered by a trained first aid provider at the injury location and not requiring follow-up treatment or examination by a physician (for example; minor cuts, bruises, stings, scrapes, and burns). Not included as Basic First-Aid are second or third degree burns, cuts, lacerations requiring stitches or butterfly bandaging, heat exhaustion, severe poisonous plant or insect bite reactions. Personnel providing medical assistance are required to be trained in First-Aid and in the requirements of OSHA's Bloodborne Pathogen Standard (29 CFR 1910.1030). Medical attention above First-Aid level support will require assistance from the designated emergency response agencies. Attachment II provides the procedure to follow when reporting an injury or illness, and the form to be used for this purpose. **If the emergency involves personnel exposures to chemicals, follow the steps provided in Figure 2-2.**

2.10 INJURY OR ILLNESS REPORTING

If any TtNUS personnel are injured or develop an illness as a result of working on site, the TtNUS “Injury or Illness Procedure” (Attachment II) must be followed. Following this procedure is necessary for documenting the information obtained at the time of the incident.

Any pertinent information regarding allergies to medications or other special conditions will be provided to medical services personnel. This information is listed on Medical Data Sheets filed on site. If an exposure to hazardous materials has occurred, provide information on the chemical, physical, and toxicological properties of the subject chemical(s) to medical service personnel**.**

FIGURE 2-2

POTENTIAL EXPOSURE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of injury situations. In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events).
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the injured person is a TtNUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. WorkCare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at 1-800-455-6155 and enter Extension 109, being prepared to provide:

    - Any known information about the nature of the injury.
    - As much of the exposure history as was feasible to determine in the time allowed.
    - Name and phone number of the medical facility to which the victim(s) has/have been taken.
    - Name(s) of the involved TtNUS employee(s).
    - Name and phone number of an informed site officer who will be responsible for further investigations.
    - Fax appropriate information to WorkCare at (714) 456-2154.

- Contact Corporate Health and Safety Department (Matt Soltis) and Human Resources Department (Marilyn Duffy) at (412) 921-7090.

As data is gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident, but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-2 (continued)
WORKCARE

POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. Exposing Agent

Name of Product or Chemicals (if known):_____

_____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing?_____

How long did individual work in area before signs/symptoms developed? _____

Was protective gear being used? If yes, what was the PPE? _____

Was their skin contact? _____

Was the exposing agent inhaled?_____

Were other persons exposed? If yes, did they experience symptoms? _____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)

Improved: _____ Worsened: _____ Remained Unchanged: _____

V. Treatment of Symptoms (check off appropriate response)

None: _____ Self-Medicated: _____ Physician Treated: _____

3.0 SITE BACKGROUND

The U.S. Marine Corps (USMC) has conducted small bore weapons training and marksmanship qualifications activities at multiple ranges at Marine Corps Base Camp Lejeune (MCBCL) in Onslow County, North Carolina. Of particular significance to this project is the D-6, 50-Foot Indoor Rifle and Pistol Range, a former indoor small arms range facility that has since been demolished and removed from the site.

3.1 FORMER BUILDING 451 INDOOR SMALL ARMS FIRING RANGE

The D-6, 50-Foot Indoor Rifle and Pistol Range, area for this Site Inspection covers an area of approximately 1 acre and is located northwest of I Street. Former Building 451 consisted of steel frame building with metal sheeting (Butler Building) constructed on a concrete slab on November 1, 1952. The Building 451 construction blueprints (April 25, 1952) indicate outside dimensions of 120 feet 6-inches long (oriented southwest to northeast) by 40-feet wide, with the entrance was on the southeastern corner and the direction of small arms fire was to the northeast.

Approximately 86 feet along the southeastern and northwestern walls and the north-eastern end of the building were lined with concrete masonry unit (CMU) walls inside the Butler Building sheet metal exterior walls. The CMU walls were typical cinder block construction. The CMU walls inside Building 451 surrounding the range area were 12 feet 10-inches high.

The D-6, 50-Foot Indoor Rifle and Pistol Range was apparently eight firing lanes wide and accommodated target practice firing from both a 50-foot distance and a 75-foot firing distance from the targets. A 75-foot firing line distance is consistent with the outside dimensions of the building and the dimensions of the CMU wall lining the inside of building walls along the firing range.

Because this range was completely enclosed, there was no safety danger zone or range fan. The investigation area within the D-6, 50-Foot Indoor Rifle and Pistol Range will include a 1-acre area where the building was previously located and where potential residual demolition debris may still be present. The area of investigation is located northwest of I Street, between Building 429 and Building 430. Based on a review of publicly available aerial photographs and site reconnaissance, the investigation area has a gently sloping terrain and is approximately 25 percent heavily vegetated with trees and thick shrub and brush undergrowth.

4.0 SCOPE OF WORK

This section of the HASP addresses proposed site activities that are to be conducted while performing this site inspection and associated field tasks. The specific tasks anticipated to be involved with this effort include the following:

- Mobilization/demobilization
- Vegetation clearing/site preparation
  - Minor brush cutting/clearing with chain saws, motorized brush cutters, etc
- Monitoring well installation via direct push technology (DPT)
- Multimedia sampling:
  - Soil sampling
  - Subsurface soil sampling
  - Groundwater sampling
- Decontamination
- Investigation derived waste (IDW) management

No other activities are anticipated to be necessary. If it becomes apparent that additional or modified tasks must be performed beyond those listed above, the work is not to proceed until the FOL or SSO notifies the PM and the HSM, so that any appropriate modifications to this HASP can first be developed and communicated to the intended task participants.

5.0 IDENTIFYING AND COMMUNICATING TASK-SPECIFIC HAZARDS AND GENERAL SAFE WORK PRACTICES

The purpose of this section is to identify the anticipated hazards and appropriate hazard prevention/hazard control measures that are to be observed for each planned task or operation. These topics have been summarized for each planned task through the use of task-specific Safe Work Permits, which are to be reviewed in the field by the SSO with all task participants prior to initiating any task. Additionally, potential hazard and hazard control matters that are relevant, but are not necessarily task-specific are addressed in this section.

Section 6.0 presents additional information on hazard anticipation, recognition, and control relevant to the planned field activities.

5.1 GENERAL SAFE WORK PRACTICES

In addition to the task-specific work practices and restrictions identified in the Safe Work Permits provided as and attachment to this HASP, the following general safe work practices are to be followed when conducting work on site.

Eating, drinking, chewing gum or tobacco, taking medication, or smoking in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists is prohibited.

- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. If a source of potable water is not available at the work site that can be used for hands-washing, the use of waterless hands cleaning products will be used, followed by actual hands-washing as soon as practicable upon exiting the site.

- Avoid contact with potentially contaminated substances including puddles, pools, mud, or other such areas. Avoid, kneeling on the ground or leaning or sitting on equipment. Keep monitoring equipment away from potentially contaminated surfaces.

- Plan and mark entrance, exit, and emergency evacuation routes.

- Rehearse unfamiliar operations prior to implementation.

- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity to assist each other in case of emergency.

- Establish appropriate safety zones including support, contamination reduction, and exclusion zones.
- Minimize the number of personnel and equipment in contaminated areas (such as the exclusion zone). Non-essential vehicles and equipment should remain within the support zone.
- Establish appropriate decontamination procedures for leaving the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the SSO.
- Observe co-workers for signs of toxic exposure and heat or cold stress.
- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

5.2 SAFE WORK PRACTICES ASSOCIATED WITH DPT OPERATIONS

DPT operations can present a variety of physical hazards to personnel. These potential hazards can be minimized or controlled through a variety of methods. These control mechanisms are summarized below:

- Identify underground utilities and buried structures before drilling. Follow the TtNUS Utility Locating and Excavation Clearance SOP located in the TtNUS Health and Safety Guidance Manual Section 7.
- Hearing protection (e.g., ear plugs or ear muffs with noise reduction rating values on the product packaging labels of at least 25 decibels) to protect personnel from exposure to excessive impact and continuous noise levels during DPT operations.
- DPT rigs will be inspected by the SSO or designee, prior to the acceptance of the equipment at the site and prior to the use of the equipment. Repairs or deficiencies identified will be corrected prior to use. Ensure that all machine guarding is in place and properly adjusted. After the initial inspection and release for use on site, additional inspections will be performed at least at the beginning of every 5- or 10-day shift, or following any repairs or significant maintenance activities.
- Block the DPT rig and use levelers to prevent uncontrolled movement of the drill.

- The work area around the point of operation will be graded to the extent possible to remove any trip hazards near or surrounding operating equipment. Mechanisms to secure heavy objects such as DPT tooling sections such as rack storage devices.

- Minimize contact to the extent possible with contaminated tooling and environmental media. Potentially contaminated tooling will be placed on polyethylene sheeting for storage and wrapped for transport to the centrally located equipment decontamination area.

- Support functions (sampling and screening stations) will be maintained a minimum distance from the drill rig of the height of the mast plus 5 feet or 25 feet, whichever is greater.

- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the DPT rig.

- During maintenance, use only manufacturer provided or approved equipment.

- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should be used to move auger flights and other heavy tooling.

- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone.

- Equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the FOL and/or the SSO to determine cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.

- Motorized equipment will be fueled prior to the commencement of the day's activities.

- When not in use, DPT rigs will be shutdown, and emergency brakes set and wheels will be chocked to prevent movement.

- Investigative areas will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards. In situations where these hazards cannot be immediately removed, the area will be barricaded to limit access.

6.0 HAZARD ASSESSMENT AND CONTROLS

This section provides reference information regarding the chemical and physical hazards which may be associated with activities that are to be conducted as part of the scope of work.

6.1 CHEMICAL HAZARDS

The proposed standard Small Arms Range analytical assessment for Camp Lejeune includes common ammunition-derived constituents: antimony, arsenic, lead, copper, tin, and zinc. Specific project samples will also be analyzed for perchlorate. There are no previous sampling data for this location.

Based on an evaluation of previous historical information about the site, the primary contaminants of concern (COCs) at this site are suspected to be metals (arsenic, antimony, lead, tin, copper, zinc) and perchlorate. Table 6-1 also shows these COCs and their current occupational exposure limits (ACGIH TLV TWA_8, and/or the OSHA PEL TWA_8 and Ceiling).

TABLE 6-1

CONTAMINANTS OF CONCERN AND CURRENT OCCUPATIONAL EXPOSURE LIMITS

Contaminant of Concern	Current OSHA PEL And ACGIH TLV
Antimony	OSHA: 0.5 mg/m3, TWA_8 ACGIH: 0.5 mg/m3 ppm TWA_8
Arsenic	OSHA: 0.5 mg/m3, TWA_8 ACGIH: 0.01 mg/m3 ppm TWA_8
Copper	OSHA: 1 mg/m3, TWA_8 ACGIH: 1 mg/m3 ppm TWA_8 (dust)
Tin	OSHA: 2 mg/m3, TWA_8 ACGIH: 2 mg/m3 ppm TWA_8
Zinc	OSHA: 5 mg/m3, TWA_8 ACGIH: 2 mg/m3 ppm TWA_8 (as zinc oxide)
Lead	OSHA: 0.05 mg/m3, TWA_8 ACGIH: 20.05 mg/m3 ppm TWA_8

Table Notes:

TWA_8: Average air concentration over an 8-hour work period that is not to be exceeded

Metals

There are 35 metals that could be of concern because of potential occupational or residential exposure; 23 of these are the heavy elements or "heavy metals": antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, copper, gallium, gold, iron, lead, manganese, mercury, nickel, platinum, silver, tellurium, thallium, tin, uranium, vanadium, and zinc. Of these, only antimony, arsenic, tin, copper, lead, and zinc are of potential concern at the site. Interestingly, small amounts of these elements are common in our environment and diet and are actually necessary for good health, but large amounts of any of them may cause acute or chronic toxicity (poisoning). Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs. Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis. Allergies are not uncommon and repeated long-term contact with some metals or their compounds may even cause cancer.

The association of symptoms indicative of acute toxicity is not difficult to recognize because the symptoms are usually severe, rapid in onset, and associated with a known exposure or ingestion: cramping, nausea, and vomiting; pain; sweating; headaches; difficulty breathing; impaired cognitive, motor, and language skills; mania; and convulsions. The symptoms of toxicity resulting from chronic exposure (impaired cognitive, motor, and language skills; learning difficulties; nervousness and emotional instability; and insomnia, nausea, lethargy, and feeling ill) are also easily recognized; however, they are much more difficult to associate with their cause.

Lead – Depending on the specific bullet type and physical composition, the typical small arms bullet consists of more than 85 percent (and sometime >96 percent) lead by weight. Lead is a poisonous metal that can damage nervous connections (especially in young children) and cause blood and brain disorders. Because of its low reactivity and solubility, lead poisoning usually only occurs in cases when the lead is dispersed, like when sanding lead based paint, or long term exposure in the case of pewter tableware. Since lead is a common MC, workers should pay special attention to the genearation and dispersion of dust, and ensure proper area wetting techniques are utilized if visible dust is observed.

Long term exposure to lead or its salts (especially soluble salts or the strong oxidant PbO_2) can cause nephropathy, and colic-like abdominal pains. The concern about lead's role in cognitive deficits in children has brought about widespread reduction in its use (lead exposure has been linked to schizophrenia). Most cases of adult elevated blood lead levels are workplace-related.

Perchlorate

Perchlorates are the salts derived from perchloric acid ($HClO_4$). They occur both naturally and through manufacturing. They have been used as a medicine for more than 50 years to treat thyroid gland disorders. They are also used as an oxidizer in rocket fuel and explosives and can be found in airbags, signal flares, smoke-producing compounds, tracer ammunition, pyrotechnics, and fireworks. High doses of perchlorate can decrease thyroid hormone production by inhibiting the uptake of iodide by the thyroid. Thyroid hormones are critical for normal growth and development of the central nervous system of fetuses and infants. The Navy has identified perchlorate as a potential contaminant of concern for this project based on the potential use of ammunition with double base powder containing trace levels of perchlorate.

6.1.1 Inhalation

None of the COCs are expected to be inhalation concerns at the site or reach concentrations that exceed permissible limits. In addition, it is important to recognize that the planned work area is outdoors, with ample natural ventilation that will reduce any airborne VOCs through dilution and dispersion.

As a result of these factors, it is very unlikely that workers participating in this activity will encounter any airborne concentrations of COCs that would represent an occupational exposure concern.

6.1.2 Ingestion and Skin Contact

Potential exposure concerns to COCs may also occur through ingesting or coming into direct skin contact with contaminated groundwater. The likelihood of worker exposure concerns through these two routes are also considered very unlikely, provided that workers follow good personal hygiene and standard good sample collection/sample handling practices, and wear appropriate PPE as specified in this HASP. In addition, area wetting techniques will be imployed to reduce viible dust, when necessary. Examples of onsite practices that are to be observed that will protect workers from exposure via ingestion or skin contact include the following:

- No hand-to-mouth activities on site (eating, drinking, smoking, etc.).
- Washing hands upon leaving the work area and prior to performing any hand to mouth activities.
- Wearing surgeon's-style gloves whenever handling potentially-contaminated media, including groundwater and any potential bullet residues, sampling equipment, and sample containers.

6.2 PHYSICAL HAZARDS

The following is a list of physical hazards that may be encountered at the site or may be present during the performance of site activities.

- Physical hazards associated with DPT operations
- Slip, trips, and falls
- Contact with underground (electric lines, gas lines, water lines, etc.)
- Strain/muscle pulls from heavy lifting
- Heat stress
- Pinch/compression points
- Natural hazards (snakes, ticks, poisonous plants, etc.)
- Vehicular and equipment traffic
- Inclement weather

These hazards are discussed further below, and are presented relative to each task in the task-specific Safe Work Permits.

6.2.1 Physical Hazards Associated with DPT Operations

DPT operations can present a variety of physical hazards to personnel. These potential hazards can be minimized or controlled through a variety of methods. These control mechanisms are summarized in Section 5.2.

6.2.2 Slips, Trips, and Falls

During various site activities there is a potential for slip, trip, and fall hazards associated with wet, steep, or unstable work surfaces. To minimize hazards of this nature, personnel required to work in and along areas prone to these types of hazards will be required to exercise caution, and use appropriate precautions (e.g., restrict access, guardrails, life lines and/or safety harnesses) and other means suitable for the task at hand. Site activities will be performed using the buddy system.

6.2.3 Contact with Underground Utilities

Underground utilities such as pressurized lines, water lines, telephone lines, buried utility lines, and high voltage power lines are known to be present throughout the facility. Clearance of underground utilities for each hand auger location will be coordinated North Carolina One Call. The TtNUS Utility Locating and

Excavation Clearance SOP is located in the Tetra Tech NUS Health and Safety Guidance Manual Section 7.

6.2.4 Strain, Sprains, and Muscle Pulls from Heavy Lifting

During execution of planned activities there is some potential for strains, sprains, and/or muscle pulls due to the physical demands and nature of this site work. To avoid injury during lifting tasks, personnel are to lift with the force of the load carried by their legs and not their backs. When lifting or handling heavy material or equipment use an appropriate number of personnel. Keep the work area free from ground clutter to avoid unnecessary twisting or sudden movements while handling loads.

6.2.5 Heat Stress

Because of the geographical location of the planned work and the physical exertion that can be anticipated with some of the planned tasks, it will be necessary for the field team to be aware of the signs and symptoms and the measures appropriate to prevent heat stress. This is addressed in detail in section 4.0 of the TtNUS Health and Safety Guidance Manual, which the SSO is responsible for reviewing and implementing as appropriate on this project.

In general, early signs of heat-related disorders include heat rash, cramps, heavy sweating which may be followed by the complete shutdown of a person's ability to sweat, pale/clammy skin, headaches, dizziness, incoordination, and other maladies. To prevent heat stress disorders, the following preventive measures are to be implemented by the SSO:

- When possible, schedule the most physically-demanding tasks so that they are performed during cooler periods of the day such as early morning or late afternoon.

- Educate the field staff in heat stress signs and symptoms so that they can monitor themselves and their co-workers.

- Schedule frequent breaks during the hottest parts of the day (such as a few minutes each hour). Breaks should be in shaded areas, and in a location where workers can remove PPE, wash their hands, and drink fluids.

- Drinking fluids should be cool and non-caffeinated. Sports-drinks with electrolytes are acceptable provided that they do not contain alcohol. Water is also acceptable.

For more information on heat stress recognition and prevention, consult section 4.0 of the TtNUS Health and Safety Guidance Manual.

6.2.6 Pinch/Compression Points

Handling of tools, machinery, and other equipment on site may expose personnel to pinch/compression point hazards during normal work activities. Where applicable, equipment will have intact and functional guarding to prevent personnel contact with hazards. Personnel will exercise caution when working around pinch/compression points, using additional tools or devices (e.g., pinch bars) to assist in completing activities.

6.2.7 Natural Hazards

Natural hazards such as poisonous plants, bites from poisonous or disease carrying animals or insects (e.g., snakes, ticks, mosquitoes) are often prevalent at sites that are being investigated as part of hazardous waste site operations. Work areas will be inspected to look for any evidence that dangerous animals may be present.

During warm months (spring through early fall), tick-borne Lyme Disease may pose a potential health hazard. The longer a disease carrying tick remains attached to the body, the greater the potential for contracting the disease. Wearing long sleeved shirts and long pants (tucked into boots and taped) will prevent initial tick attachment, while performing frequent body checks will help prevent long term attachment. Site first aid kits should be equipped with medical forceps and rubbing alcohol to assist in tick removal. For information regarding tick removal procedures and symptoms of exposure, consult Section 4.0 of the Health and Safety Guidance Manual.

Contact with poisonous plants and bites or stings from poisonous insects are other potential natural hazards. Long sleeved shirts and long pants (tucked into boots), and avoiding potential nesting areas, will minimize the potential for exposure. Additionally, insect repellents may be used by site personnel. Personnel who are allergic to stinging insects (such as bees, wasps, and hornets) must be particularly careful since severe illness and death may result from allergic reactions. As with any medical condition or allergy, information regarding the condition must be listed on the Medical Data Sheet (see Attachment I of this HASP), and the FOL or SSO notified.

6.2.8 Vehicular and Equipment Traffic

Hazards associated with vehicular and equipment traffic are likely to exist during various site activities and whenever site personnel perform work on or near roadways. Additionally, site personnel will be

instructed to maintain awareness of traffic and moving equipment when performing site activities. When working near roadways, site personnel will wear high visibility vests.

6.2.9 Inclement Weather

Project tasks under this scope of work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather (electrical storms, tornadoes, etc.) conditions arise, the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

Tropical Storms and Hurricanes

As North Carolina can be a tropical storm, hurricane prone area, the following information is supplied to explain the potential severity of these natural hazards. The decision to curtail operations and evacuate the area should be made by the FOL, PM, and the HSM.

During the early summer to late fall months, typically from the first of June through the end of November, disturbances migrating off the West Coast of Africa move into the Atlantic Ocean and develop into tropical cyclones known as tropical storms and hurricanes. Many of these cyclones become strong enough to threaten life and property along the Eastern Seaboard and Gulf Coast. There are three main threats associated with tropical storms and hurricanes:

- High winds
- Excessive rainfall
- Storm surge

The impacts of high winds and excessive rainfall occur hours, maybe days, before the tropical storm or hurricane makes landfall. However, the storm surge accompanies the storm or hurricane at the time that landfall occurs.

High Winds

Sustained winds vary greatly from storm to storm, but can range from 39 to 73 miles per hour (wind speeds associated with a tropical storm) to greater than 74 miles per hour (minimal wind speed for a Category 1 hurricane). Table 6-2 compares the type of storm or hurricane and the corresponding wind speed.

TABLE 6-2

TROPICAL STORM/HURRICANE RATING SCALE

TYPE	CATEGORY*	WINDS (MPH)
Tropical Depression	NA	>35-38
Tropical Storm	NA	39 – 73
Hurricane	1	74 – 95
Hurricane	2	96 – 110
Hurricane	3	111 – 130
Hurricane	4	131 – 155
Hurricane	5	>155

Based on the Saffir-Simpson scale

NA – Not Applicable

In addition to strong winds, there is the threat of debris (i.e. building material, trees, etc.) becoming airborne projectiles as they are carried by the high winds. Thunderstorms and tornadoes embedded within the tropical storm or hurricane can further increase the wind speeds on a localized level.

Excessive Rainfall

Heavy rains associated with tropical storms and hurricanes also vary greatly from storm to storm. On average, an inch of rainfall an hour is not uncommon with major hurricanes, somewhat lesser amounts with tropical storms. However, the primary threat is not the intensity of rain, but the duration of rainfall. Since many tropical storms and hurricanes are slow-movers, they are capable of producing sustained heavy rainfall over a long period of time. It is not uncommon for an area to receive nearly 20 inches of rain in 24 hours. Under these conditions, street; stream and creek flooding is inevitable only to be exacerbated by locally heavier rains from thunderstorms.

Storm Surge

The storm surge is an abnormal rise in sea level accompanying a hurricane or tropical storm. The height of the storm surge (usually measured in feet) is the difference in sea level from the observed level (during the storm) and the level that would have occurred in the absence of the storm or hurricane. The more intense the storm or hurricane the higher the storm surge. Storm surges become even higher if they occur during periods of high tide. Table 6-3 defines some of the terminology and possible calls to action regarding tropical cyclones:

TABLE 6-3

TROPICAL STORM/HURRICANE WATCH AND WARNING

STORM DESCRIPTION	DEFINITION	CALL TO ACTION
Tropical Storm Watch	Tropical storm conditions are possible in the specified area of the watch, usually within 36 hours	Weather conditions should be monitored for further advisories. Prepare for possible evacuation by local officials
Tropical Storm Warning	Tropical storm conditions are expected in the specified area of the warning, usually within 24 hours.	Work should be suspended in areas where lightning, high winds and rainfall could pose a threat to life. Mandatory evacuations may be enforced by local officials.
Hurricane Watch	Hurricane conditions are possible in the specified area of the watch, usually within 36 hours.	Weather conditions should be monitored for further advisories. Prepare for possible evacuation by local officials
Hurricane Warning	Hurricane conditions are expected in the specified area of the warning, usually within 24 hours.	Mandatory evacuations will most likely be enforced by local officials.

A NOAA Weather Radio is the best means to receive watches and warnings from the National Weather Service. The National Weather Service continuously broadcasts updated hurricane advisories that can be received by widely available NOAA Weather Radios.

7.0 AIR MONITORING

The contaminants of concern expected to be present are heavy metals. As a precautionary measure to assure that exposures are avoided, area wetting techniques will be utilized to minimize exposure to dust containing heavy metals. If other information indicates that VOCs are present on-site, this section will be revised, as necessary.

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for TtNUS personnel participating in on-site activities. TtNUS personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at Camp Lejeune. TtNUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of TtNUS introductory, supervisory, and refresher training as well as site-specific training will be maintained at the site. Copies of certificates or other official documentation will be used to fulfill this requirement.

8.2 SITE-SPECIFIC TRAINING

TtNUS SSO will provide site-specific training to TtNUS employees who will perform work on this project. Figure 8-1 will be used to document the provision and content of the project-specific and associated training. Site personnel will be required to sign this form prior to commencement of site activities. This training documentation will be employed to identify personnel who, through record review and attendance of the site-specific training, are cleared for participation in site activities. This document shall be maintained at the site to identify and maintain an active list of trained and cleared site personnel.

The TtNUS SSO will also conduct a pre-activities training session prior to initiating site work. This will consist of a brief meeting at the beginning of each day to discuss operations planned for that day, and a review of the appropriate Safe Work Permits with the planned task participants. A short meeting may also be held at the end of the day to discuss the operations completed and any problems encountered.

8.3 MEDICAL SURVEILLANCE

TtNUS personnel participating in project field activities will have had a physical examination meeting the requirements of TtNUS's medical surveillance program. Documentation for medical clearances will be maintained in the TtNUS Pittsburgh office and made available, as necessary, and will be documented using Figure 8-1 for every employee participating in on-site work activities.

Each field team member, including visitors, entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet (see Attachment I of this HASP). This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SITE VISITORS

All site visitors to the site must be escorted at all times and restricted from approaching any work areas where they could be exposed to hazards from TtNUS operations. If a visitor has authorization from the client and from the TtNUS PM to approach our work areas, the FOL must assure that the visitor first provides documentation indicating successful completion of the necessary OSHA introductory training, receive site-specific training from the SSO, and that they have been physically cleared to work on hazardous waste sites.

FIGURE 8-1

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing field site inspection activities at Camp Lejeune and that I have received site-specific training which included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Emergency response procedures (evacuation and assembly points)
- Review of the contents of relevant Material Safety Data Sheets
- Review of the use of Safe Work Permits

I have been given the opportunity to ask questions and all of my questions have been answered to my satisfaction. The dates of my training and my medical surveillance requirements indicated below are accurate to the best of my knowledge.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

9.0 SITE CONTROL

This section outlines the means by which TtNUS will delineate work zones and use these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This approach will be comprised of an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this approach will control access to site work areas, restricting access by the general public, minimizing the potential for the spread of contaminants, and protecting individuals who are not cleared to enter work areas.

9.1 EXCLUSION ZONE

The exclusion zone will be considered the areas of the site of known or suspected contamination. Therefore, the exclusion zones for this project will be limited to those areas of the site where active work (DPT rig plus height of mast plus 5 feet or 25 feet from rig, whichever is greater, and 15 feet area around sample collection points) is being performed. Exclusion zones will be delineated as deemed appropriate by the FOL, through means such as erecting visibility fencing, barrier tape, cones, and/or postings to inform and direct personnel.

9.1.1 Exclusion Zone Clearance

A pre-startup site visit will be conducted by members of the identified field team in an effort to identify proposed subsurface investigation locations, conduct utility clearances, and provide upfront notices concerning scheduled activities within the facility.

Subsurface activities will proceed only when utility clearance has been obtained. In the event that a utility is struck during a subsurface investigative activity, the emergency numbers provided in Section 2.0, Table 2-1, will be notified.

9.2 CONTAMINATION REDUCTION ZONE

The contamination reduction zone will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. This area will also serve as a focal point in supporting exclusion zone activities. This area will be delineated using barrier tape, cones, and postings to inform and direct facility personnel. Decontamination will be conducted at a central location. Equipment potentially contaminated will be bagged and taken to that location for decontamination.

9.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. The support zones will be established at areas of the site away from potential exposure to site contaminants during normal working conditions or foreseeable emergencies.

9.4 SAFE WORK PERMITS

Exclusion Zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permits to be used is provided in Figure 9-1. Partially completed Safe Work Permits for the work to be performed are provided in Attachment III. These permits were completed to the extent possible as part of the development of this HASP. It is the SSO's responsibility to finalize and complete all blank portions of the Safe Work Permits based on current, existing conditions the day the task is to be performed, and then review that completed permit with all task participants as part of a pre-task tail gate briefing session. This will ensure that site-specific considerations and changing conditions are appropriately incorporated into the Safe Work Permit, provide the SSO with a structured format for conducting the tail gate sessions, as well will also give personnel an opportunity to ask questions and make suggestions. All Safe Work Permits require the signature of the FOL or SSO.

9.5 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by TtNUS
- Regulatory personnel (i.e., DOD, USEPA, OSHA)
- Property Owners
- Authorized Navy Personnel
- Other authorized visitors

Non-Department of Defense (DOD) personnel working on this project are required to gain initial access to the base by coordinating with the TtNUS FOL or designee and following established base access procedures.

Once access to the base is obtained, personnel who require site access into areas of ongoing operations will be required to obtain permission from the PM. Upon gaining access to the site, site visitors wishing

to observe operations in progress will be escorted by a TtNUS representative and shall be required to meet the minimum requirements discussed below:

- Site visitors will be directed to the FOL or SSO, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.

- Site visitors wishing to enter the exclusion zone will be required to produce the necessary information supporting clearance to the site. This shall include information attesting to applicable training and medical surveillance as stipulated in Section 8.0 of this document. In addition, to enter the site operational zones during planned activities, visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items, they will be permitted to enter the operational zone. Visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. Visitors entering the exclusion zones during ongoing operations will be accompanied by a TtNUS representative. Visitors not meeting the requirements, as stipulated in this plan, for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of on-site activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished with support from base security personnel.

9.6 SITE SECURITY

Site security will be accomplished using existing base security resources and procedures, supplemented by TtNUS or subcontractor personnel, if necessary. TtNUS will retain control over active operational areas. The first line of security will take place at the station wide fences restricting the general public. The second line of security will take place at the work site referring interested parties to the FOL. The FOL will serve as a focal point for site personnel and will serve as the final line of security and the primary enforcement contact.

9.7 SITE MAP

Once the areas of contamination, access routes, topography, and dispersion routes are determined, a site map will be generated and adjusted as site conditions change. These maps will be posted to illustrate up-to-date collection of contaminants and adjustment of zones and access points.

9.8 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of personnel involved in this operation.

9.9 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

TtNUS and subcontractor personnel will provide MSDS for chemicals brought on site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of the chemicals used on site will be developed using the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request.

9.10 COMMUNICATION

It is anticipated that site personnel will be working in close proximity during proposed field activities. In the event that site personnel are in isolated areas or are separated by significant distances, a supported means of communication between field crews will be utilized. Two-way radio communication devices, if needed, will be used only with Camp Lejeune approval.

External communications will be accomplished utilizing telephones at predetermined and approved locations or through cellular phones. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of site activities, the FOL will determine and arrange for telephone communications, if it is determined a cellular means will not be used.

FIGURE 9-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): _____

II. Primary Hazards: Potential hazards associated with this task: _____

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____ TtNUS

V. Protective equipment required

Level D ☐ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required

Yes ☐ Specify on the reverse
No ☐

Modifications/Exceptions: _____

VI.

Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type –)	☐ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No
Steel toe Work shoes or boots	☐ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High Visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: _____

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No
If yes, SSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____

10.0 SPILL CONTAINMENT PROGRAM

10.1 SCOPE AND APPLICATION

It is not anticipated that bulk hazardous materials (over 55-gallons) will be handled at any given time as part of this scope of work. It is also not anticipated that such spillage would constitute a danger to human health or the environment. However, as the job progresses, the potential may exist for accumulating IDW such as decontamination fluids in a central staging area. As needed, 55-gallon drums will be used to contain decontamination fluids generated during field activities. Once the fluids and other materials have been characterized, they can be removed from this area and properly disposed. Because these fluids and soils remained uncharacterized while in the staging area, a spill containment program will be developed and instituted as part of this HASP.

10.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, limited areas are vulnerable to this hazard including:

- Resource deployment
- Waste transfer
- Central staging

It is anticipated that the IDW generated as a result of this scope of work will be containerized, labeled, and staged to await further analyses. The results of these analyses will determine the method of disposal.

10.3 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic walk-around by the personnel staging or disposing of drums area will be conducted during working hours to visually determine that storage vessels are not leaking. If a leak is detected, the contents will be transferred, using a hand pump, into a new vessel. The leak will be collected and contained using absorbents such as Oil-Dry, vermiculite, or sand, which are stored at the vulnerable areas in a conspicuously marked drum. This used material, too, will be containerized for disposal pending analysis. Inspections will be documented in the project logbook.

10.4 PERSONNEL TRAINING AND SPILL PREVENTION

Personnel will be instructed in the procedures for incipient spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and the SSO will serve as the Spill Response Coordinators for this operation, should the need arise.

10.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the types of equipment that should be maintained at the staging areas for the purpose of supporting this Spill Prevention/Containment Program.

- Sand, clean fill, vermiculite, or other non combustible absorbent (Oil-dry)
- Drums [55-gallon U.S. Department of Transportation (DOT) 1A1 or 1A2]
- Shovels, rakes, and brooms
- Container labels

10.6 SPILL CONTROL PLAN

This section describes the procedures the TtNUS field crew members will employ upon the detection of a spill or leak.

- Notify the SSO or FOL immediately upon detection of a leak or spill. Activate emergency alerting procedures for that area to remove non-essential personnel.

- Employ the PPE stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point in the vessel. Spread the absorbent material in the area of the spill, covering it completely.

- Transfer the material to a new vessel; collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment and disposal options.

- Re-containerize spills, including 2-inch of top cover impacted by the spill. Await test results for treatment or disposal options.

It is not anticipated that a spill will occur that the field crew cannot handle. Should this occur, notification of the appropriate Emergency Response agencies will be carried out by the FOL or SSO in accordance with the procedures discussed in Section 2.0 of this HASP.

11.0 CONFINED-SPACE ENTRY

It is not anticipated under the proposed scope of work that confined space and permit-required confined space activities will be conducted. Therefore, personnel under the provisions of this HASP are not allowed under any circumstances to enter confined spaces.

A confined space is defined as a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed, and the HSM will have to be notified.

12.0 MATERIALS AND DOCUMENTATION

The TtNUS FOL shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- MSDS for chemicals brought on site, including decontamination solutions, fuels, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (posted in the site trailer)
- Training/Medical Surveillance Documentation Form (Blank)
- First-Aid Supply Usage Form
- Emergency Reference Form (Section 2.0, extra copy for posting)
- Directions to the Hospital

12.1 MATERIALS TO BE POSTED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible (such as no office trailer), these documents should be separated and immediately accessible.

- **Chemical Inventory Listing (posted)** - This list represents all chemicals brought on site, including decontamination solutions, sample preservations, fuel, etc. This list should be posted in a central area.

- **MSDSs (maintained)** - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all substances employed on-site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

- **The OSHA Job Safety & Health Protection Poster (posted)** - This poster (Attachment IV) should be conspicuously posted in places where notices to employees are normally posted, as directed by 29 CFR 1903.2 (a)(1). Each FOL shall ensure that this poster is not defaced, altered, or covered by other material. The law also states that reproductions or facsimiles of the poster shall be at least 8 1/2 by 14 inches with 10 point type.

- **Site Clearance (maintained)** - This list is found within the training section of the HASP (Figure 8-1). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. The list indicates not only clearance, but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

- **Emergency Phone Numbers and Directions to the Hospital(s) (posted)** - This list of numbers and directions will be maintained at all phone communications points and in each site vehicle.

- **Medical Data Sheets/Cards (maintained)** - Medical Data Sheets will be filled out by on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to all personnel to be carried on their person.

- **Personnel Monitoring (maintained)** - All results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

- **Placards and Labels (maintained)** - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using DOT placards and acceptable [Hazard Communication 29 CFR 1910.1200(f)] labels.

The purpose of maintaining or posting this information, as stated above, is to allow site personnel quick access. Variations concerning location and methods of presentation are acceptable providing the objective is accomplished.

13.0 ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
CERCLA	Comprehensive Environmental Response, Compensation, and Liabilities Act
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CLEAN	Comprehensive Long-Term Environmental Action Navy
CSP	Certified Safety Professional
CTO	Contract Task Order
DOD	Department of Defense
DOT	Department of Transportation
FDEP	Florida Department of Environmental Protection
FOL	Field Operations Leader
HASP	Health and Safety Plan
HSM	Health and Safety Manager
IDW	Investigation Derived Waste
MSDS	Material Safety Data Sheet
NAS	Naval Air Station
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PEL	permissible exposure limit
PHSO	Project Health and Safety Officer
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
ppm	parts per million
SOP	Standard Operating Procedure
SSO	Site Safety Officer
STEL	short term exposure limit
TLV	threshold limit value
TtNUS	Tetra Tech NUS, Inc.
TWA_8	time weighted average 8-hours
USEPA	United States Environmental Protection Agency

ATTACHMENT I

MEDICAL DATA SHEET

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by on-site personnel and kept in the command post during the conduct of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project _____

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Person to notify in the event of an emergency: Name: _____

Phone: _____

Drug or other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

What medications are you presently using? _____

_____

Name, Address, and Phone Number of personal physician: _____

_____

_____

Note: Health Insurance Portability and Accountability Act (HIPAA) Requirements

HIPAA took effect April 14, 2003. Loosely interpreted, HIPAA regulates the disclosure of Protected Health Information (PHI) by the entity collecting that information. PHI is any information about health status (such as that you may report on this Medical Data Sheet), provision of health care, or other information. HIPAA also requires TtNUS to ensure the confidentiality of PHI. This Act can affect the ability of the Medical Data Sheet to contain and convey information you would want a Doctor to know if you were incapacitated. So before you complete the Medical Data Sheet understand that this form will not be maintained in a secure location. It will be maintained in a file box or binder accessible to other members of the field crew so that the can accompany an injured party to the hospital.

DO NOT include information that you do not wish others to know, only information that may be pertinent in an emergency situation or treatment.

_____ _____ _____

Name (Print clearly) Signature Date

ATTACHMENT II

INCIDENT REPORT FORM

TETRA TECH, INC.
INCIDENT REPORT

Report Date	Report Prepared By	Incident Report Number

INSTRUCTIONS:

All incidents (including those involving subcontractors under direct supervision of Tetra Tech personnel) must be documented on the IR Form.

Complete any additional parts to this form as indicated below for the type of incident selected.

TYPE OF INCIDENT (Check all that apply)	Additional Form(s) Required for this type of incident	
Near Miss (No losses, but could have resulted in injury, illness, or damage)	☐	Complete IR Form Only
Injury or Illness	☐	Complete Form IR-A; Injury or Illness
Property or Equipment Damage, Fire, Spill or Release	☐	Complete Form IR-B; Damage, Fire, Spill or Release
Motor Vehicle	☐	Complete Form IR-C; Motor Vehicle

INFORMATION ABOUT THE INCIDENT

Description of Incident

_____

_____

_____

Date of Incident	Time of Incident
	_____ AM ☐ PM ☐ *OR* Cannot be determined ☐
Weather conditions at the time of the incident	**Was there adequate lighting?**
	_____ Yes ☐ No ☐

Location of Incident

_____ Was location of incident within the employer's work environment? Yes ☐ No ☐

Street Address	City, State, Zip Code and Country
Project Name	**Client:**
Tt Supervisor or Project Manager	**Was supervisor on the scene?**
	Yes ☐ No ☐

WITNESS INFORMATION (attach additional sheets if necessary)

Name	Company
Street Address	**City, State and Zip Code**

Telephone Number(s)

CORRECTIVE ACTIONS

Corrective action(s) immediately taken by unit reporting the incident:

_____

_____

_____

Corrective action(s) still to be taken (by whom and when):

_____

_____

_____

ROOT CAUSE ANALYSIS LEVEL REQUIRED

Root Cause Analysis Level Required: Level - 1 ☐ Level - 2 ☐ None ☐

Root Cause Analysis Level Definitions

Level - 1	**Definition:** A Level 1 RCA is conducted by an individual(s) with experience or training in root cause analysis techniques and will conduct or direct documentation reviews, site investigation, witness and affected employee interviews, and identify corrective actions. Activating a Level 1 RCA and identifying RCA team members will be at the discretion of the Corporate Administration office. The following events may trigger a Level 1 RCA: ▪ Work related fatality ▪ Hospitalization of one or more employee where injuries result in total or partial permanent disability ▪ Property damage in excess of $75,000 ▪ When requested by senior management
Level - 2	**Definition:** A Level 2 RCA is self performed within the operating unit by supervisory personnel with assistance of the operating unit HSR. Level 2 RCA will utilize the 5 Why RCA methodology and document the findings on the tools provided. The following events will require a Level 2 RCA: ▪ OSHA recordable lost time incident ▪ Near miss incident that could have triggered a Level 1 RCA ▪ When requested by senior management

Complete the Root Cause Analysis Worksheet and Corrective Action form. Identify a corrective action(s) for each root cause identified within each area of inquiry.

NOTIFICATIONS

Title	Printed Name	Signature	Telephone Number	Date
Project Manager or Supervisor				
Site Safety Coordinator or Office H&S Representative				
Operating Unit H&S Representative				
Other: _____				

The signatures provided above indicate that appropriate personnel have been notified of the incident.

_____

INSTRUCTIONS:

Complete all sections below for incidents involving injury or illness.
Do NOT leave any blanks.
Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)	

EMPLOYEE INFORMATION

Company Affiliation

Tetra Tech Employee? ☐ TetraTech subcontractor employee (directly supervised by Tt personnel)? ☐

Full Name	**Company (if not Tt employee)**

Street Address, City, State and Zip Code	**Address Type**
_____	Home address (for Tt employees) ☐
_____	Business address (for subcontractors) ☐

Telephone Numbers

Work: _____	Home: _____	Cell: _____

Occupation (regular job title)	**Department**
Was the individual performing regular job duties?	**Time individual began work**
Yes ☐ No ☐	_____ AM ☐ PM ☐ *OR* Cannot be determined ☐

Safety equipment

Provided? Yes ☐ No ☐

Used? Yes ☐ No ☐ If no, explain why

_____

_____

_____

Type(s) provided:

- ☐ Hard hat
- ☐ Gloves
- ☐ Eye protection
- ☐ Safety shoes
- ☐ Respirator
- ☐ Protective clothing
- ☐ High visibility vest
- ☐ Fall protection
- ☐ Machine guarding
- ☐ Other (list)

_____

NOTIFICATIONS

Name of Tt employee to whom the injury or illness was first reported	**Was H&S notified within one hour of injury or illness?**
	Yes ☐ No ☐
Date of report	**H&S Personnel Notified**
Time of report	**Time of Report**

If subcontractor injury, did subcontractor's firm perform their own incident investigation?

Yes ☐ No ☐ If yes, request a copy of their completed investigation form/report and attach it to this report.

INJURY / ILLNESS DETAILS

What was the individual doing just before the incident occurred? Describe the activity as well as the tools, equipment, or material the individual was using. Be specific. Examples: "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from a hand sprayer"; "Daily computer key-entry"

_____

_____

_____

What Happened? Describe how the injury occurred. Examples: "When ladder slipped on wet floor and worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; Worker developed soreness in wrist over time"

_____

_____

_____

_____

Describe the object or substance that directly harmed the individual: Examples: "Concrete floor"; "Chlorine"; "Radial Arm Saw". If this question does not apply to the incident, write "Not Applicable".

_____

_____

MEDICAL CARE PROVIDED

Was first aid provided at the site: Yes ☐ No ☐ If yes, describe the type of first aid administered and by whom?

_____

Was treatment provided away from the site: Yes ☐ No ☐ If yes, provide the information below.

Name of physician or health care professional	**Facility Name**
Street Address, City State and Zip Code	**Type of Care?**
_____ _____	Was individual treated in emergency room? Yes ☐ No ☐ Was individual hospitalized overnight as an in-patient? Yes ☐ No ☐ Did the individual die? Yes ☐ No ☐ If yes, date: _____ Will a worker's compensation claim be filed? Yes ☐ No ☐
Telephone Number	

NOTE: Attach any police reports or related diagrams to this report.

SIGNATURES

I have reviewed this report and agree that all the supplied information is accurate

Affected individual (print)	**Affected individual (signature)**	**Telephone Number**	**Date**

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

INSTRUCTIONS:

Complete all sections below for incidents involving property/equipment damage, fire, spill or release.
Do NOT leave any blanks.
Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)	

TYPE OF INCIDENT (Check all that apply)

INCIDENT DETAILS

Results of Incident: Fully describe damages, losses, etc.

_____

_____

_____

Response Actions Taken:

_____

_____

_____

Responding Agency(s) (i.e. police, fire department, etc.)	**Agency(s) Contact Name(s)**

DAMAGED ITEMS (List all damaged items, extent of damage and estimated repair cost)

Item:	**Extent of damage:**	**Estimated repair cost**

SPILLS / RELEASES (Provide information for spilled/released materials)

Substance	**Estimated quantity and duration**	**Specify Reportable Quantity (RQ)**
		_____ Exceeded? Yes ☐ No ☐ NA ☐

FIRES / EXPLOSIONS (Provide information related to fires/explosions)

Fire fighting equipment used? Yes ☐ No ☐ If yes, type of equipment: _____

NOTIFICATIONS

Required notifications	**Name of person notified**	**By whom**	**Date / Time**
Client: _____ Yes ☐ No ☐			
Agency: _____ Yes ☐ No ☐			
Other: _____ Yes ☐ No ☐			

Who is responsible for reporting incident to outside agency(s)? Tt ☐ Client ☐ Other ☐ Name: _____

Was an additional written report on this incident generated? Yes ☐ No ☐ If yes, place in project file.

INSTRUCTIONS:

Complete all sections below for incidents involving motor vehicle accidents. Do NOT leave any blanks. Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)	

INCIDENT DETAILS

Name of road, street, highway or location where accident occurred	**Name of intersecting road, street or highway if applicable**

County	**City**	**State**

Did police respond to the accident?	**Did ambulance respond to the accident?**
Yes ☐ No ☐	Yes ☐ No ☐
Name and location of responding police department	**Ambulance company name and location**
Officer's name/badge #	

Did police complete an incident report? Yes ☐ No ☐ If yes, police report number: _____
Request a copy of completed investigation report and attach to this form.

VEHICLE INFORMATION

How many vehicles were involved in the accident? _____ (Attach additional sheets as applicable for accidents involving more than 2 vehicles.)

Vehicle Number 1 – Tetra Tech Vehicle		**Vehicle Number 2 – Other Vehicle**	
Vehicle Owner / Contact Information		**Vehicle Owner / Contact Information**	
Color		**Color**	
Make		**Make**	
Model		**Model**	
Year		**Year**	
License Plate #		**License Plate #**	
Identification #		**Identification #**	
Describe damage to vehicle number 1		**Describe damage to vehicle number 2**	
Insurance Company Name and Address		**Insurance Company Name and Address**	
Agent Name **Agent Phone No.**		**Agent Name** **Agent Phone No.**	
Policy Number		**Policy Number**	

DRIVER INFORMATION

Vehicle Number 1 – Tetra Tech Vehicle		Vehicle Number 2 – Other Vehicle	
Driver's Name		**Driver's Name**	
Driver's Address		**Driver's Address**	
Phone Number		**Phone Number**	
Date of Birth		**Date of Birth**	
Driver's License #		**Driver's License #**	
Licensing State		**Licensing State**	
Gender	Male ☐ Female ☐	**Gender**	Male ☐ Female ☐
Was traffic citation issued to Tetra Tech driver? Yes ☐ No ☐		Was traffic citation issued to driver of other vehicle? Yes ☐ No ☐	
Citation #		**Citation #**	
Citation Description		**Citation Description**	

PASSENGERS IN VEHICLES (NON-INJURED)

List all non-injured passengers (excluding driver) in each vehicle.
Driver information is captured in the preceding section.
Information related to persons injured in the accident (non-Tt employees) is captured in the section below on this form.
Injured Tt employee information is captured on FORM IR-A

Vehicle Number 1 – Tetra Tech Vehicle		Vehicle Number 2 – Other Vehicle	
How many passengers (excluding driver) in the vehicle? ____		How many passengers (excluding driver) in the vehicle? ____	
Non-Injured Passenger Name and Address		**Non-Injured Passenger Name and Address**	
Non-Injured Passenger Name and Address		**Non-Injured Passenger Name and Address**	
Non-Injured Passenger Name and Address		**Non-Injured Passenger Name and Address**	

INJURIES TO NON-TETRATECH EMPLOYEES

Name of injured person 1				Address of injured person 1		
Age	**Gender**	**Car No.**	**Location in Car**	**Seat Belt Used?**	**Ejected from car?**	**Injury or Fatality?**
	Male ☐ Female ☐			Yes ☐ No ☐	Yes ☐ No ☐	Injured ☐ Died ☐
Name of injured person 2				**Address of injured person 2**		
Age	**Gender**	**Car No.**	**Location in Car**	**Seat Belt Used?**	**Ejected from car?**	**Injury or Fatality?**
	Male ☐ Female ☐			Yes ☐ No ☐	Yes ☐ No ☐	Injured ☐ Died ☐

OTHER PROPERTY DAMAGE

Describe damage to property other than motor vehicles	
Property Owner's Name	**Property Owner's Address**

COMPLETE AND SUBMIT DIAGRAM DEPICTING WHAT HAPPENED

ATTACHMENT III

SAFE WORK PERMITS

SAFE WORK PERMIT

MOBILIZATION AND DEMOBILIZATION ACTIVITIES
CAMP LEJEUNE
CTO 0163

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): Mobilization and demobilization activities

II. Primary Hazards: Lifting; slips, trips and falls; vehicular and foot traffic; insect/animal bites and stings; poisonous plants; inclement weather.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, or coveralls, safety, glasses and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment.

VI.

Chemicals of Concern	**Hazard Monitoring**	**Action Level(s)**	**Response Measures**
None anticipated	None	None	None

Primary Route(s) of Exposure/Hazard: NA

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio/Cellular Phone	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type – Work)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☒ No
Steel toe work shoes/boots	☒ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐ Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass. Use insect repellants containing at least 10% DEET and tape up in such areas. Follow manufacturer's recommendations for proper application and reapplication. Hard hat when overhead hazards exist. Safety glasses when near eye hazards. Hearing protection when in high noise areas.

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Review PPE needs based on activities being performed and the associated hazards. Use safe lifting procedures and obtain assistance when handling heavy or awkward objects. Suspend site activities in the event of inclement weather. Observe site workers for signs and symptoms of heat/cold stress. Use sun block (SPF > 15) to prevent sunburn if necessary.

Permit Issued by:_____ Permit Accepted by:_____

SAFE WORK PERMIT
MULTIMEDIA SAMPLING
CAMP LEJEUNE
CTO 0163

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): Multimedia sampling including soil and groundwater sampling and subsurface soil sampling via DPT.

II. Primary Hazards: Contact with site contaminants; transfer of contamination; heavy lifting; slip, trip and fall; cuts and lacerations; vehicular and foot traffic; ambient temperature extremes; insect/animal bites and stings, poisonous plants, inclement weather, heavy equipment hazards; elevated noise; energized systems/utilities.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, or coveralls, safety, glasses and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment.

VI. Chemicals of Concern	**Hazard Monitoring /Action Level(s)**	**Response Measures**
metals	visible dust	Use area wetting techs. and retreat upwind. If dust is sustained contact SSO.

Primary Route(s) of Exposure/Hazard: inhalation, dermal, ingestion

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness/lifeline	☒ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio/Cellular Phone	☐ Yes	☒ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – Work)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☒ No
Steel toe work shoes/boots	☒Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High visibility vest	☐Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety footwear, and nitrile gloves Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass. Use insect repellants containing at least 10% DEET and tape up in such areas. Follow manufacturer's recommendations for proper application and reapplication.

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Review PPE needs based on activities being performed and the associated hazards. Use safe lifting procedures and obtain assistance when handling heavy or awkward objects. Suspend site activities in the event of inclement weather. Observe site workers for signs and symptoms of heat/cold stress. Use sun block (SPF > 15) to prevent sunburn if necessary. Complete Heavy Eqiupment Safety Chekclist.

Permit Issued by:_____ Permit Accepted by:_____

SAFE WORK PERMIT
VEGETATION CLEARING/SITE MAINTENANCE
CAMP LEJEUNE
CTO 0163

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): Vegetation and brush clearing and site maintenance using chainsaws, motorized brush cutters, etc.

II. Primary Hazards: Chemical contamination, transfer of contamination; heavy equipment hazards; elevated noise; energized systems/utilities; heavy lifting; slip, trip and fall; cuts and lacerations; vehicular and foot traffic; ambient temperature extremes; flying projectiles; insect/animal bites and stings, poisonous plants, inclement weather

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, or coveralls, safety, glasses and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment.

VI.

Chemicals of Concern	Hazard Monitoring /Action Level(s)	Response Measures
metals	visible dust	Use area wetting techs. and retreat upwind. If dust is sustained contact SSO.

Primary Route(s) of Exposure/Hazard: inhalation, dermal, ingestion

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness/lifeline	☒ Yes	☒ No
Chemical/splash goggles	☐ Yes	☐ No	Radio/Cellular Phone	☐ Yes	☒ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – Work)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☒ No
Steel toe work shoes/boots	☒Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High visibility vest	☐Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety footwear, and nitrile gloves Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass. Use insect repellants containing at least 10% DEET and tape up in such areas. Follow manufacturer's recommendations for proper application and reapplication. ....

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Review PPE needs based on activities being performed and the associated hazards. Use safe lifting procedures and obtain assistance when handling heavy or awkward objects. Suspend site activities in the event of inclement weather. Observe site workers for signs and symptoms of heat/cold stress. Use sun block (SPF > 15) to prevent sunburn if necessary. Complete Heavy Eqiupment Safety Chekclist.

Permit Issued by:_____ Permit Accepted by:_____

SAFE WORK PERMIT

MONITORING WELL INSTALLATION
CAMP LEJEUNE
CTO 0163

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): Monitoring well installation using DPT.

II. Primary Hazards: Chemical contamination, transfer of contamination; heavy equipment hazards; elevated noise; energized systems/utilities; heavy lifting; slip, trip and fall; cuts and lacerations; vehicular and foot traffic; ambient temperature extremes; flying projectiles; insect/animal bites and stings, poisonous plants, inclement weather

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, or coveralls, safety, glasses and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment.

VI.

Chemicals of Concern	Hazard Monitoring /Action Level(s)	Response Measures
metals	visible dust	Use area wetting techs. and retreat upwind. If dust is sustained contact SSO.

Primary Route(s) of Exposure/Hazard: inhalation, dermal, ingestion

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness/lifeline	☒ Yes	☒ No
Chemical/splash goggles	☐ Yes	☐ No	Radio/Cellular Phone	☐ Yes	☒ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type – Work)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☒ No
Steel toe work shoes/boots	☒Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
High visibility vest	☐Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety footwear, and nitrile gloves Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass. Use insect repellants containing at least 10% DEET and tape up in such areas. Follow manufacturer's recommendations for proper application and reapplication. ....

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Review PPE needs based on activities being performed and the associated hazards. Use safe lifting procedures and obtain assistance when handling heavy or awkward objects. Suspend site activities in the event of inclement weather. Observe site workers for signs and symptoms of heat/cold stress. Use sun block (SPF > 15) to prevent sunburn if necessary. Complete Heavy Eqiupment Safety Chekclist.

Permit Issued by:_____ Permit Accepted by:_____

SAFE WORK PERMIT
DECONTAMINATION ACTIVITIES
CAMP LEJEUNE
CTO 0163

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): Decontamination of sampling and heavy equipment .

II. Primary Hazards: Chemical exposure, transfer of contamination, inclement weather, noise.

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____TtNUS

V. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety glasses, safety footwear, and nitrile gloves. Impermeable aprons are preferred protection against soiling work clothes when lifting auger flights because of the need to carry close to the body. If it (impermeable apron) does not offer adequate protection, PVC rain suits or PE or PVC coated Tyvek should be employed. Chemical resistant boot covers if excessive liquids are generated or to protected footwear.

VI. Chemicals of Concern	**Hazard Monitoring**	**Action Level(s)**	**Response Measures**
Decontamination Fluids	refer to MSDS	refer to MSDS	Re-wash and re-scan

Primary Route(s) of Exposure/Hazard: Inhalation and direct contact

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes	☒ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☒ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio/Cellular Phone	☐ Yes	☒ No
Splash Shield	☒ Yes	☐ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type – Nitrile)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No
Steel toe Work shoes or boots	☒Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☐ No
Visibility vest	☐Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☐Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐Yes	☐ No	Other	☐ Yes	☐ No

Modifications/Exceptions: Chemical resistant boot covers if excessive liquids are generated or to protect footwear.

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated (Splash and containment barriers)	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: Suspend site activities in the event of inclement weather. Employ proper lifting techniques. When/where possible use heavy equipment to move and place containers.

Permit Issued by:_____ Permit Accepted by:_____

SAFE WORK PERMIT
IDW MANAGEMENT
CAMP LEJEUNE
CTO 0163

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. **Work limited to the following (description, area, equipment used):** IDW management activities includes containerization, staging, monitoring for leaks of IDW accumulated wastes. Wastes types include purge and decontamination wash waters.

II. **Primary Hazards:** Lifting, pinches and compressions; flying projectiles; slips, trips, and falls and chemical contamination.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____TtNUS
Equipment Inspection required ☐ Yes ☒ No Initials of Inspector _____TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

V. **Protective equipment required**
Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Yes ☐ See Reverse
No ☒

Modifications/Exceptions: None anticipated

VI. **Chemicals of Concern**: None anticipated
Hazard Monitoring /Action Level(s): none
Response Measures: none

Primary Route of Exposure/Hazard: NA

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. **Additional Safety Equipment/Procedures**

Hard-hat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☒ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio/Cellular Phone	☐ Yes	☐ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type – Leather/Cotton)	☒ Yes	☐ No
Impermeable apron	☐ Yes	☒ No	Work/rest regimen	☐ Yes	☒ No
Steel toe work shoes/boots	☒ Yes	☐ No	Chemical Resistant Boot Covers	☐ Yes	☒ No
High visibility vest	☐ Yes	☐ No	Tape up/use insect repellent	☐ Yes	☐ No
First Aid Kit	☒ Yes	☐ No	Fire Extinguisher	☐ Yes	☐ No
Safety Shower/Eyewash	☐ Yes	☒ No	Other	☐ Yes	☐ No

Modifications/Exceptions: If you are using pneumatic/electric power to open drums – Safety glasses are required; If power equipment is employed to move drums or you are working near operating equipment hard hats will be employed. Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass. Use insect repellants containing at least 10% DEET if necessary. Follow manufacturer's recommendations for proper application and reapplication. If working in areas where snakes are a threat, wear snake chaps to protect against bites. High visibility vest if near active traffic areas.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	☐	☐	☐
Physical Hazards Identified and Isolated	☐	☐	☐
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).	☐	☐	☐

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Suspend site activities in the event of inclement weather. Employ proper lifting techniques. When/where possible use heavy equipment to move and place containers. When placing drums – Place the label and retention ring nut on the outside where it is readily visible. Place 4-drums to a pallet. Maintain a minimum distance of 4-feet between pallet rows. An IDW inventory shall be generated to provide the number of drums, contents, and volumes. This inventory should be provided to the facility contact. Inspect equipment prior to use.

Permit Issued by:_____ Permit Accepted by:_____

ATTACHMENT IV

EQUIPMENT INSPECTION CHECKLIST

FOR DPT/DRILL RIGS

Equipment Inspection Checklist for Drill/DPT Rigs

Company:_____ **Unit/Serial No#:**_____

Inspection Date: _____/_____/_____ **Time:**_____:_____ **Equipment Type:**_____
(e.g, Drill Rigs Hollow Stem, Mud Rotary, Direct Push, HDD, MIP)

Project Name:_____ **Project No#:**_____

Yes	No	NA	Requirement	Comments
			Emergency Stop Devices	
☐	☐	☐	• Emergency Stop Devices (At points of operation)	
☐	☐	☐	• Have all emergency shut offs identified been communicated to the field crew?	
☐	☐	☐	• Has a person been designated as the Emergency Stop Device Operator?	
			Highway Use	
☐	☐	☐	• Cab, mirrors, safety glass?	
☐	☐	☐	• Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	
☐	☐	☐	• Seat Belts?	
☐	☐	☐	• Is the equipment equipped with audible back-up alarms and back-up lights?	
☐	☐	☐	• Horn and gauges	
☐	☐	☐	• Brake condition (dynamic, park, etc.)	
☐	☐	☐	• Tires (Tread) or tracks	
☐	☐	☐	• Windshield wipers	
☐	☐	☐	• Exhaust system	
☐	☐	☐	• Steering (standard and emergency)	
☐	☐	☐	• Wheel Chocks?	
☐	☐	☐	• Are tools and material secured to prevent movement during transport? Especially those within the cab?	
☐	☐	☐	• Are there flammables or solvents or other prohibited substances stored within the cab?	
☐	☐	☐	• Are tools or debris in the cab that may adversely influence operation of the vehicle (in and around brakes, clutch, gas pedals)	

Yes	No	NA	Requirement	Comments
☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐	Fluid Levels: • Engine oil • Transmission fluid • Brake fluid • Cooling system fluid • Hoses and belts • Hydraulic oil	
☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	High Pressure Hydraulic Lines • Obvious damage • Operator protected from accidental release • Coupling devices, connectors, retention cables/pins are in good condition and in place	
☐ ☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐ ☐	Mast Condition • Structural components/tubing • Connection points • Pins • Welds • Outriggers • Operational • Plumb (when raised)	
☐ ☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐ ☐	☐ ☐ ☐ ☐ ☐ ☐ ☐	Hooks • Are the hooks equipped with Safety Latches? • Does it appear that the hook is showing signs of wear in excess of 10% original dimension? • Is there a bend or twist exceeding 10% from the plane of an unbent hook? • Increase in throat opening exceeding 15% from new condition • Excessive nicks and/or gouges • Clips • Number of U-Type (Crosby) Clips (cable size 5/16 – 5/8 = 3 clips minimum) (cable size 3/4 – 1 inch = 4 clips minimum) (cable size 1 1/8 – 1 3/8 inch = 5 clips minimum)	

Yes	No	NA	Requirement	Comments
			Power cable and/or hoist cable	
☐	☐	☐	• Reduction in Rope diameter π (5/16 wire rope>1/64 reduction nominal size -replace) (3/8 to 1/2 wire rope>1/32 reduction nominal size-replace) (9/16 to 3/4 wire rope>3/64 reduction nominal size-replace)	
☐	☐	☐	• Number of broken wires (6 randomly broken wires in one rope lay) (3 broken wires in one strand)	
☐	☐	☐	• Number of wire rope wraps left on the Running Drum at nominal use (≥3 required)	
☐	☐	☐	- Lead (primary) sheave is centered on the running drum	
☐	☐	☐	• Lubrication of wire rope (adequate?)	
☐	☐	☐	• Kinks, bends – Flattened to > 50% diameter	
			Hemp/Fiber rope (Cathead/Split Spoon Hammer)	
☐	☐	☐	• Minimum ¾; maximum 1 inch rope diameter (Inspect for physical damage)	
☐	☐	☐	• Rope to hammer is securely fastened	
			Safety Guards –	
☐	☐	☐	• Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?	
☐	☐	☐	• Hot pipes and surfaces exposed to accidental contact?	
☐	☐	☐	• High pressure lines	
☐	☐	☐	• Nip/pinch points	
			Operator Qualifications	
☐	☐	☐	• Does the operator have proper licensing where applicable, (e.g., CDL)?	
☐	☐	☐	• Does the operator, understand the equipment's operating instructions?	
☐	☐	☐	• Is the operator experienced with this equipment?	
☐	☐	☐	• Is the operator 21 years of age or more?	

Yes	No	NA	Requirement	Comments
			PPE Required for Drill Rig Exclusion Zone	
☐	☐	☐	• Hardhat	
☐	☐	☐	• Safety glasses	
☐	☐	☐	• Work gloves	
☐	☐	☐	• Chemical resistant gloves_____	
☐	☐	☐	• Steel toed Work Boots	
☐	☐	☐	• Chemical resistant Boot Covers	
☐	☐	☐	• Apron	
☐	☐	☐	• Coveralls Tyvek, Saranex, cotton)_____	
			Other Hazards	
☐	☐	☐	• Excessive Noise Levels? _____dBA	
☐	☐	☐	• Chemical hazards (Drilling supplies - Sand, bentonite, grout, fuel, etc.)	
☐	☐	☐	- MSDSs available?	
☐	☐	☐	• Will On-site fueling occur	
☐	☐	☐	- Safety cans available?	
☐	☐	☐	- Fire extinguisher (Type/Rating -_____ _)	

Approved for Use ☐ Yes ☐ No ☐ See Comments

_____ _____

Site Health and Safety Officer Operator

ATTACHMENT V

OSHA POSTER

Job Safety and Health

It's the law!

OSHA

Occupational Safety and Health Administration
U.S. Department of Labor

EMPLOYEES:

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthful conditions in your workplace. You or your representative may participate in that inspection.
- You can file a complaint with OSHA within 30 days of retaliation or discrimination by your employer for making safety and health complaints or for exercising your rights under the *OSH Act*.
- You have the right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violations.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records and records of your exposures to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.
- You must comply with all occupational safety and health standards issued under the *OSH Act* that apply to your own actions and conduct on the job.

EMPLOYERS:

- You must furnish your employees a place of employment free from recognized hazards.
- You must comply with the occupational safety and health standards issued under the *OSH Act*.

This free poster available from OSHA –
The Best Resource for Safety and Health

Free assistance in identifying and correcting hazards or complying with standards is available to employers, without citation or penalty, through OSHA-supported consultation programs in each state.

1-800-321-OSHA
www.osha.gov

OSHA 3165-12-06R

APPENDIX D

FIELD STANDARD OPERATING PROCEDURES

APPENDIX D

STANDARD OPERATING PROCEDURES TABLE OF CONTENTS

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SOP-02 Sample Identification Nomenclature
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SOP-06 Borehole Advancement, Soil Coring, and Temporary Well Placement Using Direct-Push Technology
SOP-07 Surface Water Sampling
SOP-08 Sediment Sampling
SOP-09 Groundwater Sampling from a Temporary Well
SOP-10 Management of Investigation-Derived Waste
SOP-11 Use of Global Positioning System
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SOP-13 Calibration and Care of Water Quality Meter
SOP-14 Use of Field Portable X-Ray Fluorescence Analysis of Soil and Sediment

STANDARD OPERATING PROCEDURE
SOP-01

SAMPLE LABELING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used for labeling sample containers. Sample labels are used to document the sample ID, date, time, analysis to be performed, preservative, matrix, sampler, and the analytical laboratory. A sample label will be attached to each sample container.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Disposable medical-grade gloves (e.g. latex, nitrile)
Sample log sheets
Required sample containers: All sample containers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.
Sample labels
Chain-of-custody records
Sealable polyethylene bags
Heavy-duty cooler
Ice

3.0 PROCEDURES

3.1 The following information will be printed on each sample label prior to shipping to the fixed-base laboratory for analysis:

- Project number (112G01716)
- Sample location ID
- Contract Task Order number (CTO 163)
- Sample ID
- Matrix

- Preservative
- Analysis to be performed
- Laboratory name

3.2 Select the container(s) that are appropriate for a given sample. Complete a sample label with the sample-specific information and affix to the sample container(s).

3.3 Fill the appropriate containers with sample material. Securely close the container lids without overtightening.

3.4 Place the sample container in a sealable polyethylene bag and place in a cooler containing ice.

Example of a sample label is attached at the end of this SOP.

4.0 ATTACHMENTS

1. Sample Label

ATTACHMENT 1
SAMPLE LABEL

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** **Location:** **CTO:**	
Sample No:		**Matrix:**
Date:	**Time:**	**Preserve:**
Analysis:		
Sampled by:	**Laboratory**	

STANDARD OPERATING PROCEDURE
SOP-02

SAMPLE IDENTIFICATION NOMENCLATURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent sample nomenclature system that will facilitate subsequent data management at MCB Camp Lejeune. The sample nomenclature system has been devised such that the following objectives can be attained.

- Sorting of data by site, location, or matrix
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints
- Ease of sample identification

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Sample container labels

3.0 SAMPLE IDENTIFICATION NOMENCLATURE

3.1 <u>Samples</u>

All samples will be properly labeled with a sample label affixed to the sample container. Each sample will be assigned a unique sample tracking number.

3.1.1 Sample Numbering Scheme

The sample tracking number will consist of a five- or six-segment alpha-numeric code that identifies the sample's associated site, sample type, location, and for aqueous samples, where applicable, whether a sample is filtered. For soil samples, the final four tracking numbers will identify the depth in units of feet below ground surface (bgs) at which the sample was collected (rounded up to nearest foot). For

sediment samples, the final four tracking numbers will identify the depth in units of inches bgs at which the sample was collected.

The alphanumeric coding to be used is explained in the following diagram and subsequent definitions:

AAAANN	**AA**	**NNN**	**A (Soil and Sediment only)**	**NNNN (Soil and Sediment only)**	**N (Aqueous only)**
Site Identifier	Matrix	Sample Location Number	Discrete (D) or Composite (C)	Sequential depth interval from freshly exposed surface	Indicates whether sample has been filtered (F)

Character Type:

A = Alpha

N = Numeric

Site Identifier (AAAANN):

This investigation includes MMRP Site D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451) identified as (ASR2.64) under the Military Munitions Response Program. Therefore, the prefix “MMRP64” will be used.

MMRP64 = D-6 Small Arms Range

Matrix Code (AA):

SS = Surface Soil Sample

SB = Subsurface Soil Sample

SD = Sediment Sample

SW = Surface Water Sample

TW = Groundwater from Temporary Well

Location Number (NNN):

Sequential number beginning with “001” for each matrix.

Sample Type (A):

This code section will identify if the sample is Discrete (D) or Composite (C).

Depth Interval (NNNN):

This code section will be used for soil and sediment samples only.

The depth code is used to note the depth bgs at which a soil or sediment sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet (soil) or inches (sediment) bgs of the sample. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet, boring log, logbook, etc.

Filtered (N):

This code section will be used for aqueous samples only.

For aqueous samples filtered in the field, a "F" will follow the sample location number and denote whether the sample was filtered in the field prior to shipping to the FBL for analysis.

3.1.2 Examples of Confirmation Sample Nomenclature

A surface soil sample collected from the D-6 Small Arms Range from sample location 003, to a depth of 6 inches bgs would be labeled as "MMRP64-SS003-0001". A sediment sample collected from the D-6 Small Arms Range from sampling location 010, to a depth of 6 inches bgs would be labeled as "MMRP64-SD010-0006". A surface water sample collected from the D-6 Small Arms Range from sample location 005, and filtered in the field would be labeled as MMRP64-SW005-F.

3.2 Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature

Field QA/QC samples as described in the Site Specific Work Plan will be designated using a different coding system than the one used for regular field samples, with the exception of MS/MSDs.

3.2.1 QC Sample Numbering

The QC code will consist of a three- to four-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN
QC Type	Date	Sequence Number (per day)

Character Type:

A = Alpha

N = Numeric

QC Types:

FD = Field Duplicate

RB = Rinsate Blank

SB = Source Blank

The sampling time recorded on the Chain-of-Custody Form, labels, and tags for field duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

3.2.2 Examples of Field QA/QC Sample Nomenclature

The first duplicate of the day at site the D-6 Small Arms Range for a surface soil sample collected on March 24, 2009 would be designated as FD03240901.

The third duplicate of the day taken at the D-6 Small Arms Range for a surface soil sample collected on April 12, 2009 would be designated as FD04120903.

All MS/MSD samples will have the sample sample ID as the associated sample location ID. The MS/MSD samples will be entered on the same line as the associated field sample on the COC. The total number of sample containers submitted will be entered on the COC and “MS/MSD” will be indicated in the comments section.

STANDARD OPERATING PROCEDURE
SOP-03

SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures for sample custody and documentation of field sampling and field analyses activities.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following logbooks, forms, labels, and equipment are required.

Writing utensil (preferably black pen with indelible ink)
Site logbook
Field logbook
Sample label
Chain-of-Custody Form
Custody seals
Equipment calibration log
Soil and Sediment Sample Log Sheet
Surface Water Sample Log Sheet
Groundwater Sample Log Sheet (Temporary well samples)

3.0 PROCEDURES

This section describes custody and documentation procedures. All entries made into the logbooks, custody documents, logs, and log sheets described in this SOP must be made in indelible ink (black is preferred). No erasures are permitted. If an incorrect entry is made, the entry will be crossed out with a single strike mark, initialed, and dated.

3.1 Site Logbook

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, the following activities and events will be recorded (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily on-site activities performed each day
- Sample pickup information
- Health and safety issues
- Weather conditions

The site logbook is initiated at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that on-site activities take place.

The following information must be recorded on the cover of each site logbook:

- Project name
- Project number
- Book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). At the completion of each day's entries, the site logbook must be signed and dated by the Field Operations Leader (FOL).

3.2 Field Logbooks

The field logbook is a separate dedicated notebook used by field personnel to document his or her activities in the field. The use of separate notebook is typically used by field personnel

conducting different, but simultaneously activities than the FOL. This notebook is hardbound and paginated.

3.3 Sample Labels

Adhesive sample container labels must be completed and applied to every sample container. Information on the label includes the project name, location, sample number, date, time, preservative, analysis, matrix, sampler's initials, and the name of the laboratory performing the analysis.

3.4 Chain-of-Custody Form

The Chain-of-Custody Form (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as it is transferred from person to person. Each COC is uniquely numbered. This form must accompany any samples collected for laboratory chemical analysis. A copy of a blank COC form is attached at the end of this SOP.

The FOL must include the name of the laboratory in the upper right hand corner section to ensure that the samples are forwarded to the correct location. If more than one COC is necessary for any cooler, the FOL will indicate "Page __ of __" on each COC. The original (top) signed copy of the COC will be placed inside a sealable polyethylene bag and taped inside the lid of the shipping cooler. Once the samples are received at the laboratory, the sample custodian checks the contents of the cooler(s) against the enclosed COC(s). Any problems are noted on the enclosed COC Form (bottle breakage, discrepancies between the sample labels, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the Tetra Tech Project Chemist. The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

3.5 Custody Seal

The custody seal is an adhesive-backed label, and it is part of the COC process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The custody seals are signed and dated by a sampler and affixed across the opening edges of each cooler (two seals per cooler) containing environmental samples. The laboratory sample custodian will examine the custody seal for evidence of tampering and will notify the Tetra Tech Project Chemist if evidence of tampering is observed.

3.6 Equipment Calibration Log

The Equipment Calibration Log is used to document calibration of measuring equipment used in the field. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device requiring calibration. Entries must be made for each day the equipment is used.

3.7 Sample Log Sheets

The Soil and Sediment Sample Log Sheets are used to document the sampling of soils and sediments (see SOPs-05, 06, and -08). The surface water sample log sheets are used to document the sampling of surface waters (see SOP-07). The groundwater sample log sheets are used to document the sampling of the temporary groundwater wells (see SOP-09).

4.0 ATTACHMENTS

1. Chain-of-Custody Record
2. Equipment Calibration Log
3. Soil and Sediment Sample Log Sheet
4. Surface water Sample Log Sheet
5. Groundwater Sample Log Sheet

ATTACHMENT 1
CHAIN-OF-CUSTODY RECORD

CHAIN OF CUSTODY | NUMBER | PAGE ____ OF _____

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER	CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR ____	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS	CONTAINER TYPE PLASTIC (P) or GLASS (G)								COMMENTS
						PRESERVATIVE USED								
						TYPE OF ANALYSIS								

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

ATTACHMENT 2
EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____

SITE NAME: _____

PROJECT No.: _____

INSTRUMENT NAME/MODEL: _____

MANUFACTURER: _____

SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT 3

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT 4

SURFACE WATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc. **SURFACE WATER SAMPLE LOG SHEET**

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Date:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	mV
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-04

DECONTAMINATION OF FIELD SAMPLING EQUIPMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures to be followed when decontaminating non-dedicated field sampling equipment during the field investigation.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Writing utensil (preferably black pen with indelible ink)
Non-latex rubber or plastic gloves
Cotton gloves
Field logbook
Potable water
Deionized water
Isoproponal (optional)
LiquiNox detergent
Brushes, spray bottles, paper towels, etc.
Container to collect and transport decontamination fluids

3.0 DECONTAMINATION PROCEDURES

3.1 Don non-latex and/or cotton gloves and decontaminate sampling equipment (in accordance with the following steps) prior to field sampling and between samples.

3.2 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.3 Wash the equipment with a solution of LiquiNox detergent. Prepare the LiquiNox wash solution in accordance with the instructions on the LiquiNox container. Collect the LiquiNox wash solution into a container. Use brushes or sprays as appropriate for the equipment. If oily residue has

accumulated on the sampling equipment, remove the residue with an isopropanol wash and repeat the Liquinox wash.

3.4 Rinse the equipment with potable water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the potable water rinsate into a container.

3.5 Rinse the equipment with deionized water. Rinsing may be conducted by spraying with water from a spray bottle or by dipping. Collect the deionized water rinsate into a container.

3.6 Remove excess water by air drying, shaking, or by wiping with paper towels as necessary.

3.7 Document decontamination by recording it in the field logbook.

3.8 Containerized decontamination solutions will be managed in accordance with the procedures described in SOP-10 and this Site Specific Work Plan.

STANDARD OPERATING PROCEDURE

SOP-05

SOIL CORING AND SAMPLING USING HAND AUGER TECHNIQUES

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for collecting surface soil cores from unconsolidated overburden materials using hand augering techniques.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Disposable medical-grade gloves (e.g., latex, nitrile)
Writing utensil (preferably black pen with indelible ink)
Indelible marker
Stainless Steel Auger Buckets
Stainless Steel Extension Rods
Cross Handle
Plastic liner tube with egg shell liner
Required decontamination materials
Bentonite pellets
Sealable polyethylene bags
Sample labels
Shipping containers (containing ice)
Disposable plastic trowels or stainless steel trowels
Stainless steel mixing bowls
Sample containers: Sample containers are certified clean by the laboratory supplying the containers.
Soil Sample Log Forms
Daily Activity Logs
Chain-of-Custody Form
Soil Boring Log

3.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A HAND AUGER

Hand Augers may be employed to collect the soil cores. A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e. cylinders 6-1/2" long and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4' and 5' lengths), a cross handle.

3.1 The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil, both from the surface, or to depths in excess of 12 feet. However, the presence of rock layers and the collapse of the borehole normally contribute to its limiting factors.

Attach a properly decontaminated bucket bit into a clean extension rod and further attach the cross handle to the extension rod. If working in sandy or loose soils, the sampler may utilize a disposable plastic liner tube, fitted with an eggshell catcher to prevent sample loss.

3.2 Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, letter, etc.).

3.3. Turn the hand auger sampler into the ground to the desired sampling depth. Should the auger bucket become filled with soil prior to reaching the desired depth, the auger will be slowly and carefully removed from the borehole and the soil deposited into a sealable polyethylene bag using a decontaminated stainless steel trowel or disposable trowel. The auger will then be returned to the borehole and the above process continued until reaching the desired sampling depth. For this particular field event, 0- to 6-inches below ground surface (bgs) will be the soil interval for surface soil. Subsurface soil samples will be collected at depths greater than 6 inches bgs.

3.4 Note in the field notebook or on a standardized data sheet any changes in the color, texture or odor of the soil.

3.5 Thoroughly homogenize the sample material and write sample ID, date, and time on the bag with an indelible marker.

3.6 For discrete samples, the soil from each individual sample bag will undergo processing for field XRF analysis.

3.7 For composite samples, take an equal amount of soil from each of the aliquot sample bags and place into a larger sealable polyethylene bag and thoroughly homogenize. The soil within this

baggie, comprised of soil from the individual aliquots, will undergo processing for field XRF analysis.

3.8 Complete required information on the Soil Sample Log Sheet (copy attached at the end of this SOP). Update the Chain-of-Custody (COC) Form.

3.9 Excess soil core materials will be returned to the hole and tamped. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole, and hydrated with potable water.

3.10 Decontaminate all soil sampling equipment in accordance with SOP-04 before collecting the next sample.

3.11 Soil samples will be transported to the field office where a portion of the sample will undergo XRF analysis for lead (See SOP-14).

3.12 For soil samples selected for fixed-base laboratory analysis, a portion of the sample will be used to fill the required sample containers as supplied by the laboratory. The sample labels will be completed and affixed to the sample container. The samples will then be packaged and shipped to the fixed-base laboratory in accordance with SOP-12.

4.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet
2. Soil Boring Log Sheet

ATTACHMENT 1

SOIL AND SEDIMENT SAMPLE LOG SHEET

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT 2

BORING LOG

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING No.: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): _____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

STANDARD OPERATING PROCEDURE
SOP-06

BOREHOLE ADVANCEMENT, SOIL CORING, AND TEMPORARY WELL PLACEMENT USING DIRECT-PUSH TECHNOLOGY

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the general guidelines for the collection of subsurface soil cores from unconsolidated overburden materials using direct-push technology (DPT). This SOP also includes the guidelines for installation of temporary wells intended for groundwater sampling. For this investigation, a Geoprobe® rig with a Macrocore Sampler is the intended type of DPT to be used.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Cut-resistant non-latex impermeable gloves
Cotton gloves
Disposable medical-grade gloves (e.g., latex, nitrile)
Writing utensil (preferably black pen with indelible ink)
Indelible marker
Pre-cleaned sampling containers (supplied by the laboratory)
Boring log sheets: A copy of this form is included in SOP-10
Geoprobe® or equivalent DPT equipment
Geoprobe® Macrocore Sampler or equivalent
Geoprobe® Sampling Kit or equivalent
Clear acetate liners: one new liner for each soil core
Required decontamination materials (see SOP-04)
Bentonite pellets or chips (supplied by the driller)
Decontaminated polyvinyl chloride (PVC) Schedule 40, 1-inch interior diameter (ID) riser, flush threaded, factory slotted screen (supplied by the driller)
Decontaminated 1-inch ID PVC pointed screen base (supplied by the driller)
Decontaminated 1-inch ID PVC cap (supplied by the driller)

Clean ¼-inch ID polyethylene tubing

Peristaltic pump

3.0 BOREHOLE ADVANCEMENT AND SOIL SAMPLING USING A GEOPROBE®

DPT will be employed to collect all subsurface soil cores. DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional rotary drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. Geoprobe® is a manufacturer of a hydraulically powered, percussion/probing machine utilizing DPT to collect subsurface environmental samples. A truck-mounted or track-mounted rig with a Macrocore Sampler will be used for the site investigation at the D-6 Small Arms Range, MCB Camp Lejeune to collect soil cores.

3.1 Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).

3.2 Place a new clear acetate liner in the detachable Macrocore core barrel and attach coring device to the Geoprobe® rig.

3.3 Drive the Macrocore sampler (lined with acetate) into the ground to the desired depth using hydraulic pressure. Subsurface soil samples will be collected at depths greater than 1 foot below ground surface.

3.4 Retract the sampler from the borehole and remove the acetate liner and the soil core from the Macrocore barrel.

3.5 Attach the metal trough from the Geoprobe® Sampling Kit firmly to a suitable surface.

3.6 Place the acetate liner containing the soil core in the trough.

3.7 While wearing cut-resistant gloves, cut the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe® Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. **CAUTION**: Do not attempt to cut the acetate liner while holding it in your hand.

3.8 Place the desired interval of the soil core in a sealable polyethylene bag, thoroughly homogenize the sample material and write sample ID, date, and time on the bag with an indelible marker.

3.9 Complete required information on the Soil Sample Log Sheet (copy attached at the end of this SOP). Update the Chain-of-Custody (COC) Form.

3.10 Repeat steps 3.2 through 3.9 for the next depth intervals, if required.

3.11 Depth to the water table if encountered should be recorded on the Soil Sample Log, and the estimated moisture content of the soil and the presence or absence of water in the boring should be noted.

3.12 If a temporary well is to be installed at this particular boring, proceed to Section 3.17 for temporary well installation guidelines; otherwise, proceed with Section 3.13.

3.13 After completion of the boring, backfill the borehole with any remaining soil. If insufficient soil is available to fill the hole to the ground surface, then bentonite pellets mixed with the soil will be used to backfill the hole, and hydrated as per manufacture recommendation.

3.14 Decontaminate all soil sampling equipment in accordance with SOP-04 prior to collecting the next sample.

3.15 Soil samples will be transported to the field office where a portion of the sample will undergo XRF analysis for lead (See SOP-14).

3.16 For soil samples selected for fixed-base laboratory analysis, a portion of the sample will be used to fill the required sample containers as supplied by the laboratory. The sample labels will be completed and affixed to the sample container. The samples will then be packaged and shipped to the fixed-base laboratory in accordance with SOP-12.

3.17 Temporary well points are to be sampled immediately after installation or within 24 hours of installation. They do not have to be purged since there is no non-representative formation water to be purged.

3.18 Ensure all well materials are decontaminated. Well point installers will wear clean gloves, as specified in the Health and Safety Plan.

3.19 Attach the pointed well screen base to the base of the screen. Thread sections of riser onto the screen and lower the screen and riser into the boring allowing direct contact with formation groundwater.

3.20 Sample the well point using the ¼-inch ID polyethylene tubing and peristaltic pump in accordance with SOP-09.

3.21 If the sampling can not be completed immediately, then a temporary annular seal must be established per Section 3.22. If the formation does not collapse around the temporary well point screen, add filter pack to a depth of 2 feet above the top of the screen section.

3.22 Complete the temporary annular seal by adding granular bentonite or bentonite pellets/chips to ground surface. Hydrate the granular bentonite or bentonite chips/pellets per manufacturers specifications. Attach the PVC cap prior to adding any materials to the borehole annulus. Formation collapse to within 4 feet of ground surface is allowable as long as a single water-bearing unit is penetrated. If multiple water-bearing units are penetrated, then natural collapse to the top of the unit being sampled is allowable and granular bentonite or bentonite chips/pellets will be added from the top of the unit being sampled to ground-surface.

3.23 Hydrate the granular bentonite or bentonite chips/pellets per manufacturers specifications.

3.24 Attach the PVC cap prior to adding any materials to the borehole annulus.

3.25 Return within 24 hours to complete well sampling. If the well is still not producing enough groundwater, consult with the Field Operations Leader.

3.26 When complete, remove the temporary well point and abandon the borehole per Section 3.13.

STANDARD OPERATING PROCEDURE
SOP-07

SURFACE WATER SAMPLING/ SMALL STREAM FLOW ESTIMATION

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for collecting surface water samples and provides technical guidance on the measurement of stream channel cross-section and flow in a small stream. Stream flow measurements will be obtained to evaluate the migration potential of contaminants in a stream channel. This method is applicable for free flowing streams with uniform flow and widths greater than 3 feet and depths greater than about 6 inches. Stream flow rates will be measured at the same time when water level measurements are collected.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT (SURFACE WATER SAMPLING)

Surface Water Sample Log Sheet: A copy of this form is attached at the end of this SOP.

Field logbook

Writing utensil (preferably black pen with indelible ink)

Indelible marker

Multi-parameter water-quality meter: The water-quality meter is used for the measurement of dissolved oxygen, pH, specific conductance, temperature, and oxidation-reduction potential (see SOP-13).

LaMotte Turbidity Meter: Used to measure turbidity in the field.

Disposable sample containers: Disposable sample containers are used to fill sample containers and transport sample(s) to a pump for filtering.

Sample containers: Certified-clean sample containers will be provided by the laboratory that performs the analyses.

0.45-micron filter assembly: These are single-use filter cartridges used to filter samples scheduled for dissolved metals or dissolved thorium isotope analyses. The filters become investigation-derived waste (IDW) after one use.

Peristaltic pump

Silicon tubing

Sealable polyethylene bags

Shipping containers (coolers)

2.1 REQUIRED FIELD FORMS AND EQUIPMENT (SMALL STREAM FLOW ESTIMATION)

Measuring rod or yardstick
Measuring tape
Waders or rubber boots
Colored flagging tape
2x2 inch wooden stakes
Bound Field Log Book
Waterproof pen
Orange or apple
Surface Water Sample Log Sheet
Indelible marker
Stopwatch

3.0 SURFACE WATER SAMPLING PROCEDURES

3.1 Sampling will start at the downstream of the investigation area and proceed to a location upstream of the investigation area.

3.2 While standing downstream or from the bank, gently remove any floating leaves or twigs that may be present in a sample pool area in a manner that will not disturb the bottom sediment.

3.3 While standing downstream or from the bank, place the sample container in the water at the sampling location at a 45-degree angle and lower it to approximately half the sample pool depth. With the mouth of the container facing upstream, fill the container with water, being careful not to disturb the sediment.

3.4 All samples will be collected into certified-clean, pre-preserved bottles (if preservation is required for the analysis to be performed) supplied by the laboratory performing the analyses. Sample containers should <u>not</u> be filled completely; a small amount of air should be left at the top.

3.5 Record the date and time that the sample containers are filled on the Surface Water Sample Log Sheet, the sample labels, and the Chain-of-Custody Form.

3.6 After the sample label is completed and checked, place the sample container into a sealable polyethylene bag and place the plastic storage bag holding the sample container into a cooler containing ice.

3.7 Repeat steps 3.3 through 3.6 until all the sample bottles containing unfiltered samples have been filled.

3.8 Fill two 1-liter unpreserved polyethylene bottles. Use these bottles to transfer the sample for field filtering. Set up a peristaltic pump for filtering of the dissolved metals samples. Using new, clean, disposable silicone tubing and a 0.45-micron filter, place the intake tubing from the pump into the transfer bottle with the filter attached to the discharge end and start the pump. Pre-rinse the filter with approximately 50-mL of sample water prior to filling the sample containers.

3.9 Using the discharge from the filter cartridge, fill one 1-liter polyethylene sample bottle for dissolved metals. Repeat steps 3.8 and 3.9 for these sample containers.

3.10 Obtain measurements of dissolved oxygen, pH, specific conductance, temperature, oxidation-reduction potential, and turbidity using the multi-parameter water-quality meter and LaMotte Turbidity Meter (see SOP-13). Record the readings in the appropriate fields on the Surface Water Sample Log Sheet.

3.11 Decontaminate all equipment and load the equipment and the sample cooler in the sample vehicle for transport.

4.0 SMALL STREAM FLOW ESTIMATION PROCEDURES

4.1 Establish a transect across the stream, along a straight reach where the stream is relatively narrow and velocity across the stream is relatively uniform. Orient the transect perpendicular to the flow.

4.2 Mark both ends of the transect with colored plastic flagging tape. Tie the flagging to a tree branch or other elevated (about eye level) object. Drive wooden stakes into the ground at both ends of transect and tack a short piece of brightly colored flagging to the stakes. Use a black marker to identify the transect number, which will be the same as the surface water sample location.

4.3 Measure the total distance across the stream with a measuring tape and record the stream width (in feet) in the field logbook.

4.4 Measure the depth of water in the stream at three or four points across the stream. Record these measurements and calculate an average depth. Record the average depth (in feet) in the field logbook.

4.5 Measure a distance of 20 feet upstream of the transect. Tie a piece of flagging on a tree branch or other visible location above the stream.

4.6 Go another 20 feet upstream and place the orange or apple in the center of the stream or where the water current is fastest.

4.7 Using a watch with a timer or a stopwatch, measure the length of time it takes the orange (or apple) to travel from the first marker flag to the transect location (distance of 20 feet). Record the time.

4.8 Repeat step 3.7 two more times. Record the readings and calculate an average time.

4.9 Calculate approximate flow rate in the stream channel by multiplying the stream width (from step 3.3) times the average depth (from step 3.4) times the average velocity (from step 3.8). Record the estimated flow rate (in ft^3/s) in the field logbook and on the Surface Water Sample Collection Log Sheet.

5.0 ATTACHMENTS

1. Surface Water Sample Log Sheet

ATTACHMENT 1

SURFACE WATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc. **SURFACE WATER SAMPLE LOG SHEET**

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	ORP
Date:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	mV
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-08

SEDIMENT SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for sediment sampling in streams and other waterways.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for sediment sampling.

Sediment Sample Log Forms: A copy of this form is attached at the end of this SOP.
Writing utensil (preferably black pen with indelible ink)
Indelible marker
Bound field logbook
Disposable plastic trowels
Survey stakes and flagging: Used to mark sampling locations after completion of sampling.
Labeled sample containers: See SOP-02 for sample identification procedures. Sample containers are certified clean by the laboratory supplying the containers.
Sealable polyethylene bags
Shipping containers (containing ice)
Disposable medical-grade gloves (e.g., latex, nitrile)
Chain-of-Custody Form

3.0 SEDIMENT SAMPLE LOCATION SELECTION

In general, sediments composed of fine-grained materials with greater surface area available for adsorption are more desirable for sample selection. The fined-grained materials may act as a sink or reservoir for adsorbing heavy metals and organic contaminants even if surface runoff concentrations are below detection limits. Therefore, it is important to locate the specific sampling points where the sediment has the greatest percentage of fine particles. The sampling personnel will determine specific sampling locations with these goals in mind.

4.0 SEDIMENT SAMPLING PROCEDURES

4.1 The sampler will wear clean, disposable medical-grade gloves. Clear vegetative matter or debris, if present, from the sample location using a disposable sampling trowel or spoon. Use the trowel to dig up and homogenize the sediment in an 18-inch-diameter circular area that is 6 inches deep. Stir the sediment within the circular area; do not move the sediment outside the circle. Also, do not dig or stir sediment that is deeper than 6 inches below the ground surface.

- Use the same trowel to scoop the homogenized sediment into the requisite labeled sample container(s).

4.2 Record the sample time (using military time) on the Sediment Sample Log Form and sample container labels. Record all other information required on the labels as specified by SOP-01.

4.3 Place the labeled sample container into a sealable polyethylene bag and then place the bag holding the sample container into a cooler containing ice.

4.4 Record date, sampling site, site conditions, location map, and other information (e.g., presence and flow rate of water in channel) on the Sediment Collection Log Sheet. Enter the sample information onto the Chain-of-Custody Form in accordance with SOP-03.

4.5 Using an indelible marker, write the sample identification on a survey stake, and drive the stake into the ground at the sample location. Tack a piece of brightly colored flagging to the stake. In addition, tie a piece of flagging to an overhead tree branch or other eye-level object to improve the ability to relocate the sampling site in the future.

5.0 ATTACHMENTS

1. Soil and Sediment Sample Log Sheet

ATTACHMENT 1

SOIL AND SEDIMENT SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-09

TEMPORARY GROUNDWATER WELL SAMPLING

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedure for collecting groundwater samples from a temporary monitoring well. Low-flow sampling techniques will be used for groundwater sampling at the MCB Camp Lejeune – Former Building 451 Indoor Small Arms Firing Range (B-451 Range).

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

The following field forms and equipment are required for low-flow sampling of monitoring wells:

Writing utensil (preferably black ink)
Stainless steel Geoprobe Screen Point Groundwater Sampler (or equivalent)
Groundwater Sample Log Form: A copy of this form is attached at the end of this SOP
Bound field log book
Chain-of-Custody Form
Peristaltic pump:
Power source for peristaltic pump;
Disposable polyethylene tubing: ¼-inch interior diameter
Required sample containers with appropriate preservative: All sample containers for analysis by fixed-base laboratories will be supplied and deemed certified clean by the laboratory.
Surgical gloves
Water-level indicator
0.45-micron filter cartridge: If the metal analysis requires field filtering.
IDW container: to collect water
Plastic storage bags
Shipping containers with ice

3.0 SAMPLING PROCEDURES FOR TEMPORARY MONITORING WELLS

3.1 Record the sample start time (using military time) on the Groundwater Sample Log Sheet.

3.2 Record the depth to water with the electronic water level indicator from the top of the casing on the Groundwater Sample Log Sheet. Measure and record the length of well casing above the ground surface.

3.3 Insert the polyethylene tubing into the temporary well casing at adequate depth as to contact groundwater within the screened portion of the well. Avoid placing the tubing at the very bottom of the well. Preferably, the tubing should be in the middle of the screen. Run the tubing through the peristaltic pump and attach the tubing to the inlet of the flow-through cell. Tubing connected to the outfall of the flow-through cell shall be placed in an IDW container for collecting the water.

3.4 Once the flow through cell has filled and water begins flowing into the IDW container, record the field measurements for pH, oxidation-reduction potential (ORP), specific conductance, temperature, dissolved oxygen, and turbidity. For water samples with a turbidity reading greater than 10 NTUs, a dissolved metals sample should be collected in accordance with 3.12.

3.5 With the pump continuing to run, disconnect the flow-through cell from the pump discharge tube and immediately start filling sample bottles directly from the pump discharge. All sample containers will be supplied by the laboratory, and the laboratory will pre-preserve all sample containers, where appropriate.

3.6 Allow the pump discharge to flow gently down the inside of the container with minimal turbulence when filling sample containers. Avoid immersing the discharge tube into the sample as the sample container is being filled. The sample containers should have air space included when the container lid is secured.

3.7 Cap each container immediately after filling.

3.8 Record the sample time on the Groundwater Sample Log Form and the sample label.

3.9 Place the tagged sample container into a plastic storage bag and then into a cooler containing ice.

3.10 Enter the proper information on the Chain-of-Custody Form for each sample container (see SOP-03).

3.11 Repeat steps 3.6 through 3.10 for each sample container collected.

3.12 Filtered aliquots of groundwater shall be collected last. Without turning off the pump, attach a disposable, inline, 0.45-um filter cartridge at the end of the discharge tube. Fill sample containers marked for dissolved metals so that the laboratory knows that these aliquots are distinct sample fractions and that the results should be reported as dissolved analytes.

3.13 Repeat steps 3.6 through 3.10 for the filtered sample containers.

3.14 After completion of sample collection, remove the dedicated tubing from the well and dispose of it, along with disposable gloves and other trash into a non-translucent black trash bag.

3.15 Proceed to abandon the temporary well as per Section 3.13 in SOP-06.

4.0 ATTACHMENTS

1. Groundwater Sample Log Sheet

ATTACHMENT 1

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Time:	(Visual)	(S.U.)	(mS/cm)	(^{0}C)	(NTU)	(mg/l)	(%)	
Method:								

PURGE DATA:

Date:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

STANDARD OPERATING PROCEDURE
SOP-10

MANAGEMENT OF INVESTIGATION-DERIVED WASTE

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes how investigation-derived waste (IDW) will be collected, segregated, classified, and managed during the field investigation at MCB Camp Lejeune. The following types of IDW will be generated during this investigation:

- Decontamination solutions
- Minimal amount of soil
- Personal protective equipment and clothing (PPE)
- Miscellaneous trash and incidental items

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Health and safety equipment (with PPE)
Decontamination equipment
Field logbook
Writing utensil (preferably black pen with indelible ink)
Plastic sheeting and/or tarps
Black non-translucent trash bags

3.0 PROCEDURES

Management of IDW includes the collection, segregation, temporary storage, classification, final disposal, and documentation of the waste-handling activities if necessary.

3.1 Liquid Wastes

Liquid wastes that will be generated during the site activities include decontamination solutions from sampling equipment. These wastes will be collected and containerized at the field investigation site at MCB Camp Lejeune for proper disposal at the base wastewater treatment plant.

3.2 Solid Wastes

The only solid waste anticipated to be generated during this field investigation will be the minimal amount accumulated from the four subsurface borings (estimated at less than an amount to fill a 5-gallon bucket). The soil will undergo field XRF analysis for heavy metals. It is assumed that all soil IDW will be considered non-hazardous and will be bagged and disposed of at the base landfill prior to demobilization from the site. Offsite disposal will be arranged at an appropriate facility if the soil cannot be disposed of at the base landfill.

3.3 PPE and Incidental Trash

All PPE wastes and incidental trash materials (e.g., wrapping or packing materials from supply cartons, waste paper) will be decontaminated (if contaminated), double bagged, securely tied shut, and placed in a designated waste receptacle at MCB Camp Lejeune.

STANDARD OPERATING PROCEDURE
SOP-11

GLOBAL POSITIONING SYSTEM

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the Field Technicians with basic instructions for operating a handheld Global Positioning System (GPS) unit allowing them to set GPS parameters in the receiver, record GPS positions on the field device, and update existing Geographic Information System (GIS) data. This SOP is specific to GIS quality data collection for Trimble-specific hardware and software.

If possible, the Trimble GeoXM or GeoXH Operators Manual should be downloaded onto the operator's personal computer for reference before or while in the field. The manual can be downloaded at http://trl.trimble.com/docushare/dsweb/Get/Document-311749/TerraSyncReferenceManual.pdf

Unless the operator is proficient in the setup and operation of the GPS unit, the Project Manager (or designee) should have the GPS unit shipped to the project-specific contact listed below in the Pittsburgh, Pennsylvania office at least five working days prior to field mobilization so project-specific shape files, data points, background images, and correct coordinate systems can be uploaded into the unit.

Tetra Tech NUS, Inc.
Attn: Mr. John Wright
661 Anderson Drive, Bldg #7
Pittsburgh, PA 15220

2.0 REQUIRED EQUIPMENT

The following hardware and software should be utilized for locating and establishing GPS points in the field:

2.1 Required GPS Hardware

- Hand-held GPS Unit capable of sub-meter accuracy (i.e. Trimble GeoXM or Trimble GeoXH). This includes the docking cradle, a/c adapter, stylus, and USB cable for data transfer.

Optional Accessories:

  - External antenna
  - Range pole
  - Hardware clamp (for mounting Geo to range pole)
  - GeoBeacon
- Indelible marker
- Non-metallic pin flags for temporary marking of positions

2.2 Required GPS Software

The following software is required to transfer data from the handheld GPS unit to a personal computer:

- Trimble TerraSync version 2.6 or later (pre-loaded onto GPS unit from vendor)

- Microsoft ActiveSync version 4.2 or later. Download to personal computer from:
  http://www.microsoft.com/windowsmobile/en-us/downloads/eulas/eula_activesync45_1033.mspx?ProductID=76

- Trimble Data Transfer Utility (freeware version 2.1 or later). Download to personal computer from:
  http://www.trimble.com/datatransfer.shtml

3.0 START-UP PROCEDURES

Prior to utilizing the GPS in the field, ensure the unit is fully charged. The unit may come charged from the vendor, but an overnight charge is recommended prior to fieldwork.

The Geo-series GPS units require a docking cradle for both charging and data transfer. The Geo-series GPS unit is docked in the cradle by first inserting the far domed end in the top of the cradled, then gently seating the contact end into the latch. The power charger is then connected to the cradle at the back end using the twist-lock connector. Attach a USB cable as needed between the cradle (B end) and the laptop/PC (A end).

It is recommended that the user also be familiar and check various Windows Mobile settings. One critical setting is the Power Options. The backlight should be set as needed to conserve power when not in use.

Start Up:

1) Power on the GPS unit by pushing the small green button located on the lower right front of the unit.

2) Utilizing the stylus that came with the GPS unit, launch **TerraSync** from the Windows Operating System by tapping on the start icon located in the upper left hand corner of the screen and then tap on **TerraSync** from the drop-down list.
3) If the unit does not default to the Setup screen, tap the Main Menu (uppermost left tab, just below the Windows icon) and select Setup.
4) If the unit was previously shipped to the Pittsburgh office for setup, you can skip directly to Section 4.0. However, to confirm or change settings, continue on to Section 3.1.

3.1 Confirm Setup Settings

Use the Setup section to confirm the TerraSync software settings. To open the Setup section, tap the Main Menu and select Setup.

1) Coordinate System
   a. Tap on the Coordinate System.
   b. Verify the project specs are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu. **Note:** It is always best to utilize the Cancel tab rather than the OK tab if no changes are made since configurations are easily changed by mistake.
   c. Tap on the Units.
   d. Verify the user preferences are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
   e. Tap Real-time Settings.
   f. Verify the Real-time Settings are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
   g. The GPS unit is now configured correctly for your specific project.

4.0 Antenna Connection

1) If a connection has been properly made with the internal antenna, a satellite icon along with the number of usable satellites will appear at the top of the screen next to the battery icon. If no connection is made (e.g.: no satellite icon), tap on the GPS tab to connect antenna.
2) At this point the GPS unit is ready to begin collecting data.

5.0 Collecting New Data in the Field

1) From the Main Menu select Data.

2) From the Sub Menu (located below the Data tab) select New which will bring up the New Data File menu.
3) An auto-generated filename appears and should be edited for your specific project. If the integral keyboard does not appear, tap the small keyboard icon at the bottom of the screen.
4) After entering the file name, tap Create to create the new file.
5) Confirm antenna height if screen appears. Antenna height is the height that the GPS unit will be held from the ground surface (Typically 3 to 4 feet).
6) The Choose Feature screen appears.

5.1 Collecting Features

1) If not already open, the Collect Feature screen can be opened by tapping the Main Menu and selecting Data. The Sub Menu should default to Collect.
2) **Do not begin the data logging process until you are at the specific location for which you intend to log the data.**
3) A known reference or two should be shot at the beginning and at the end of each day in which the GPS unit is being used. This allows for greater accuracy during post-processing of the data.
4) Upon arriving at the specific location, tap on Point_generic as the Feature Name.
5) Tap Create to begin data logging.
6) In the Comment Box enter sample ID or location-specific information.
7) Data logging can be confirmed by viewing the writing pencil icon in the upper part of the screen. Also, the logging counter will begin. As a Rule of Thumb, accumulate a minimum of 20 readings on the counter, per point, as indicated by the logging counter before saving the GPS data.
8) Once the counter has reached a minimum number of counts (i.e. 20), tap on OK to save the data point to the GPS unit. Confirm the feature. All data points are automatically saved within the GPS unit.
9) Repeat steps 2 through 8, giving each data point a unique name or number.

   Note: If the small satellite icon or the pencil icon is blinking, this is an indication the GPS unit is not collecting data. A possible problem may be too few satellites. While still in data collection mode, tap on Main Menu in upper left hand corner of the screen and select Status. Skyplot will display as the default showing the number of available satellites. To increase productivity (number of usable satellites) use the stylus to move the pointer on the productivity and precision line to the left. This will decrease precision, but increase productivity. The precision and productivity of the GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly recording data, see Section 5.2.

5.2 Viewing Data or Entering Additional Data Points to the Current File

1) To view the stored data points in the current file, tap on the Main Menu and select Map. Stored data points for that particular file will appear. Use the +/- and <-/-> icons in lower left hand corner of screen to zoom in/out and to manipulate current view.
2) To return to data collection, tap on the Main Menu and select Data. You are now ready to continue to collect additional data points.

5.3 Viewing Data or Entering Data Points from an Existing File

1) To view data points from a previous file, tap on Main Menu and select Data, then select File Manager from the Sub Menu.
4) Highlight the file you want to view and select Map from the Main Menu.
5) To add data points to this file, tap on Main Menu and select Data. Continue to collect additional data points.

6.0 NAVIGATION

This section provides instructions on navigating to saved data points in an existing file within the GPS unit.

1) From the Main Menu select Map.
2) Using the Select tool, pick the point on the map to where you want to navigate.
3) The location you select will have a box placed around the point.
4) From the Options menu, choose the Set Nav Target (aka set navigation target).
5) The location will now have double blue flags indicating this point is you navigation target.
6) From the Main Menu select Navigation.
7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
8) Follow the navigation guide until you reach the point you select.
9) Repeat as needed for any map point by going back to Step 1.

7.0 PULLING IN A BACKGROUND FILE

This section provides instructions on pulling in a pre-loaded background file. These files are helpful in visualizing your current location.

1) From the Main Menu select Map, then tap on Layers, select the background file from drop down list.
2) Select the project-specific background file from the list of available files.
3) Once the selected background file appears, the operator can manipulate the screen utilizing the +/- and <-/-> functions at the bottom of the screen.

4) In operating mode, the operator's location will show up on the background file as a floating "x".

8.0 DATA TRANSFER

This section provides instructions on how to transfer stored data on the handheld GPS unit to a personal computer. Prior to transferring data from the GPS unit to a computer, Microsoft ActiveSync and Trimble Data Transfer Utility software must be downloaded to the computer from the links provided in Section 2.2 (Required GPS Software). If a leased computer is utilized in which the operator can not download files, see the Note at the end of Section 8.0.

1) See Attachment A at the end of this SOP for instructions on how to transfer data from the GPS to a personal computer.

Note: If you are unable to properly transfer data from the GPS unit to a personal computer, the unit should be shipped to the project-specific contact listed in Section 1.0 where the data will be transferred and the GPS unit then shipped back to the vendor.

9.0 SHUTTING DOWN

This section provides instruction for properly shutting down the GPS unit.

1) When shutting down the GPS unit for the day, first click on the "X" in the upper right hand corner.
2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

ATTACHMENT A

How to Transfer Trimble GPS Data between Data Collector and PC
original 11/21/06 (5/1/08 update) – John Wright

Remember – Coordinate System, Datum, and Units are critical!!!

Trimble Data Collection Devices:
Standard rental systems include the Trimble ProXR/XRS backpack and the newer handheld GeoXT or GeoXH units. Some of the older backpack system may come with either a RECON "PDA-style" or a TSCe or TSC1 alpha-numeric style data collector.

The software on all of the above units should be Trimble TerraSync (v 2.53 or higher – current version is 3.20) and to the user should basically look and function similar. The newer units and software versions (which should always be requested when renting) include enhancements for data processing, real-time display functions, and other features.

Data Transfer:
Trimble provides a free transfer utility program to aid in the transfer of GIS and field data. The Data Transfer Utility is a standalone program that will run on a standard office PC or laptop.

To connect a field data collector such as a RECON, GeoXM, GeoXT, GeoXH, or ProXH, you must first have Microsoft ActiveSync installed to allow the PC and the data collector to talk to one another. A standard USB cable is also needed to connect the two devices.

A CD or USB drive is provided with the data collector for use in data transfer. If needed, these programs are also available without charge via the web at:

- **Trimble Data Transfer Utility** (v 1.38) program to download the RECON or GeoXH field data to your PC: http://www.trimble.com/datatransfer.shtml

- **ActiveSync** from Microsoft to connect the data collector to the PC. The latest version (v4.5) can be found at: http://www.microsoft.com/windowsmobile/activesync/default.mspx
  (see page 2 for data transfer instructions)

To Transfer Data Collected in the Field:

- Install the Data Transfer and ActiveSync software installed on your PC
- Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
- ActiveSync should auto-detect the connection and recognize the data collector
- Make sure the data file desired is CLOSED in TerraSync prior to transfer
- Connect via ActiveSync as a guest (not a partnership)
- Run the Trimble Data Transfer Utility program on your PC
- Select "***GIS Datalogger on Windows CE***" or similar selection
- Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
- Select the "***Receive***" data tab (under device)
- Select "***Data***" from file types on the right
- Find the file(s) needed for data transfer. You can sort the data files by clicking on the date/time header
- Select or browse to a C-drive folder you can put this file for emailing

- When the file appears on the list, hit the "***Transfer All***"
- Go to your Outlook or other email, send a message to: John.Wright@tetratech.com (or GIS department)
- Attach the file(s) you downloaded from your C-drive. For each TerraSync data file created you should have a packet of multiple data files. All need to be sent as a group – make sure you attach all files (the number of files may vary – examples include: ssf, obx, obs, gix, giw, gis, gip, gic, dd, and car)

To Transfer GIS Data from PC to the Field Device (must be converted in Pathfinder Office):

- Obtain GIS file(s) desired from GIS Department and have converted to Trimble extension
- Contact John Wright (John.Wright@tetratech.com) if needed for file conversion and upload support
- The GIS file(s) can be quickly converted if requested and sent back to the field user in the needed "Trimble xxx.imp" extension via email – then quickly downloaded from Outlook to your PC for transfer
- Install the Data Transfer and ActiveSync software installed on your PC
- Connect the RECON or GeoXH to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
- ActiveSync should auto-detect the connection and recognize the data collector
- Connect via ActiveSync as a guest (not a partnership)
- Run the Trimble Data Transfer Utility program on your PC
- Select "***GIS Datalogger on Windows CE***" or similar selection
- Hit the green connect icon to the right - the far right area should say "***Connected to ....***" if successful
- Select the "**Send**" data tab (under device)
- Select "**Data**" from file types on the right (you can also send background files)
- Browse to the location of the data on your PC (obtain the file from Pathfinder Office or from the person who converted the data for field use)
- Select the options as appropriate for the name and location of the data file to go on the data collector (usually you can choose main memory or a data storage card)
- When the file(s) appears on the list, hit the "***Transfer All***"
- Run TerraSync on the field device and open the existing data files. Your transferred file should appear (make sure you have selected Main Memory, Default, or Storage Card as appropriate)

STANDARD OPERATING PROCEDURE
SOP-12

SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for sample preservation, packaging, and shipping to be used in handling soil, sediment, and aqueous samples.

2.0 REQUIRED FIELD FORMS AND EQUIPMENT

Shipping labels
Custody seals
Chain-of-custody (COC) form(s)
Sample containers with preservatives: All sample containers for analysis by fixed-base laboratories will be supplied, with preservatives added (if required) and deemed certified clean by the laboratory.
Sample shipping containers (coolers): All sample shipping containers are supplied by the laboratory.
Packaging material: Bubble wrap, sealable polyethylene bags, strapping tape, etc.

3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING

3.1 The laboratory provides sample containers with preservative already included (as required) for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at 4°C. This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice.

3.2 The sampler shall maintain custody of the samples until the samples are relinquished to another custodian or to the common carrier.

3.3 Check that each sample container is properly labeled, the container lid is securely fastened, and the container is sealed in a polyethylene bag.

3.4 If the container is glass, place the sample container into a bubble-out shipping bag and seal the bag using the self-sealing, pressure sensitive tape supplied with the bag.

3.5 Inspect the insulated shipping cooler. Check for any cracks, holes, broken handles, etc. If the cooler has a drain plug, make certain it is sealed shut, both inside and outside of the cooler. If the cooler is questionable for shipping, the cooler must be discarded.

3.6 Line the cooler with large plastic bag, and line the bottom of the cooler with a layer of bubble wrap. Place the sample containers into the shipping cooler in an upright position (containers will be upright, with the exception of any 40-ml vials). Continue filling the cooler with ice until the cooler is nearly full and the movement of the sample containers is limited.

3.7 Wrap the large plastic bag closed and secure with tape.

3.8 Place the original (top) signed copy of the COC form inside a sealable polyethylene bag. Tape the bag to the inside of the lid of the shipping cooler.

3.9 Close the cooler and seal the cooler with approximately four wraps of strapping tape at each end of the cooler. Prior to wrapping the last wrap of strapping tape, apply a signed and dated custody seal to each side of the cooler (one per side). Cover the custody seal with the last wrap of tape. This will provide a tamper evident custody seal system for the sample shipment.

3.10 Affix shipping labels to each of the coolers, ensuring all of the shipping information is filled in properly. Overnight (e.g., FedEx Priority Overnight) courier services will be used for all sample shipments.

3.11 All samples will be shipped to the laboratory no more than 72 hours after collection. Under no circumstances should sample hold times be exceeded.

STANDARD OPERATING PROCEDURE
SOP-13

CALIBRATION AND CARE OF WATER QUALITY METER

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the procedures for the calibration and maintenance of field instruments used to measure water quality and for the proper documentation of calibration and maintenance. The multi-parameter water quality meter will be used to measure pH, temperature, oxidation-reduction potential (ORP), specific conductance (SC), and dissolved oxygen (DO). A LaMotte Model 2020 turbidity meter will be used to measure turbidity in water. The water meter will have a multiprobe sensor that can be used in conjunction with a flow-through cell attached to a pump discharge tube to measure water-quality parameters in a surface water body such as a stream, pond, or drainage ditch.

2.0 FIELD FORMS AND EQUIPMENT LIST

The following logbooks, forms, equipment, and supplies are required:

Site logbook
Writing utensil (preferably black pen with indelible ink)
Equipment calibration log sheet
Multi-parameter Water Quality Meter
Equipment manual
Calibration kit
Deionized water, paper towels, spray bottle, etc.
Disposable medical-grade gloves (e.g., latex, nitrile)

3.0 PROCEDURES

This section describes the general calibration procedure for the multi-parameter water quality meter. The meter will be supplied with an instruction manual. The manual will be on site and will be used as the calibration guidance document for the meter's calibration. This procedure will list requirements for frequency of calibration and checks to be performed on the meter.

The multi-parameter water-quality meter may be used to measure open water bodies (streams, ponds, springs, etc.) with the probe guard installed. The parameters to be measured by the meter for this field effort are as follows:

- DO
- SC
- Temperature
- pH
- ORP

3.1 Documentation

The Equipment Calibration Log is used to document calibration of measuring equipment used in the field. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including the frequency of calibration, type of standards used, and checks performed on calibration during the course of using the equipment. An Equipment Calibration Log must be maintained for each measuring device that requires calibration. Entries must be made for each day the equipment is used. A blank Equipment Calibration Log form is attached at the end of this SOP.

3.2 Calibration

All the parameters listed in Section 3.0 must be calibrated prior to the start of each field effort. After this initial calibration, the meter will be checked each day that it is used. If the check shows any out-of-specification readings, the specific probe will be recalibrated. Meter specifications can be found in the equipment manual. Calibration and calibration checks will be documented in the field logbook and on the Equipment Calibration Log. The name, lot number, and expiration date for all calibration buffers and standards used will be recorded on the Equipment Calibration Log. The meter's model, serial number, and name of rental company will also be recorded on the equipment calibration form.

3.3 Tips for Good Calibration

- The DO calibration is a water-saturated air calibration. Make certain to loosen the calibration cup seal to allow pressure to equilibrate before calibrating.

- Make certain that sensors are completely submersed in solution and readings are stable when calibration values are entered.

- Use a small amount of calibration solution (previously used solution may be used, then discarded for this purpose) to pre-rinse the sonde.

- Fill a bucket with ambient temperature water to rinse the sonde between calibration solutions.

- Make sure to rinse and dry the probe between calibration solutions. This will reduce carry-over contamination and increase the accuracy of the calibration.

4.0 MAINTENANCE

The water quality meter will be rented for the duration of each brief field effort. Therefore, little field maintenance will be required. For any maintenance other than the routine cleaning, calibrating, or battery charging, the instrument should be returned to the vendor and a replacement sent immediately to the job site.

4.1 Meter Storage

For this field effort, the meter storage will be short term, [i.e. over night or between work shifts (2-day break)]. During these breaks, the meter will be charged. One-half inch of tap or distilled water will be placed in the meter calibration cup and the cup threaded onto the sonde. The key for short-term storage of probes is to use a minimal amount of water so the calibration cup will remain at 100 percent humidity. The water level must be low enough so that none of the probes are actually immersed. Proper storage of the sonde between usage will extend its life and will also ensure that the unit is ready for use as quickly as possible for the next application.

Multi-parameter short term storage key points:

- Use enough water to provide humidity but not enough to cover the probe surfaces.
- Make sure the storage vessel is sealed to minimize evaporation.
- Check periodically to make certain that water is still present.

4.2 Probe Cleaning

- Rinse the probe thoroughly with potable water.
- Wash the probe in a mild solution of Liquinox and water and wipe with paper towels and/or cotton swabs.
- Rinse and soak the probe in deionized water.
- If stronger cleaning is required, consult the equipment manual.

Note: Reagents that are used to calibrate and check the water quality meter may be hazardous. Review the health and safety plan, appropriate Appendix of the equipment manual, and Material Safety Data Sheets (MSDSs), all of which are on file in the field trailer.

5.0 ATTACHMENTS

1. Equipment Calibration Log

ATTACHMENT 1
EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____

SITE NAME: _____

PROJECT No.: _____

INSTRUMENT NAME/MODEL: _____

MANUFACTURER: _____

SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

STANDARD OPERATING PROCEDURE
SOP-14

FIELD PORTABLE X-RAY FLUORESCENCE ANALYSIS OF SOIL AND SEDIMENT SAMPLES

1.0 PURPOSE

This procedure is for the semiquantitative analysis of metallic lead particles and chemical compounds of lead in soil using a field portable x-ray fluorescence (FPXRF) spectrometer. This procedure is based on the United States Environmental Protection Agency (USEPA)-approved XRF field screening method for elemental analysis (Method 6200). Use of the Innov-X alpha series XRF is planned for this site investigation.

2.0 SCOPE, APPLICATION, AND LIMITATIONS

2.1 Scope of Procedure

Analysis of any other elements beside lead using FPXRF may require changes to this Standard Operating Procedure (SOP), and are therefore outside the scope of this SOP.

Although it is possible to use FPXRF to measure analytes in situ, this SOP requires removal of a soil sample from its native environment prior to analysis. By removing, drying, and homogenizing the sample prior to analysis, more precise and accurate results are obtained.

2.2 Analyst Training

Use of this method is restricted to personnel both trained and knowledgeable in the operation of the Innov-X alpha series XRF instrument or under the supervision of a trained and knowledgeable individual. Proper training for the safe operation of the instrument should be completed by the analyst prior to analysis. This training may be obtained directly from INNOV-X, an INNOV-X instrument distributor or lessor, or another trained Tetra Tech person.

3.0 ACRONYMS AND ABBREVIATIONS

FPXRF: Field portable x-ray fluorescence.
mg/kg: milligrams per kilogram.
MDL: Method detection limit.
PQL: Practical quantitation limit.
QC: Quality control.
RPD: Relative percent difference.
USGS: United States Geological Survey.
XRF: X-ray fluorescence.

4.0 RESPONSIBILITIES

Analyst/Chemist - Responsible for all aspects of sample preparation and analysis including equipment maintenance. Also responsible for maintaining chain-of-custody of samples after receipt from sampling personnel.

5.0 PROCEDURES

5.1 Safety

5.1.1 Radiation Safety

Radiation safety practices for the INNOV-X instrument can be found in the operator's manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer.

An additional hazard present with x-ray tubes is the danger of electric shock from the high voltage supply. The danger of electric shock is as substantial as the danger from radiation but is often overlooked because of its familiarity.

5.1.2 Protective Equipment

Analysts must wear disposable plastic gloves whenever sample aliquots are being transferred from one vessel to another. Consult the health and safety plan for other protection requirements.

5.2 Apparatus and Materials

Apparatus and materials consist of the following:

INNOV-X Alpha Series FPXRF spectrometer with data processing unit (iPAQ) pocket personnel computer):

INNOV-X Alpha Series XRF instrument manual to match the INNOV-X Alpha Series instrument.

Aluminum drying pans or aluminum foil: Sized suitably to hold as much as 50 grams of sample and fit into the drying oven.

Calibration verification check sample: A National Institute of Standards and Technology (NIST) or other Standard reference material (SRM) that contains lead in a concentration range that is compatible with the project objectives to verify the accuracy of the instrument. SRMs can be obtained from the NIST, the U.S. Geological Survey (USGS), the Canadian National Research Council, and the national bureau of standards in foreign nations. Pertinent NIST SRMs for FPXRF analysis include 2704, Buffalo River Sediment; 2709, San Joaquin Soil; and 2710 and 2711, Montana Soil. These SRMs contain soil or sediment from actual sites that has been analyzed using independent inorganic analytical methods by many different laboratories. Acceptable limits for SRM percent recoveries are usually provided with the SRM. In their absence, a limit of ± 30 percent will be used as a guideline.

Instrument Blank: May be silicon dioxide, a Teflon block, a quartz block, "clean" sand, or lithium carbonate.

Lead calibration check standard: Supplied by the FPXRF manufacturer.

Method blank material for performing method blank checks: May be lead-free silica sand or lithium carbonate that undergoes the same preparation procedure as the samples.

Battery charger.

Polyethylene sample cups: 31 millimeters (mm) to 40 mm in diameter with collar, or equivalent (appropriate for FPXRF instrument).

X-ray window film: Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent; 2.5 to 6.0 micrometers (µm) thick.

Sample containers: glass or plastic to store samples.

Sieves: 60-mesh Stainless steel, Nylon, or equivalent for preparing soil and sediment samples if necessary.

Trowels: for collecting soil samples.

Plastic bags: used for collection and homogenization of soil samples. May also be used as sample presentation device.

Drying oven: standard convection or toaster oven, for soil samples that require drying.

Rolling pin (optional): Wooden rolling pin for crushing samples.

5.3 Sample Collection, Preservation, and Handling

Samples shall be provided to the FPXRF analyst in plastic bags. The analyst is responsible for maintaining chain-of-custody of all samples until all analyses have been successfully completed. No sample preservation is necessary. All samples shall be handled in accordance with sample handling SOPs in effect for the field event.

5.4 Preventive Maintenance

Refer to the instrument manual for specific manufacturer's recommendations.

5.5 Instrument Start-Up

5.5.1 Ensure the pocket PC (iPAQ) is plugged into the FPXRF instrument body and install a fully charged battery into the instrument.

5.5.2 Press the ON/OFF button on the base of the pistol grip of the instrument. If the iPAQ does not automatically power up, press the Power button in the to right corner of the iPAQ.

5.5.3 Tap the Microsoft icon at the upper left corner of the iPAQ.

5.5.4 Chose START.

5.5.5 Tap "Soil Mode" on the menu or choose Mode (bottom of screen) and then choose Soil Mode from the drop down menu.

5.5.6 Allow the instrument to warm up (approximately 3 minutes).

5.5.7 Release the manual trigger lock.

5.5.8 Standardize the instrument in accordance with Section 5.6.

5.6 Standardization/Calibration Check

It is not possible to start an analysis if the instrument has not been standardized. To verify proper calibration of the instrument it is necessary to periodically standardize it using the automated standardization procedure. This must be done anytime the instrument is restarted and every 4 hours of operation, although re-standardization may be done at any other time (e.g., when instrument drift is suspected).

5.6.1 Click the standardization piece (supplied with the instrument) on the front of the instrument, verifying that the solid portion of the standard completely covers the analysis window.

5.6.2 Select "Tap here to Standardize" or select *File* → *Standardize*. The red light on top of the instrument will blink indicating that the instrument is producing x-rays and the shutter is open. The amber light on the rear of the instrument will also be illuminated and a status bar will appear to display the progress of the standardization.

5.6.3 Upon successful standardization the message "Successful Standardization" will appear along with the instrument resolution. In this case tap "ok" to dismiss the completion message. If problems are encountered, either follow the prompts that appear and/or repeat the standardization. Contact the FOL if problems persist. Take note of any error messages that appear as they may be useful if the instrument manufacturer must be contacted. Additional assistance is also available in the manufacturer's instrument manual.

5.7 Quality Control

The quality control (QC) program includes analysis of blanks calibration verification checks, duplicate analyses, and field duplicate samples. For all the above areas, any identified problems and corrective

action must be documented in the instrument run log, analysis narrative report, and instrument maintenance log or standards log (as applicable). Identical operating conditions will be used for each sample.

5.7.1 Laboratory Blanks

Two types of blank samples shall be analyzed for FPXRF analysis: instrument blanks and method blanks.

5.7.1.1 At the beginning of each day, at the end of each day, and after every 20th sample or when potential contamination of the instrument is suspected, analyze an instrument blank to verify that no contamination exists in the spectrometer or on the probe window.

If the lead concentration in the blank exceeds the method detection limit (MDL), see Section 5.9.3) check the probe window and other potentially contaminated instrument components for contamination. If contamination is not causing the elevated blank readings, restandardize the instrument according to manufacturer's instructions.

5.7.1.2 After every 20th sample analyze a method blank. If the method blank lead concentration exceeds the practical quantitation limit (PQL, see Section 5.9.4), identify the cause of the elevated lead concentration and reanalyze all samples since the last acceptable method blank.

5.7.2 Calibration Verification Checks

5.7.2.1 After performing each blank check (Section 5.7.2), analyze a calibration verification check sample to check the accuracy of the instrument and to assess the stability and consistency of the analysis for the analytes of interest.

5.7.2.2 If the measured lead percent recovery (See Section 5.9.1) is less than 60 percent or greater than 135 percent, reanalyze the check sample. If the value continues to fall outside this acceptance range, the instrument should be restandardized according to the manufacture instructions and the batch of samples analyzed before the unacceptable calibration verification check must be reanalyzed.

5.7.3 XRF Duplicate Samples

XRF duplicate samples are two portions of the same sample that have been prepared and homogenized together, and then split and analyzed in the same manner by the XRF analyst.

5.7.3.1 Analyze an XRF duplicate at a frequency of 1 per 20 or once per day, whichever is more frequent.

5.7.3.2 If the computed RPD (See Section 5.9.2) exceeds 50 percent reanalyze both samples. If the RPD again exceeds 50 percent RPD consider whether the high degree of imprecision is caused by sample heterogeneity or other causes. This assessment may be aided by repeating the analysis of a sample that was analyzed previously. If the observed imprecision is attributed to sample heterogeneity, increase the number of readings made per sample to try to limit the imprecision and repeat the analyses. If this does not correct the problem notify the FOL.

5.8 Sample Analysis

Note:

This section provides sample analysis instructions, assuming that appropriate instrument start-up and calibration checks have been completed. The longer the instrument count time, the lower the detection limits and the less uncertainty there is with a recorded result. Count time is user-selectable through the instrument's software. Because the XRF data will be used in a screening capacity to make preliminary decisions concerning the soil concentrations relative to 400 mg/kg, it is not necessary to obtain a high degree of accuracy or precision with the instrument. Therefore, count times should be limited to less than 60 seconds unless an usually high degree of precision is expected. To change the count time, select Options → Setup Testing and enter the same value (in seconds) to minimum and maximum count times.

Note:

Section 5.7 identifies the appropriate frequencies for conducting various QC sample analyses and the associated acceptance limits and corrective actions for potentially unsuitable conditions. The specified QC analysis frequencies are minimum frequencies. More frequent QC sample analyses are permitted, especially when diagnosing quality problems.

5.8.1 Ensure that calibration checks and blanks have been analyzed according to Sections 5.6, 5.7.1, and 5.7.2. Count times shall be at least 30 seconds but generally less than 60 seconds.

5.8.2 Acquire enough soil sample to fill an 8-ounce jar and separate from it all particles greater than the size of a pea.

5.8.3 Homogenize the remaining finer grained portion of the sample by simple mixing until it appears as uniform in texture and composition as practicable. Mixing may be done in a beaker or other suitable lead-free container. If the sample is moist and has high clay content, it may be kneaded in a plastic bag. Mixing shall continue for at least two minutes to ensure that the sample is well mixed. To aid mixing, the sample may be placed into a thick-walled (3 mil or thicker) gallon-sized freezer bag (e.g., ZipLoc®) and rolled flat with a rolling pin to break up large chunks of dirt.

5.8.4 Place approximately 20 to 50 grams (one U.S. nickel weighs about 5 grams) in a suitable container (e.g., aluminum drying pan) for drying.

5.8.5 Dry the homogenized sample from Step 5.8.4 for approximately 20 to 30 minutes in the oven at a temperature not greater than 150°C (a setting of approximately 300°F). If the sample is not visibly dry after this initial drying time, place the sample back into the oven until the sample is dry.

5.8.6 Re-homogenize the dried sample aliquot in a beaker or other suitable lead-free container to obtain a well mixed soil sample. Mixing shall continue for at least one minute.

5.8.7 Place a portion (approximately 1.5 cubic inches) of the dried, homogenized sample aliquot into the instrument manufacturer's recommended sample cup (e.g., a 31.0-mm polyethylene sample cup (or equivalent) or place it in a thin-walled (1.0 mil or thinner) plastic sandwich bag (e.g., ZipLoc®).

5.8.8 If using a disposable plastic sample cup, ensure the cup is at least three-quarters full and cover with mylar (or other) film per the manufacturer's recommendations.

5.8.9 Present the sample to the instrument in Soil Mode.

5.8.10 Perform a single pull of the trigger to start the count. The count time shall be the same as was used for the calibrations, calibration checks, and blank analyses. The message "Test in progress" will appear on the instrument and the red light on top of the instrument and will illuminate.

5.8.11 When the predetermined count period has expired the message "Test complete" will appear on the instrument. A slight delay may also be incurred during which time the message "calculating" may appear to indicate that results are being computed.

5.8.12 Record the displayed results for lead concentration in mg/kg and the associated error on Figure 1.

CAUTION

Inconsistent positioning of samples in front of the probe window is a potential source of error because the x-ray signal decreases by the square of the distance from the radioactive source. This error is minimized by maintaining the same distance between the window and each sample. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample surface should be flat and smooth to provide a good contact surface.

5.8.13 Remix the sample in the plastic bag (or rotate the sample cup approximately one-third of a turn) then acquire another measurement by repeating Steps 5.8.10 and 5.8.11. Record the result and associated error on Figure 1.

5.8.14 Repeat Steps 5.8.10 and 5.8.11. Record the result and associated error on Figure 1 (XRF Field Form).

5.8.15 Based on the degree of precision demonstrated by the three individual measurements, determine whether additional readings should be acquired on the sample. This determination shall be based on professional judgment of the FPXRF analyst and shall consider the degree of precision observed during calibration checks and previous sample analyses. The objective will be to ensure that the average reading reported for each sample is representative of the true sample concentration. If the analyst feels that non-representative readings are being obtained the analyst shall correct the analytical system or notify the FOL prior to continuing with analyses.

5.8.16 Ensure that measured results are reported to the following standards

- Results < 1000 mg/kg (or parts per million) are reported to two significant figures and results > 1000 mg/Kg are reported to three significant figures.
- All values < MDL shall be reported as the MDL and flagged with the letter “U”.
- All values > MDL and < PQL shall be reported as is and flagged with the letter “B”.

5.9 Calculations

5.9.1 Percent Recovery: The equation for determining percent recovery of calibration verification check standards and standard reference materials is:

$$\%R = \frac{\text{Experimental Concentration}}{\text{Certified or Known Concentration}} \text{ X } 100\,\%$$

5.9.2 Relative Percent Difference: The equation for determining relative percent difference for laboratory and field duplicate samples is:

$$RPD = \frac{|\text{Amount in Sample 1} - \text{Amount in Sample 2}|}{0.5\,(\text{Amount in Sample 1} + \text{Amount in Sample 2})} \text{ X } 100\,\%$$

5.9.3 Method Detection Limit (MDL): Because the analyses governed by this SOP are semi-quantitative, the manufacturer-specified detection limit will be reported as the MDL unless the specified detection limit is less than 20 mg/kg. Care will taken to ensure that the appropriate count time is consistent with the reported detection limit. However, no value less than 20 mg/kg will be reported as an MDL.

5.9.4 Practical Quantitation Limit (PQL): Multiply the MDL by 3 to obtain the PQL: PQL = MDL*3

6.0 REFERENCES

Innov-X Systems, Inc. Innov-X Systems X-Ray Fluorescence Spectrometers Instruction Manual. Woburn, MA. June 2002.

Stephen Shefsky, NITON Corporation. Comparing Field Portable X-Ray Fluorescence (XRF) To Laboratory Analysis of Heavy Metals In Soil. Presented at the International Symposium of Field Screening Methods for Hazardous Wastes and Toxic Chemicals. Las Vegas, Nevada. January 29-31, 1997.

USEPA (U.S. Environmental Protection Agency), Method 6200: Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment, Office of Solid Waste, Washington, D.C. January 1998.

USEPA, Region I, Northeast Waste Management Officials' Association (NEWMOA) Technology Review Committee Advisory Opinion. Innovative Technology: X-Ray Fluorescence Field Analysis. September 21, 1999.

FIGURE 1

FIELD PORTABLE XRF SAMPLE ANALYSIS LOG SHEET

Page___ of ___

Project Site Name: ____________________ Run Length/Duration: ____________________
Project No.: ____________________ Measurement Units: ____________________
Analyzed By: ____________________ Reference/Calibration: ____________________

SAMPLING AND FIELD PORTABLE XRF RESULTS DATA:

SAMPLE ID	ANALYSIS DATE	ANALYSIS TIME	ELEMENT ANALYSIS	RESULT RUN 1	RESULT RUN 2	RESULT RUN 3	RESULTS AVERAGE	ERROR RUN 1	ERROR RUN 2	ERROR RUN 3	ERROR AVERAGE

APPENDIX E

LABORATORY STANDARD OPERATING PROCEDURES

APPENDIX E

LABORATORY STANDARD OPERATING PROCEDURES (SOPs)
TABLE OF CONTENTS

SOP NUMBER	REV #*	QAPP	TITLE
			MITKEM LABORATORIES
20.0003	3		Logging Work Orders and Samples into Omega ME
30.0003	12		Sample Receipt, Storage, Tracking, and Disposal
30.0024	8		Sample and Waste Disposal
100.0003	6		Sample Preparation of Aqueous Samples by Acid Digestion for ICP, Method 3005/3010
100.0012	9		Mercury by Methods 7470/7471
110.0026	6		Handling Evidentiary Materials
100.0104	6		Sample Preparation of Soils by Acid Digestion for ICP, Method 3050
100.0111	10		Metals by ICP-AES, Method 6010
110.0034	0		Sample Data Control for Inorganic CLP/ILM
110.0035	1		Sample Data Control for CLP (SOM 01.2)
			COLUMBIA ANALYTICAL SERVICES
HPLC-6850	3		Perchlorate in Water, Soils and Solid Wastes by HPLC/ESI/MS

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE
For

Logging Workorders and Samples into Omega ME.

SOP 20.0003

Rev. 3

	Signature	Date
QA Director:	Sharon B Lauk	4/9/08
Lab Director:	[illegible]	4/9/08

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE
For

Logging Workorders and Samples into Omega ME

Rev. 3

1 Scope and/or Applications

This Standard Operating Procedure (SOP) describes the procedures used to create workorders and log samples into Omega ME. Other steps in sample receipt and chain of custody documentation are described in separate SOP, Number 30.0003, entitled SOP for Sample Receipt, Storage and Tracking

2. Personnel Qualification and Responsibilities

Employees should have read and understood this SOP.

3. Summary of Procedure

This document assumes that a client and project profile has already been defined in Omega ME.

IMPORTANT: Omega ME generates unique sequence numbers (workorder numbers). These are assigned in order as samples are received at the laboratory. **It is essential that all new workorder numbers be assigned in sequence.** This number is assigned by the laboratory and is recorded on the chain of custody form **before** the samples are logged into Omega ME. The Omega ME work order number and the Mitkem project number are the same. If care is not taken, the information logged into Omega ME Work Order and the information in the Mitkem Project folder will not match.

4. Sample Preservation, Container, Handling and Storage

See separate SOP, Number 30.0003, entitled SOP for Sample Receipt, Storage and Tracking

5. Interferences and Potential Problems

Not applicable

6. Equipment and Apparatus

Not applicable

7. Reagents

Not applicable

8. Procedure

8.1 CREATING A WORKODER

8.1.1 From the main page of Omega ME click [WorkOrders] Figure 1.

8.1.2 The Omega ME - WorkOrders Form will open.

8.1.3 On the menu bar at the top of the screen click the [Add] button. This will add the next available WorkOrder and clear the screen of any prior information.

On the screen click the down arrow next to the [Client ID] button to open a list of all of Mitkem's current clients. Instead of searching through the long list of clients type in the first letters of the client name to shorten the selection. Select the proper client. The client name and address will automatically appear in the Client Information box. Figure 2.

Choose the appropriate project by pressing the down arrow on the [Client Project] button, Figure 3. If the client provides a purchase number (PO) enter it in the box provided.

Enter the received date (date samples received by the lab). It is necessary to assign the WorkOrder numbers in order by date samples received. The hardcopy due date [HC Due] is then filled in automatically by Omega based on the number of days (TAT HC/FAX) listed.

If a workorder requires a short turnaround time (**24,48 or 72 hours, etc.**), click the checkmark for the [**Fax Results to Client**] box. The cursor will automatically move to the (**TAT HC/FX**) box which is the box on the right-hand side in which the turnaround time number will need to be entered: **24=1,48=2,72=3**. When this is complete tab down to the box that is highlighted red which will exhibit the date the workorder is due. If the hardcopy due date differs from the fax due date, enter this information now.

For EPA workorders the client is **EPAINV.** The project (I,II,III,IV,V,VI,VII,VIII,IX,X, SOM_PE) is next selected by looking at the Scheduling Notification Form. This form identifies the case number, the Region the samples are from, the analyses required and

turnaround time. Setting up an EPA workorder differs from a commercial workorder in that the Case Number and SDG fields must be completed from the Chain of Custody after protocol has been selected. In some cases, a particular Case will have samples for both water and soils. The soil samples and aqueous samples may be logged into separate Work Orders. The Mitkem project manager will provide this information. Some EPA / commercial projects are kept open for more than one day, so be careful to change the received date as the samples arrive at the lab in order to update the due date properly. Click the [Login] button to begin logging in the samples.

8.1.4 A new screen appears in order to log in the sample information. The fields that need to be completed include:

1. **Click on ADD Samp.** This will add the first sample to be logged in or the information entered into the other fields will not be saved. **Date Received:** Enter the date and time that the samples were received, **Figure 4.**
2. **Client Sample ID:** Type the client ID for each sample as it appears on the Chain of Custody. **Tag Number:** If the ID needs to be truncated because it is more than 10 characters long, type the truncated ID in the Tag Number field. Example: **SB29S-32-12302 = 29S3212302.**
3. **Collection Date:** Enter the date and time that the sample was collected, if a date and time are present. A date is necessary as this is used to keep track of hold times (for non-EPA work). The time of collection is not a necessity, unless the analysis has a 24-hour or 48-hour hold time.
4. **Matrix:** Select the down arrow and choose the appropriate matrix for the sample. If a solid matrix is chosen the PMOIST automatically appears to schedule a percent solids analysis.
5. **Bottle Type:** Choose the type of bottle for each sample fraction by clicking the down arrow and selecting the appropriate bottle.
6. **Containers:** Enter the total number of bottles received per sample.
7. **Storage/Status:** Type the location where the bottle will be stored in the Sample Receiving area. Most of the samples are stored in the walk-in (R1). VOA samples are stored in the refrigerators in the VOA lab. Aqueous metals are stored outside the walk-in cooler on a metal rack.
8. **COC ID:** Some clients require this information to be included. The Mitkem project manager will notify the Receiving department when this needs to be done. The COC ID is required for SOM01.2. If there is more than one COC, associate the correct COC ID to the correct sample. To input the COC ID, go to the AFCEE tab and type in the COC ID in COC ID. Figure 5
9. **SA (CODE):** If the workorder requires the COC ID field to be completed, then this field also must be completed. Select whether the sample is a FB (field blank),TB (trip blank), RB (rinsate blank), or EB (equipment blank). This information can be found on the COC. This field is found under the AFCEE tab
10. **Temp (C): The temperature of the cooler needs to be completed for SOM01.2. In EPA cases where there is more than one cooler received for a particular Case, the correct temperature needs to be associated with the correct samples.** This field is also found under the AFCEE tab.

11. When all the above information has been entered, the next step is to choose the correct test. The tests for a particular project may be found by clicking on the Test column and using the drop down arrow.
12. Click ADD Frac if another fraction needs to be added. Fractions are added when different bottles with different preservatives are present. For example, a client sends in a sample for volatile, semivolatile, pesticides, metals and cyanide analysis. There will be an "A", a "B", a "C" and a "D" fraction. For example, they will be logged in as "A" for volatile, "B" for semivolatile and pesticides, "C" for metals and "D" for cyanide. This is due to each sample bottle being different and having different preservatives. Figure 6.
13. To add additional samples, click on the ADD Samp button. Enter the sample ID, date and time of collection, matrix, type of bottle and storage location. Once all this info has been entered, choose the test. An easier method when logging in a number of samples with identical analyses is to use the Multilog button, Figure 6. Clicking the Multilog button automatically copies all information to the next sample except for Client ID, Date andTime of collection, and Tag Number. If multi-logging, type the client ID, date of collection and time of collection for each sample. Once this is done, click on POST. Figure 7.
14. If samples arrive with designated QC (duplicates and matrix spikes) then check the MS button on the right side of the screen after you have chosen the appropriate test Be sure to change the number of bottles for this sample, as there will be more sample bottles. Figure 8
15. If specific tests are included on the Chain of Custody but the analysis is on hold, then check the "Sample on Hold" box. Figure 9
16. Comments should be added if warranted. For example, if there is limited sample volume, or the Chain-of-Custody indicates that the samples are dirty. Go to the Comments: and type in the necessary comment.
17. Labels are printed and affixed to the bottles. Labels may be printed by clicking on the Label button. Click over the samples in which labels need to be printed. Click the OK button and then the printer icon.
18. Once the labels have been printed, a work order needs to be printed. Back out to the work order page. Click on WO Rpt. Place the work order into the folder. Figures 10 and 11
19. A preliminary invoice will also need to be printed and placed into the folder. Click on the Reports button. Click on Base Report. Click on Clear All. Check on Invoice and then click on Preview Report and print the invoice. Figures 12, 13 and 14

8.1 5 Any correction to the workorder that greatly impacts the workorder such as a significant change in holding time or turn around time, the addition of new tests, and/or the addition or cancellation of samples must also be verbally communicated to the appropriate lab supervisor by the project manager. An email is also an effective means of communication.

8.2 REVIEW of the Work Order

8.2.1 The Mitkem Project folders are handed out by the Project Managers. It is the responsibility of the project manager to ensure that the sample ID, date and time of sample collection, date of sample receipt and the correct tests are logged in for each sample. Corrections are made, if necessary, and a new Work Order printed out and placed in the red folder.

8.2.2 When adding a workorder that is not going to be invoiced (Mitkem work, PE, etc..) or if the workorder is cancelled one of the following steps must be performed:

1)The workorder client name is changed to Mitkem.

2)All samples are designated as non-billable

3)For PE samples the characters "PE" are added to the SDG number field.

4) If the workorder is to be cancelled with no billable fractions and/or tests, the following steps should be followed:

4.1 Fill in Log Review with the date.

4.2 Click on Cancel Work Order button

4.3 The Completed, Validated, Reported, Faxed, Mailed and Invoiced fields will be populated with the current date. The Project No:, Case No:, SDG No: and EDD By: fields will be populated with Canceled.

5)If the workorder is to be cancelled but some fractions and/or test codes can be billed, then follow these steps:

5.1 One sample should be logged in with NO-TEST and the correct priced added.

5.2 Fill in Log Review with the date.

5.3 Click on Cancel Work Order button

5.4 The Completed, Validated, Reported, Faxed, Mailed and Invoiced fields will be populated with the current date. The Project No:, Case No:, SDG No: and EDD By: fields will be populated with Canceled.

5.5 An invoice can be generated.

9. Data Reduction and Calculations

Not applicable

10. Quality Assurance / Quality Control

The Project Manager reviews the work order within one day of sample receipt. Any changes or corrections are implemented at this step.

11. Data validation and Reporting

Not applicable

12. Corrective Action Procedures

Not applicable

13. Health and Safety

Not applicable

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

Not applicable

Figure 1

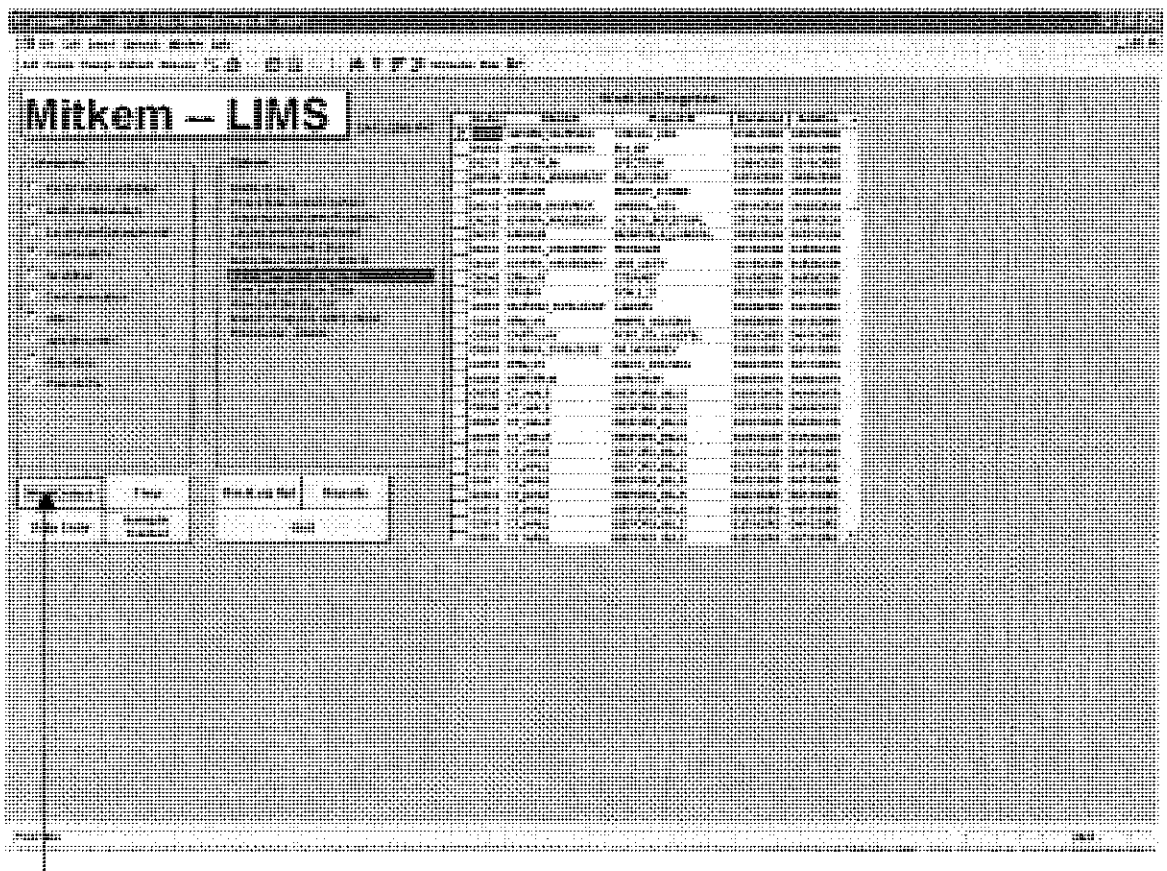
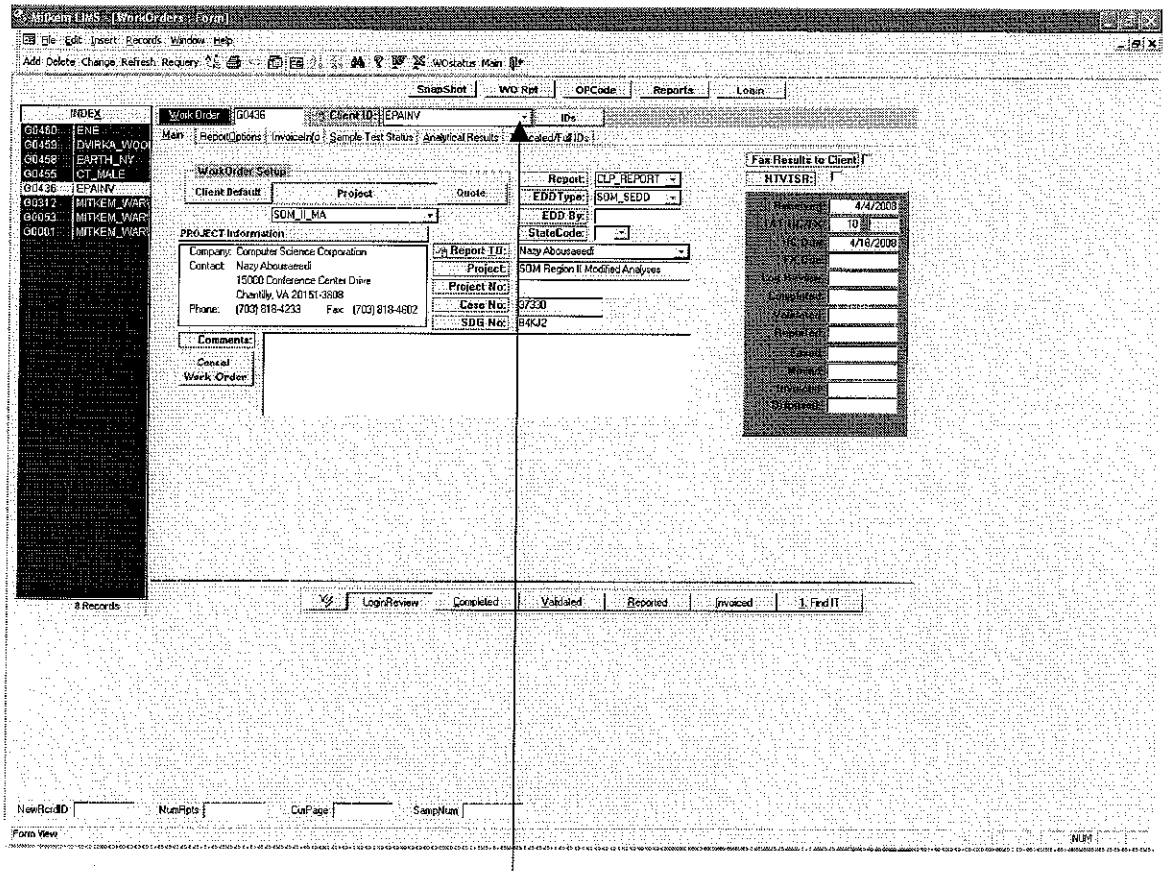


Figure 2


Mitkem LIMS - [WorkOrders : Form]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
SnapShot
WO Rpt
OPCode
Reports
Login
INDEX
G0460 ENE
G0459 DVIRKA_WOO
G0458 EARTH_NY
G0455 CT_MALE
G0436 EPAINV
G0312 MITKEM_WAR
G0053 MITKEM_WAR
G0001 MITKEM_WAR
Work Order G0436
Client ID: EPAINV
IDs
Main
ReportOptions
InvoiceInfo
Sample Test Status
Analytical Results
Scaled/Full IDs
WorkOrder Setup
Client Default
Project
Quote
SOM_II_MA
PROJECT Information
Company: Computer Science Corporation
Contact: Nazy Abousaeedi
15000 Conference Center Drive
Chantilly, VA 20151-3808
Phone: (703) 818-4233 Fax: (703) 818-4602
Report: CLP_REPORT
EDDType: SOM_SEDD
EDD By:
StateCode:
Report TO: Nazy Abousaeedi
Project: SOM Region II Modified Analyses
Project No:
Case No: 37330
SDG No: 84KJ2
Comments:
Cancel Work Order
Fax Results to Client
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4/4/2008
10
4/16/2008
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Reported
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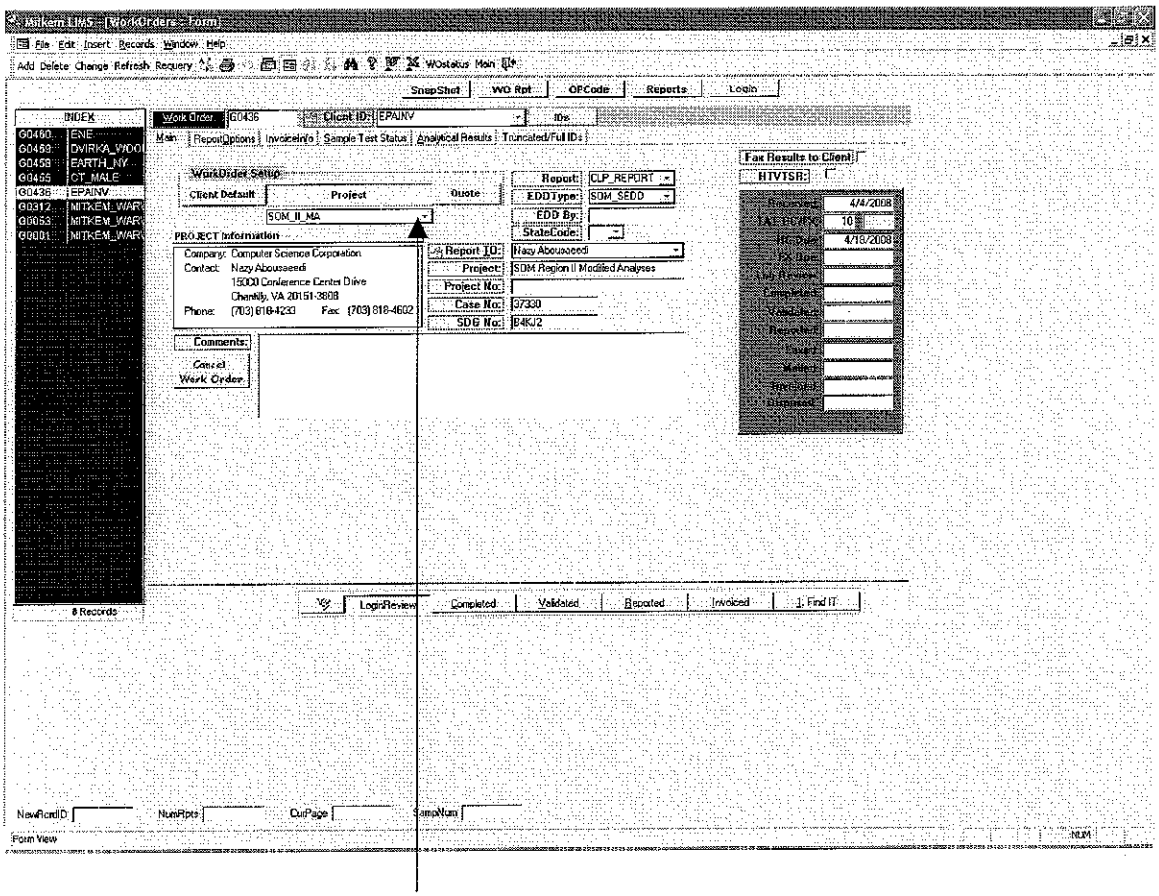
Figure 3


Mitkem Lims - [WorkOrders - Form]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
WOstatus Main
SnapShot
WO Rpt
OPCode
Reports
Login
INDEX
G0460 ENE
G0459 DVIRKA_WOO
G0458 EARTH_NY
G0455 CT_MALE
G0436 EPAINV
G0312 MITKEM_WAR
G0053 MITKEM_WAR
G0001 MITKEM_WAR
8 Records
Work Order G0436
Client ID: EPAINV
IDs
Main
ReportOptions
InvoiceInfo
Sample Test Status
Analytical Results
Truncated/Full IDs
WorkOrder Setup
Client Default
Project
Quote
SOM_II_MA
PROJECT Information
Company: Computer Science Corporation
Contact: Nazy Abousseedi
15000 Conference Center Drive
Chantilly, VA 20151-3808
Phone: (703) 818-4233 Fax: (703) 818-4602
Report: CLP_REPORT
EDDType: SOM_SEDD
EDD By:
StateCode:
Report ID: Nazy Abousseedi
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Project No:
Case No: 37330
SDG No: B4KJ2
Comments:
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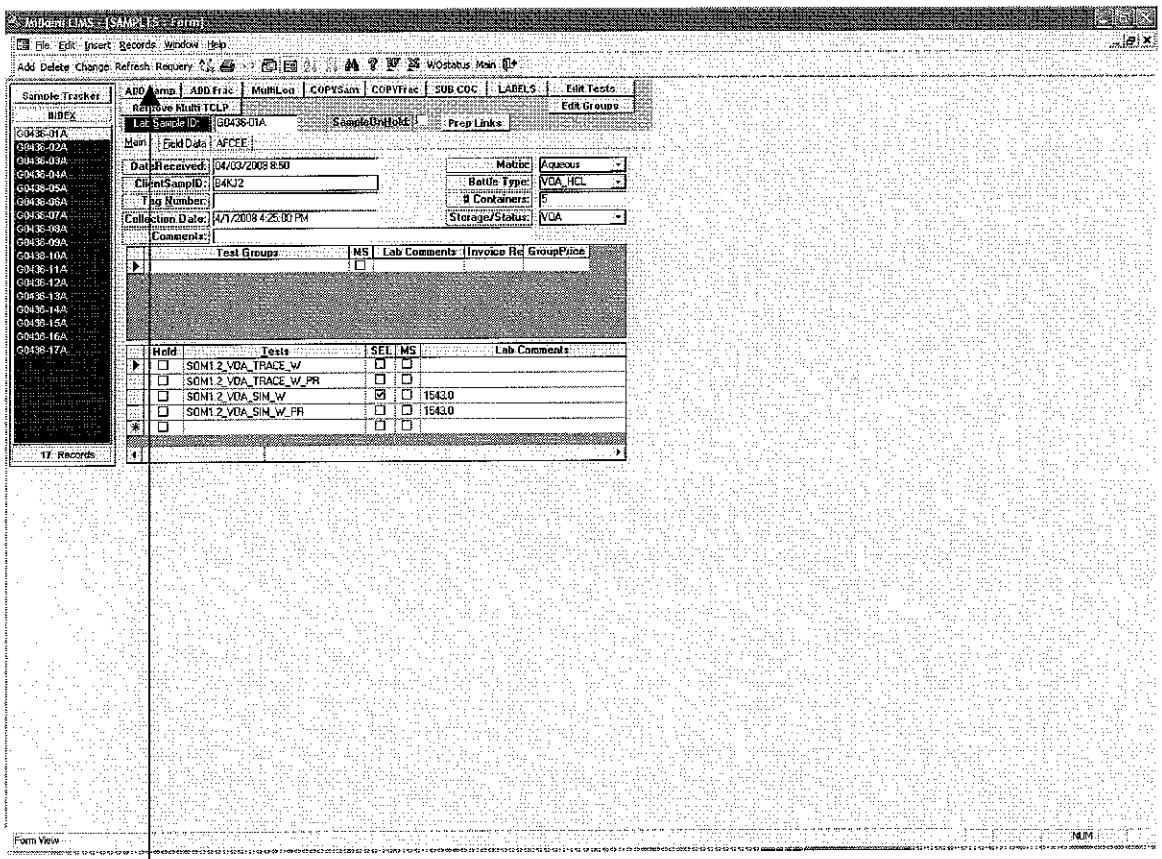
SampNum
Form View
NUM

Figure 4


Mitkem LIMS - [SAMPLES - Form]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
Sample Tracker
INDEX
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G0436-02A
G0436-03A
G0436-04A
G0436-05A
G0436-06A
G0436-07A
G0436-08A
G0436-09A
G0436-10A
G0436-11A
G0436-12A
G0436-13A
G0436-14A
G0436-15A
G0436-16A
G0436-17A
17 Records
ADD Samp
ADD Frac
MultiLog
COPYSam
COPYFrac
SUB COC
LABELS
Edit Tests
Edit Groups
Remove Multi TCLP
Lab Sample ID:
G0436-01A
SampleOnHold
Prep Links
Main
Field Data
AFCEE
DateReceived:
04/03/2008 8:50
ClientSampID:
04KJ2
Tag Number:
Collection Date:
4/1/2008 4:25:00 PM
Comments:
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Aqueous
Bottle Type:
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Containers:
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Storage/Status:
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Test Groups
MS
Lab Comments
Invoice Re
GroupPrice
Hold
Tests
SEL
MS
Lab Comments
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SOM1.2_VOA_TRACE_W_PR
SOM1.2_VOA_SIM_W
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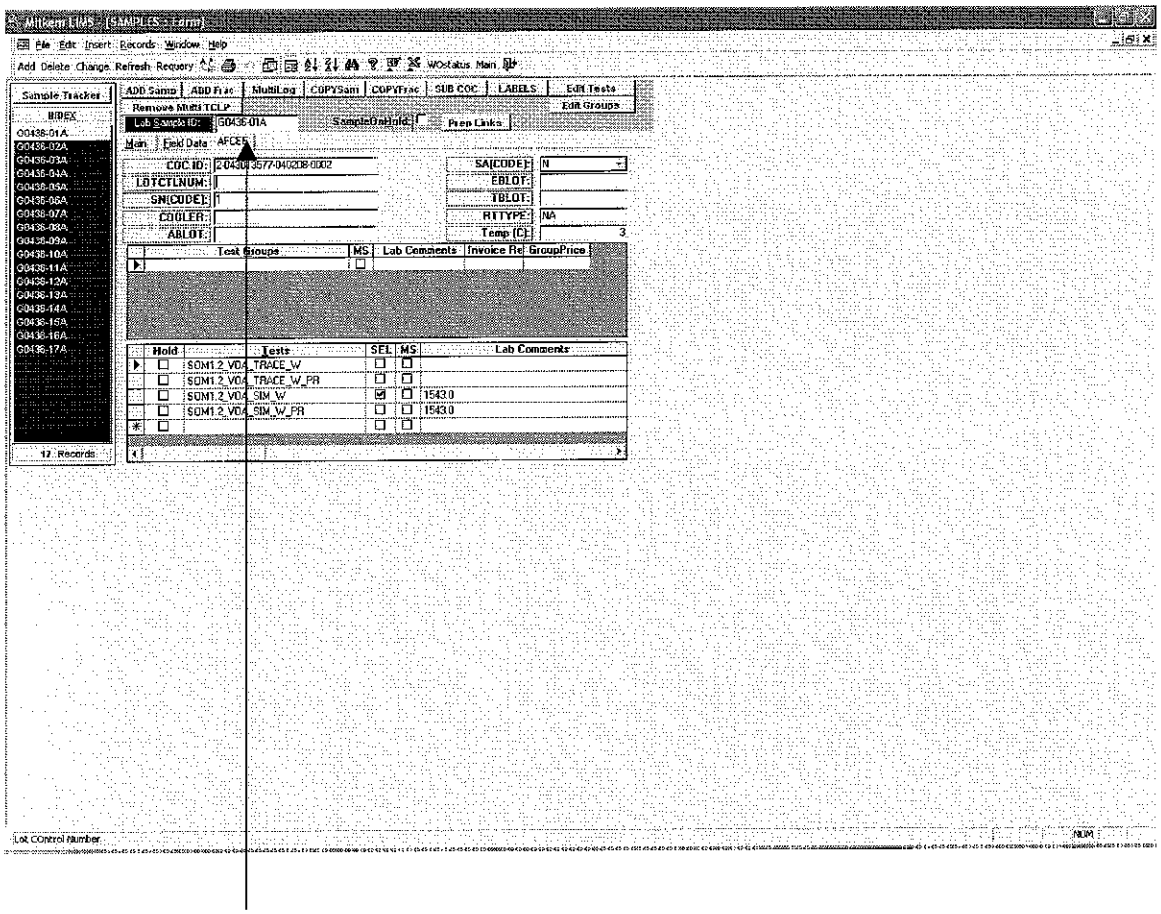
SOM1.2_VOA_SIM_W_PR
1543.0
Form View
NUM

Figure 5


Mitkem LIMS - [SAMPLES - Large]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
WOstatus Main
Sample Tracker
INDEX
G0436-01A
G0436-02A
G0436-03A
G0436-04A
G0436-05A
G0436-06A
G0436-07A
G0436-08A
G0436-09A
G0436-10A
G0436-11A
G0436-12A
G0436-13A
G0436-14A
G0436-15A
G0436-16A
G0436-17A
12 Records
ADD Samp
ADD Frac
MultiLog
COPYSam
COPYFrac
SUB COC
LABELS
Edit Tests
Edit Groups
Remove Multi TCLP
Lab Sample ID:
G0436-01A
SampleOnHold:
Prep Links
Main
Field Data
AFCEE
COC ID:
LOTCTLNUM:
SN(CODE):
COOLER:
ABLOT:
SA(CODE):
EBLOT:
TBLOT:
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Test Groups
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Lab Comments
Invoice Re
GroupPrice
Hold
Tests
SEL
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Lab Comments
SOM1.2_V04_TRACE_W
SOM1.2_V04_TRACE_W_PR
SOM1.2_V04_SIM_W
SOM1.2_V04_SIM_W_PR
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15430
Lot Control Number
NUM

Figure 6

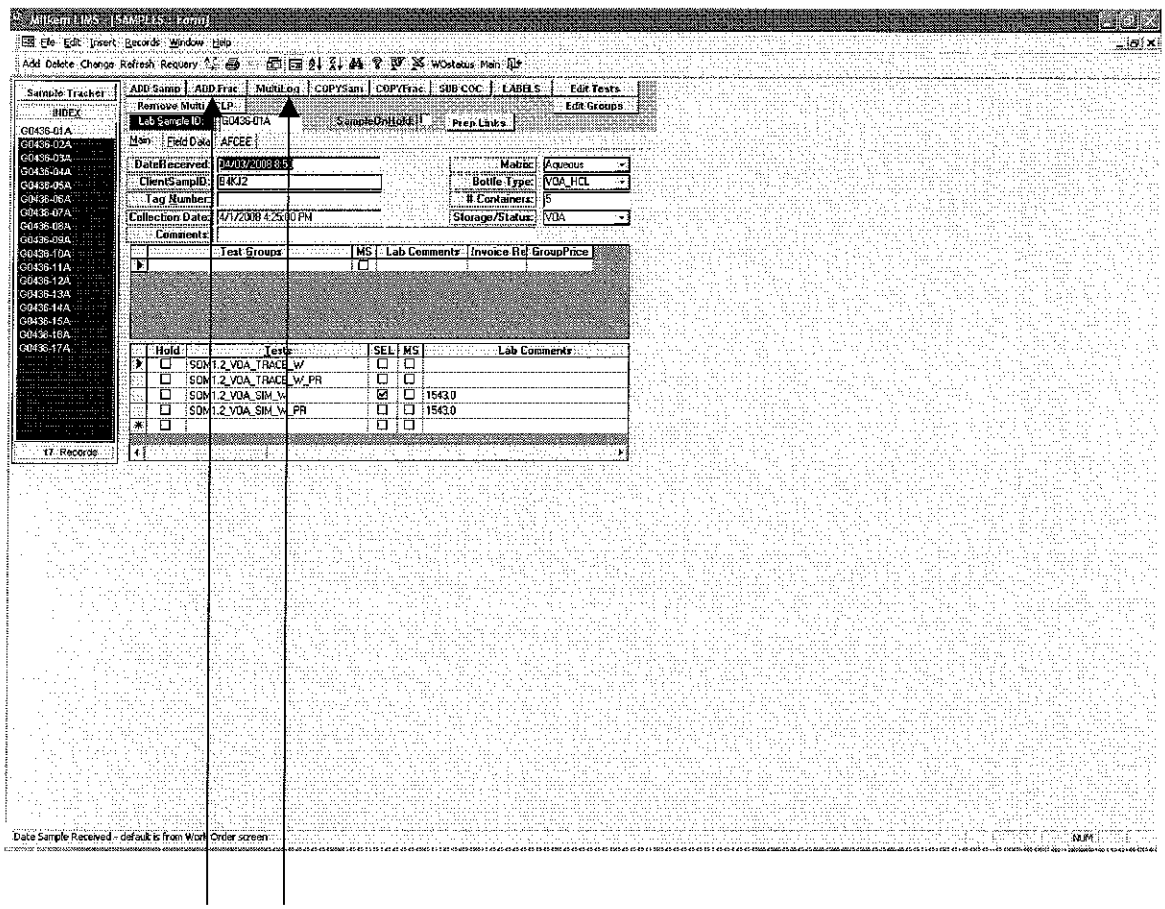
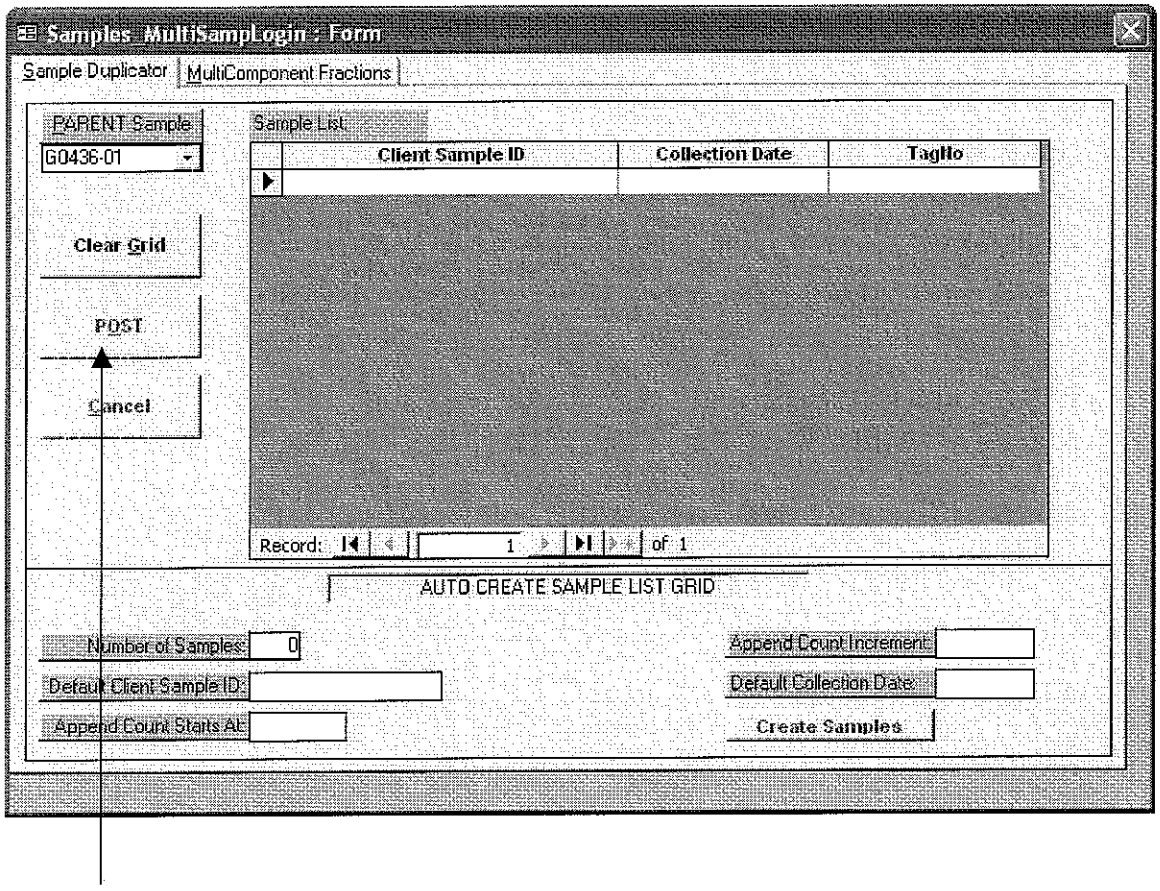

Sample Tracker
ADD Samp
ADD Frac
MultiLog
COPYSam
COPYFrac
SUB COC
LABELS
Edit Tests
Edit Groups
Lab Sample ID:
G0436-01A
Prep Links
Date Received:
Client Sample ID:
Tag Number:
Collection Date:
Comments:
Matrix:
Aqueous
Bottle Type:
VOA_HCL
Containers:
Storage/Status:
VOA
Test Groups
MS
Lab Comments
Invoice Re
GroupPrice
Hold
Tests
SEL
MS
Lab Comments
SOM1.2_VOA_TRACE_W
SOM1.2_VOA_TRACE_W_PR
SOM1.2_VOA_SIM_W
SOM1.2_VOA_SIM_W_PR
1543.0
1543.0
17 Records
Date Sample Received - default is from Work Order screen
NUM

Figure 7


Samples_MultiSampLogin : Form
Sample Duplicator
MultiComponent Fractions
PARENT Sample
G0436-01
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Collection Date
TagNo
Clear Grid
POST
Cancel
Record:
1
of 1
AUTO CREATE SAMPLE LIST GRID
Number of Samples:
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Default Client Sample ID:
Append Count Starts At:
Append Count Increment:
Default Collection Date:
Create Samples

Figure 8

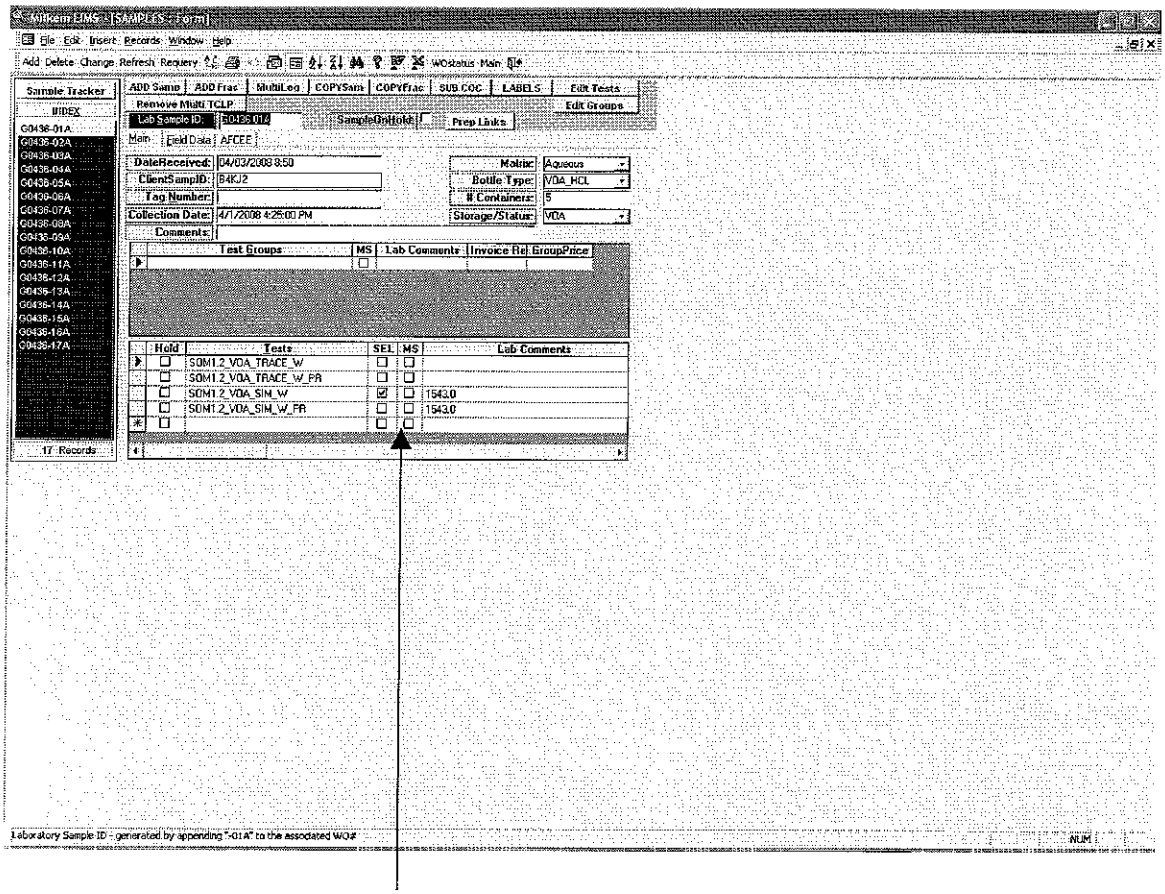

Mitkem EIMS - [SAMPLES : Form]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
Sample Tracker
INDEX
G0436-01A
G0436-02A
G0436-03A
G0436-04A
G0436-05A
G0436-06A
G0436-07A
G0436-08A
G0436-09A
G0436-10A
G0436-11A
G0436-12A
G0436-13A
G0436-14A
G0436-15A
G0436-16A
G0436-17A
17 Records
ADD Samp
ADD Frac
MultiLog
COPYSam
COPYFrac
SUB COC
LABELS
Edit Tests
Remove Multi TCLP
Edit Groups
Lab Sample ID:
G0436-01A
SampleOnHold:
Prep Links
Main
Field Data
AFCEE
DateReceived:
04/03/2008 8:50
ClientSamplID:
84KJ2
Tag Number:
Collection Date:
4/1/2008 4:25:00 PM
Comments:
Matrix:
Aqueous
Bottle Type:
VOA_HCL
Containers:
5
Storage/Status:
VOA
Test Groups
MS
Lab Comments
Invoice Re
GroupPrice
Hold
Tests
SEL
MS
Lab Comments
SOM1.2_VOA_TRACE_W
SOM1.2_VOA_TRACE_W_PR
SOM1.2_VOA_SIM_W
1543.0
SOM1.2_VOA_SIM_W_PR
1543.0
Laboratory Sample ID - generated by appending "-01A" to the associated WO#
NUM

Figure 9

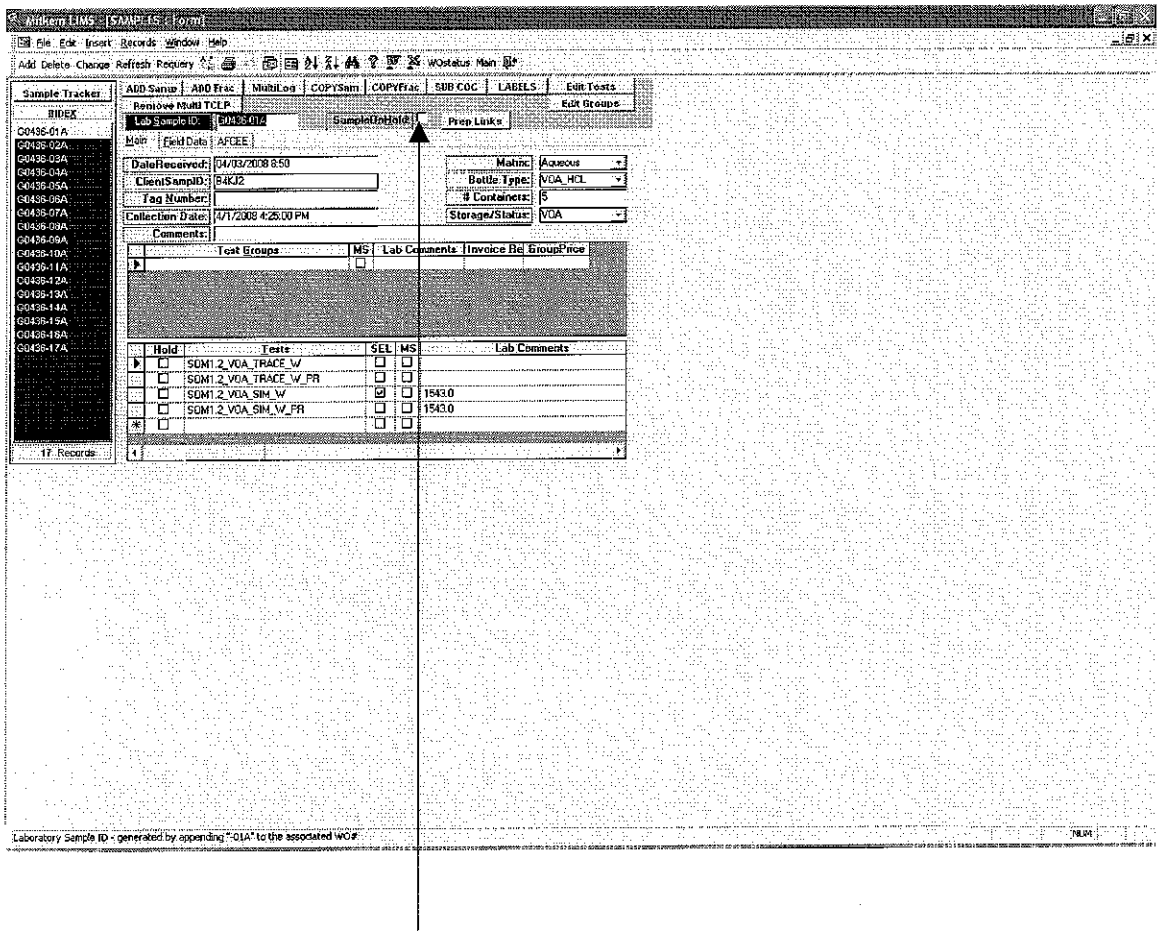

Mitkem LIMS - [SAMPLES : Form]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
WOstatus Main
Sample Tracker
INDEX
G0436-01A
G0436-02A
G0436-03A
G0436-04A
G0436-05A
G0436-06A
G0436-07A
G0436-08A
G0436-09A
G0436-10A
G0436-11A
G0436-12A
G0436-13A
G0436-14A
G0436-15A
G0436-16A
G0436-17A
17 Records
ADD Samp
ADD Frac
MultiLog
COPYSam
COPYFrac
SUB COC
LABELS
Edit Tests
Remove Multi TCLP
Edit Groups
Lab Sample ID:
G0436-01A
SampleOnHold
Prep Link»
Main
Field Data
AFCEE
DateReceived:
04/03/2008 8:50
ClientSampID:
84KJ2
Tag Number:
Collection Date:
4/17/2008 4:25:00 PM
Comments:
Matrix:
Aqueous
Bottle Type:
VOA_HCL
Containers:
5
Storage/Status:
VOA
Test Groups
MS
Lab Comments
Invoice Be
GroupPrice
Hold
Tests
SEL
MS
Lab Comments
SOM1.2_VOA_TRACE_W
SOM1.2_VOA_TRACE_W_PR
SOM1.2_VOA_SIM_W
1543.0
SOM1.2_VOA_SIM_W_PR
1543.0
Laboratory Sample ID - generated by appending "-01A" to the associated WO#
NUM

Figure 10

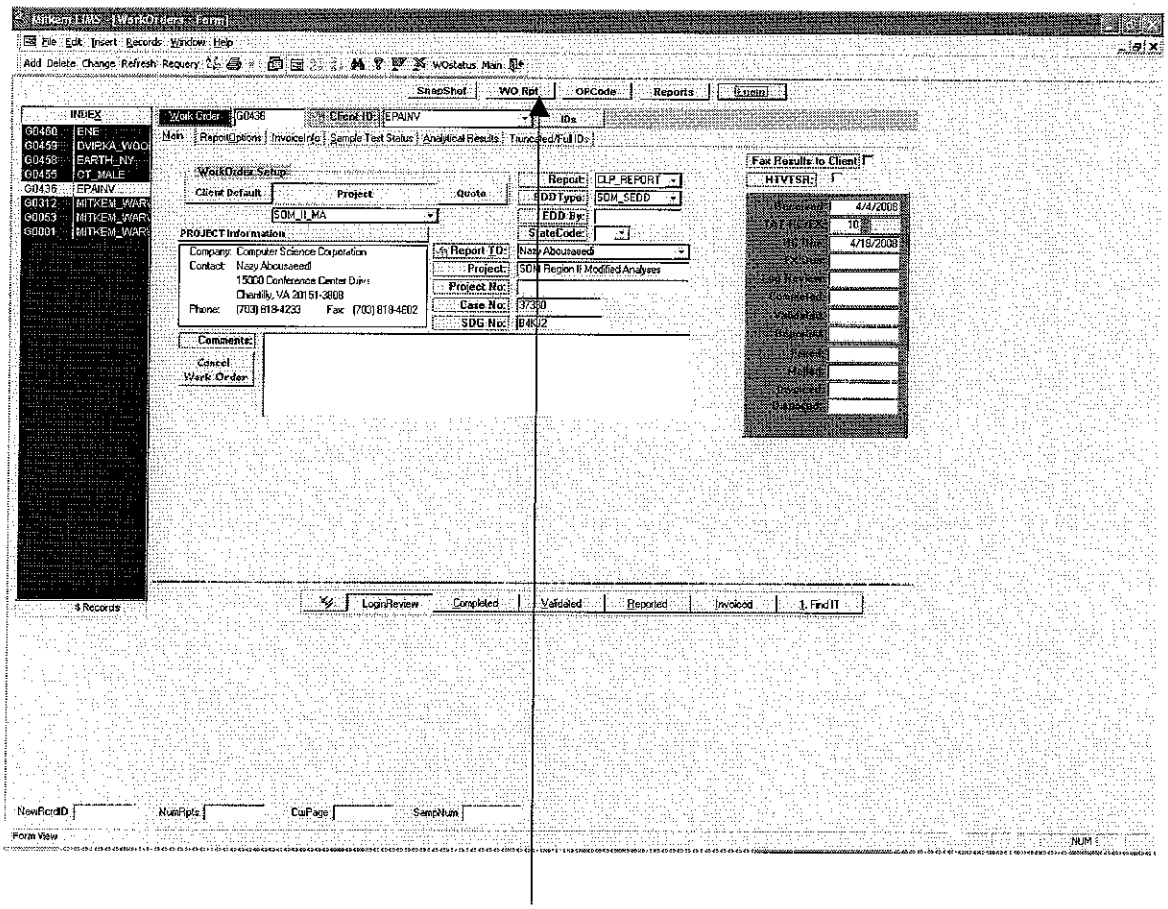

Mitkem LIMS - [WorkOrders : Form]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
SnapShot
WO Rpt
OPCode
Reports
INDEX
Work Order
G0436
Client ID:
EPAINV
Main
ReportOptions
InvoiceNo
Sample Text Status
Analytical Results
Truncated/Full IDs
WorkOrder Setup
Client Default
Project
Quote
SOM_II_MA
PROJECT Information
Company: Computer Science Corporation
Contact: Nazy Abousaeed
15000 Conference Center Drive
Chantilly, VA 20151-3808
Phone: (703) 818-4233
Fax: (703) 818-4602
Report:
OLP_REPORT
EDD Type:
SOM_SEDD
EDD By:
StateCode:
To Report TO:
Nazy Abousaeed
Project:
SOM Region II Modified Analyses
Project No:
Case No:
37350
SDG No:
04K02
Comments:
Cancel Work Order
Fax Results to Client
HTVTSR:
4/4/2008
10
4/18/2008
LoginReview
Completed
Validated
Reported
Invoiced
1. Find IT
NewRecID
NumRpts
CurPage
SampNum
Form View
NUM

Figure 11

Mitkem Laboratories *08/Apr/08 16:19* **WorkOrder: G0436**

Client ID: EPAINV
Project: SOM Region II Modified Analyses
Location:
Comments: N/A

Case: 37330
SDG: B4KJ2
PO: EP-W-05-030

Report Level: CLP_REPORT
EDD: SOM_SEDD
HC Due: 04/18/08
Fax Due:

Sample ID	HS Client Sample ID	Collection Date	Date Rec'd	Matrix	Test Code	Lab Test Comments	Hold	MS	SEL	Storage
G0436-01A	B4KJ2	04/01/2008 16:25	04/03/2008	Aqueous	SOM1.2_VOA_SIM_W	1543.0	☐	☐	☑	VOA
					SOM1.2_VOA_TRACE_W		☐	☐	☐	VOA
G0436-02A	B4KJ3	04/01/2008 12:20	04/03/2008	Aqueous	SOM1.2_VOA_SIM_W	1543.0	☐	☐	☑	VOA
					SOM1.2_VOA_TRACE_W		☐	☐	☐	VOA
G0436-03A	B4KJ4	04/01/2008 16:20	04/03/2008	Aqueous	SOM1.2_VOA_SIM_W	1543.0	☐	☐	☑	VOA
					SOM1.2_VOA_TRACE_W		☐	☐	☐	VOA
G0436-04A	B4KJ5	04/01/2008 17:30	04/03/2008	Aqueous	SOM1.2_VOA_SIM_W	1543.0	☐	☐	☑	VOA
					SOM1.2_VOA_TRACE_W		☐	☐	☐	VOA
G0436-05A	B4KJ7	04/01/2008 9:30	04/03/2008	Aqueous	SOM1.2_VOA_SIM_W	1543.0	☐	☐	☑	VOA
					SOM1.2_VOA_TRACE_W		☐	☐	☐	VOA
G0436-06A	B4KK0	04/01/2008 8:00	04/03/2008	Aqueous	SOM1.2_VOA_SIM_W	1543.0	☐	☐	☑	VOA
					SOM1.2_VOA_TRACE_W		☐	☐	☐	VOA
G0436-07A	B4KH4	04/03/2008 11:10	04/04/2008	Aqueous	SOM1.2_VOA_SIM_W	1543.0	☐	☐	☑	VOA

Client Rep. Agnes R Ng

Page 1 of 3

Figure 12

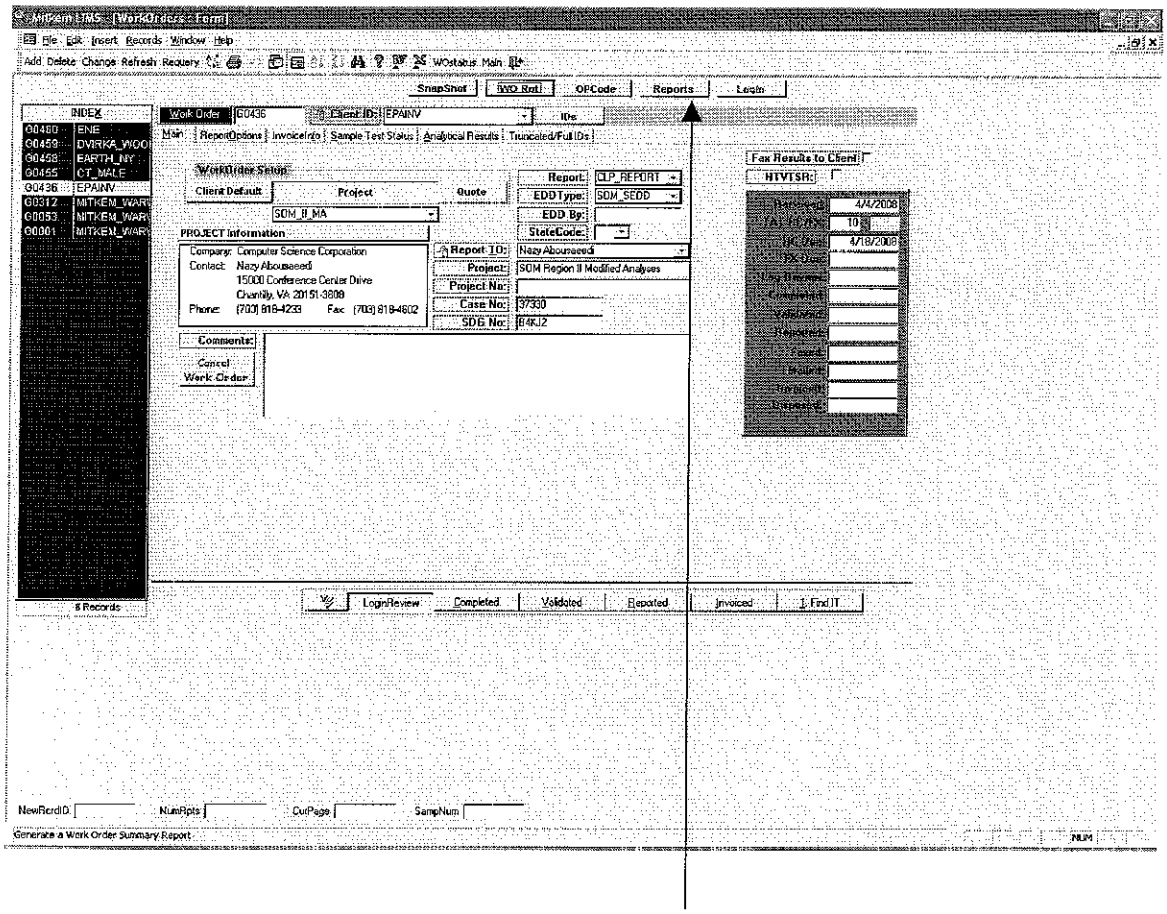

Mitkem LIMS - [WorkOrders : Form]
File Edit Insert Records Window Help
Add Delete Change Refresh Requery
WOstatus Main
SnapShot
WO Rptl
OPCode
Reports
Login
INDEX
Work Order
G0436
Client ID:
EPAINV
IDs
Main
ReportOptions
InvoiceInfo
Sample Test Status
Analytical Results
Truncated/Full IDs
WorkOrder Setup
Client Default
Project
Quote
Report:
CLP_REPORT
EDDType:
SDM_SEDD
EDD By:
StateCode:
SDM_II_MA
PROJECT Information
Company: Computer Science Corporation
Contact: Nazy Abousaeed
15000 Conference Center Drive
Chantilly, VA 20151-3809
Phone: (703) 818-4233
Fax: (703) 818-4602
Report ID:
Nazy Abousaeed
Project:
SDM Region II Modified Analyses
Project No:
Case No:
37330
SDG No:
Comments:
Cancel Work Order
Fax Results to Client
HTVISR:
10
4/18/2008
LoginReview
Completed
Validated
Reported
Invoiced
Find IT
NewRecID:
NumRpts:
CurPage:
SampNum:
Generate a Work Order Summary Report
NUM

Figure 13

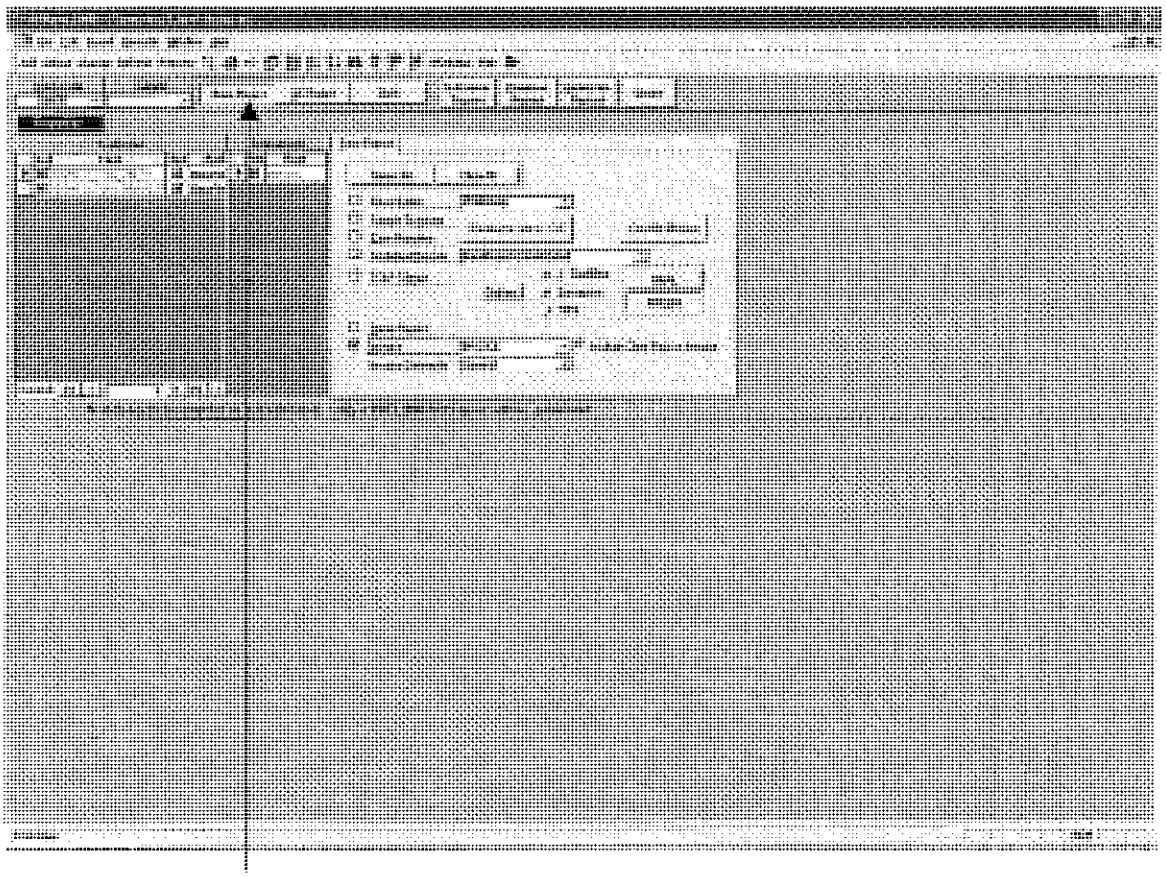


Figure 14

Bill To:

INVOICE

EPA Financial Management Center
Attn:
Research Triangle Park
Research Triangle Park, NC 27711

Number:
**G0436
Date:

Client Rep: Nazy Abousaeedi
Work Order: G0436
PO Number: EP-W-05-030
Date Received: 04/04/2008

Project No:
Project Name: SOM Region II Modified Analyses
Case No: 37320
SDG No: B4KJ2

Test	Remarks	Matrix	Qty	Price	Test Total
SOM1.2_VOA_SIM_W	1543.0	Aqueous	17	$1.00	$17.00
SOM1.2_VOA_TRACE_W		Aqueous	17	$85.00	$1,445.00

Subtotal:	$1,462.00
Discount:	0.00%
Surcharge:	0.00%
Misc Charges:	$0.00
Payment Received:	$0.00
INVOICE Total:	$1,462.00

All invoices are due and payable within 30 days from receipt.

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE

for

Sample Receipt, Storage, Tracking and Disposal

SOP No. 30.0003

Rev. 12

	Signature	Date
QA Director:		10/17/08
Lab Director:		10/21/08

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE

for

Sample Receipt, Storage, Tracking and Disposal

Rev. 12

1. Scope and Application

This Standard Operating Procedure describes the procedures that must be followed upon receipt of samples at MITKEM. It describes the procedures to log-in and store samples. It also describes procedures for checking samples out of the storage area for analysis, and for final disposal of samples. Detailed procedures for entering work orders and samples into Mitkem's Laboratory Information Management System (LIMS) are described in a separate SOP Number 20.0003.

2. Personnel Qualifications and Responsibilities

The Sample Custodian should have a two-year degree in environmental science or a related field or have six months of on-the-job experience working with a trained and qualified Sample Custodian.

3. Summary of Procedure

When sample coolers are received, cooler custody seals and temperature are checked. The chain-of-custody forms are signed, and the condition of the samples are checked, including any sample custody seals. Each sample is assigned a specific individual sample number. Any discrepancies are documented and resolved. Samples are logged-in to the Omega LIMS following procedures in SOP 20.0003. Labels are generated, and affixed to samples. The pH of aqueous samples (Inorganic only, never VOA) are checked and if need be, either acid or base is added. The addition of preservative(and its lot number) is recorded on the Condition Form. Samples are stored in secure area under documented custody conditions. Certain types of VOC soil samples require special handling, as described in **Section 8.2.2**. Samples are kept at Mitkem for a specific time as called for by contract with the client, and then disposed of in accordance with federal, state and local regulations. The door to the sample receiving room is locked at all times, using a keypad code lock.

4. Sample Preservation, Containers, Handling, and Storage

Samples received at Mitkem are collected by our clients. Mitkem does provide preservatives and sample containers pre-cleaned by bottle suppliers.

Tables 7-1, 7-2 and 7-3 of Mitkem's Quality Assurance Plan (QAP) lists the type of container needed for a particular type of analyte and the proper preservative.

5. Interferences and Potential Problems

Any problem with sample condition including custody seals, breakage, discrepancies in chain of custody or other shipping documentation, cooler temperature, missing samples, etc. must be communicated to the client promptly and resolved. The Sample Custodian or assistant documents the problem and notifies the Mitkem Project Manager, who will then notify the client. For CLP the Project Manager will notify the Sample Management Office (SMO).

6. Equipment and Apparatus

6.1 NIST-calibrated temperature "gun".

6.2 Condition Forms: Non-CLP, CLP (DC-1).

6.3 Orange colored Sample Condition Notification forms.

6.4 Narrow range pH paper, capable of recording pH 0- 2.5, and 11-13.

6.5 Computer with Accessories to run the LIMS Omega system.

6.6 Label printer and labels.

7. Reagents

7.1 Hydrochloric Acid (HCl), Fisher Trace Metal Grade.

7.2 Nitric Acid (HNO_3), Fisher Trace Metal Grade.

7.3 Sodium Hydroxide (NaOH), Certified A.C.S.

7.4 Zinc Acetate $(CH_3CO_2)_2$ Zn $2H_2O$, certified.

7.5 Sulfuric Acid (H_2SO_4), Fisher Trace Metal Grade.

7.6 Phosphoric Acid (H_3PO_4), Fisher Trace Metal Grade.

Reagents are ordered by the inorganic laboratory section, and kept in the sample receiving and bottle prep areas. Zinc Acetate is stored in the volatile laboratory as it is only used with volatile sample bottle prep.

If the reagent needed is in neat form (NaOH or Zinc Acetate) a new bottle may be obtained from the chemical storage area. If you take the next to the last or the last bottle for login dept use, you must inform the inorganic lab supervisor so more can be ordered.

8. Procedure

8.1 Log-In Procedures:

Samples received at Mitkem are received from private courier (FedEx, UPS, etc.) or Mitkem courier or delivery by the clients. All samples received must be accompanied by a chain-of-custody (COC) record.

8.1.1 Prior to opening coolers the receiving hood must be turned on, and safety glasses, lab coat, and gloves worn.

8.1.2 Select the next sequential red workorder folder with a pre-assigned work order number. Work order numbers consist of one alpha character followed by a four digit number YXXXX, in which Y is the alpha character indicating the number of years that the Omega LIMS System has been operational and XXXX is a sequential number for this workorder for the current year. For example, 2006 is assigned the alpha character "E" and the 5th set of samples received during 2006 is assigned work order number E0005. Occasionally, a client wishes for a workorder number to be ongoing for several shipments of samples (i.e. EPA). The project manager will notify the sample custodian if additional samples are to be added to an existing workorder (an open Sample Delivery Group or SDG).

8.1.3 Before opening coolers, check the outside of the opening of the shipping cooler for the presence of custody seals. Remove any shipping air bills and note the work order number on them. This information should be noted on the Sample Condition Form (See **Attachments 1 and 2**).

NOTE: There are two different types of Sample Condition Forms; one for commercial samples, and one for the US EPA contract samples (see Attachments). Place air bills and all other paperwork for this shipment in the appropriate red workorder folder.

8.1.4 Open the cooler underneath the hood and remove the chain-of-custody form. This is typically located in a plastic zip-lock bag on the top of the samples or taped to the inside of the cooler lid. Write the Mitkem workorder number on

the COC. Sign the COC, noting the date and time of receipt of the samples at Mitkem. Look for return air bills to return coolers to the client, these are typically included in EPA projects. If the COC is missing, notify the Mitkem project manager using the Mitkem Sample Condition Notification (printed on orange paper) form immediately. Do not process the samples. Store the samples in the walk-in cooler until the client is contacted and responds.

8.1.5 Take the temperature of the contents using the temperature gun or thermometer.

8.1.5.1 Use the Temperature Gun as follows:

8.1.5.1.1 Unwrap a sample in the opened cooler. Unwrap enough of the sample in order to take a temperature reading.

8.1.5.1.2 Take the temperature by holding the gun no more than two inches from the sample container. Do not aim at the label or cap of the sample. Take several readings on at least 2 samples at opposite ends of the cooler. . Record the temperature on the lower right hand corner of the chain-of-custody or where noted on the Chain-of-Custody. The acceptable temperature range is 4° ± 2°C (2° to 6°C). If the temperature is acceptable, move on to **Section 8.1.6**. If the temperature is not within this range, enter the temperature on the Sample Condition Form, circle "yes" to the question regarding the Sample Notification form, and fill out the Sample Notification form (See **Attachment 3**). For CLP projects, if the temperature exceeds 10°C, the project manager will contact SMO for corrective action guidance. Give the entire folder and the Sample Notification form to the project manager. The project manager will contact the client for instructions on how to proceed and return the folder to the sample custodian indicating action to be taken. During the interim, the samples in question will not be processed, but the closed cooler will be stored in the walk-in cooler.

8.1.5.2 If a temperature blank is present, use a thermometer as follows:

8.1.5.2.1 Insert the thermometer in the temperature blank.

8.1.5.2.2 Let stand for up to five minutes.

8.1.5.2.3 Read the temperature and record in the lower right hand corner of the COC or where noted on the Chain-of-Custody. If the temperature is not within 4° ± 2°C (2° to 6°C), proceed as in **section 8.1.4** above. For CLP projects, if the temperature

exceeds 10°C, the project manager will contact SMO for corrective action.

8.1.5.3 A calibration check of the thermometer is to be done quarterly or as the thermometer is replaced by comparing it's reading to the NIST thermometer and recording the results in the QA/QC Thermometer Calibration Logbook. See **SOP No. 110.0006** for the calibration procedure.

8.1.5.4 The presence/absence of a temperature blank in the shipment is documented on the Form DC-1. Follow the instructions on the DC-1 Form for contacting SMO, and for documentation in the event a temperature blank is not present.

8.1.6 If the Sample Custodian is not present, the person receiving the samples should perform all steps through **Section 8.1.5.2.5**, then store the cooler in the walk-in refrigerator, R1, until the Sample Custodian returns, after removing any VOC samples. Samples for VOC analysis require special handling, as described in **Section 8.2.2**. In general, if not logged-in immediately, VOA vials must be removed from the cooler and stored in refrigerator R2 until logged-in to the LIMS. If VOC samples are received in Encore devices (typically contained in silver foil pouches), or are noted as requiring freezing to preserve, they must be removed and stored in the freezer F2. Encore samples must be extruded into pre-weighed VOC vials as soon as possible. Contact one of the following to insure this occurs: VOA Laboratory Supervisor, Sample Custodian, Project Manager, Laboratory Operations Manager or QA Director. Leave the paperwork in the red folder on the sample custodian's desk.

8.1.7 Once all of the coolers received have been inspected as above, prioritize them for logging into the LIMS with fastest turn-around times and short holding times processed first. The labs should be notified immediately about quick-turn analyses. This can be done either verbally, or by copying the COC and distributing that to the laboratories.

8.1.8 Remove and inspect samples from the coolers for the first workorder. Sample containers are removed from the cooler and lined-up on the counter in the same order as listed on the chain of custody form. Check to see that the correct number of samples is present. Check to see if any samples are broken. Check aqueous VOA sample vials for the presence of bubbles larger than the size of a pea. If bubbles are larger than the size of a pea, a Sample Notification form should be filled out and given to the Project Manager. Check to see that the quantity present is sufficient for the test requested. Make sure the client IDs on the bottles agree with the COC. Check the custody seals, if any, on the sample containers to ensure the all seals are present and intact.

8.1.9 For U.S. EPA samples, sign the COC and note the temperature on the bottom right corner of the COC. Place the project number in the top right hand corner of the COC. Record the following information on the Form DC-1.

- Sign DC-1. Note that the person signing should be the person who signed for receipt on the COC. There will be one DC-1 form for each cooler received for a particular case. Only the samples in that particular cooler will be listed on that DC-1 form.
- EPA Case number from the COC.
- List sample tag control numbers and compare these with the COC records.
- Document whether or not these numbers agree.
- If Sample tag numbers are not listed on the COC form, record this fact.
- Record the custody seal numbers if present.
- Write the work order number on the air bill and place it in the red project folder. Record the name of the courier and the air bill number on Form DC-1.
- Date of receipt.
- Time of receipt.
- EPA sample numbers.
- SDG-Final Sample must be documented on EPA TR/COC.
- SDG (Sample Delivery Group) number. The SDG is the lowest alphanumeric sample on the first shipment and remains the same until the work order is closed.
- EPA sample numbers.
- Assigned Lab ID numbers. Note that with EPA projects, shipments may be received over several days to be added to the same work order, up to twenty field samples, not including PE samples. The SDG number stays the same, but the sample ID numbers run consecutively.
- Whether samples were delivered by hand or not.
- Any problems and discrepancies in "remarks" box.
- The cooler temperature is entered in item #10 of the Form DC-1.

Note from the COC whether the work order is closed, or if more samples are expected to be added (work order/SDG is still open). EPA projects are closed automatically after one week from the date of receipt, for cases with a turnaround time of 14 or 21 days and three days for samples with a turnaround time of 7 days, of the first shipment or sooner if the client checks the box that the project is closed.

Discrepancies in EPA shipments should be reported to the Project Manager directly. Any irregularities in the above information should be documented and the client contacted by either Project Manager or the Sample Custodian. Until an answer is received from the client, samples should be stored in the walk-in cooler.

If there are any discrepancies, note them on the Sample Condition Notification Form and give the form and the workorder folder to the project manager. Samples with

issues will not be processed further, but stored in the walk-in cooler until a resolution has been reached with the client. For CLP (EPA) samples, the Sample Management Office (SMO) will be contacted for corrective action. Communication of the corrective action will be placed in the red project folder.

8.1.10 Log the workorder and samples into the Omega Laboratory Information Management System (LIMS) following procedures described in SOP 20.0003. Labels are generated and attached to each sample container. In the case of pre-preserved samples in VOA vials (sodium bisulfate, DI water and/or methanol), be sure the Mitkem sample ID label does not cover the tare weight of the vials.

8.1.11 Have the project manager or a second person check the Lab IDs on the labels vs. the client IDs on the COC to confirm the bottles have been properly labeled. Ensure the reviewer initials the proper line of the Sample Condition Form or DC-1 form.

8.1.12 Enter the workorder number, date received, and client name in the Sample Receipt and Tracking Logbook (**Attachment 6**). Occasionally, a client wishes for a project number to be ongoing for several shipments of samples (i.e. EPA). In such cases the date of arrival of each subsequent shipment should be noted for the original work order number.

8.1.13 Inorganic preserved samples must now be tested for pH as follows:

For metals, wet chem, etc., pour a small amount of sample over a strip of pH paper that is suspended over the mouth of a waste container. The pH of the acidified samples are taken by using the narrow range pH strips which measures pH 0 to 2.5. The sample pH should be less than two, as indicated by the color on the pH indicator package. The pH of the basic samples are taken by using the narrow range pH strips which measures pH 11.0 – 13.0. The basic samples should have a pH 12 or greater, as indicated by the color of the pH indicator package. (See **Attachment 4** for instructions on the use of the pH paper.) Acidified samples must have a pH of less than 2. Any pH adjustments that need to be made are recorded on the Sample Condition Form for the workorder. Record the lot number and ID of the reagent used and the approximate volume used to adjust the pH. For metals samples requiring acidification, alert the inorganic laboratory to allow 24 hours before metals preparation to allow enough time for the acids to dissolve any metals that adsorb to container walls.

8.1.14 Some samples (i.e. fecal coliform bacteria) which require subcontracting must be done so immediately as the analysis has an extremely short hold time. A list of analyses typically subcontracted can be printed from the LIMS Omega system. An Outside Services Purchase Order is also generated from the LIMS system when the batch of samples to subcontract is created.

8.1.15 Receiving personnel make one copy of the sub contract COC. This COC accompanies the samples and is signed by the laboratory that will perform the analysis. A copy of the COC is placed into the red workorder folder and one copy is sent to Accounting.

8.2 Storage and Location of Samples:

8.2.1 Semivolatile Organic, Pesticides/PCBs, and Wet Chemistry Samples:

Samples are stored in the main walk-in refrigerator (R1) in the sample receipt room at 4° ± 2°C. Once the samples have been placed on a shelf, or shelves, record the location(s) in the Sample Receipt and Tracking Logbook . The person putting the samples into the walk-in must put their initials in the logbook beside the location entries.

8.2.2 Volatile Organic Samples:

Samples for VOA are stored separately from all other samples, in refrigerators or freezers dedicated for this purpose. These refrigerators and freezers are located in the VOA Laboratory. A soil sample for VOA may contain one or more of the sample types listed below. Care must be taken to insure each sample vial type receives the proper handling. Soil samples for volatiles analysis must have special handling performed by the VOA lab staff.

A storage blank must accompany all VOA samples requiring EPA/CLP or New York State ASP analyses when placed in the VOA refrigerators. The storage blanks are prepared in the volatiles department using the VOA Type I water. The 40ml vial is filled so there is **no** headspace, capped immediately and tightly, and labeled with the date prepared and any preservative added. The storage blanks for unpreserved low/medium soil samples are prepared by placing approximately 5 g of inert sand in dry closed-system purge-and-trap vials. These inert sand storage blanks will be stored in the same freezer with unpreserved low/medium soil samples.

8.2.2.1 Samples suspected of containing high concentrations of volatile organics must be stored in a separate VOA refrigerator designated for such samples. This isolates these high concentration samples from other samples, and helps to control cross-contamination.

8.2.2.2 Soil samples in pre-weighed, dry closed-system vials (no liquid inside the vial) should be stored in a VOA freezer (containing no standards or sample extracts). These vials are to be weighed by VOA lab staff prior to analysis.

8.2.2.3 Soil samples that contain up to 5 mL of water. These vials are also to be stored in a VOA freezer. These vials are to be weighed by VOA lab staff prior to analysis.

8.2.2.4 Soil samples that contain 5mL of water containing a sodium bisulfate preservative. These vials are also to be held in a VOA freezer (specifically for EPA CLP samples). Samples for Method 8260 analysis may be held in a VOA refrigerator. These vials are to be weighed by VOA lab staff prior to analysis.

8.2.2.5 Soil samples received in the Encores (typically contained in silver foil pouches), the samples must be extruded into tared, dry closed-system purge-and-trap vials by the VOA lab staff, then re-weighed to obtain the final sample weight. This should happen immediately (for EPA CLP samples), but no longer than 48hours of sample collection. The vials are then to be placed into a VOA freezer.

8.2.2.6 Soil samples may also arrive as methanol preserved samples. These samples do not require freezing, but they shall be held in a VOA refrigerator to be weighed by VOA lab staff prior to analysis. If possible, check that the methanol covers the soil samples within the vial. If the methanol is insufficient, note this on the Sample Condition Form and relay the information to the VOA lab.

8.2.2.7 Unpreserved VOA soil samples should be stored in a VOA freezer (EPA CLP samples) or a VOA refrigerator (for Method 8260 samples) until the time of analysis.

8.2.2.8 Water samples are stored in VOA refrigerators. Trace Volatile samples for the EPA/CLP SOM01.2 contract must be stored in a separate refrigerator from all other samples. At present, this has been designated as **R13 and R4**.

8.2.2.9 Log the samples into the VOA lab. Enter the workorder and other pertinent information in the Volatile Receiving Logbook (See **Attachment** 7) and sign off that the samples have been relinquished. If the samples are ever removed from VOA they must be signed out of the VOA lab as well.

8.2.3 Metals Samples:

Aqueous preserved samples for metals analyses are stored on the rack in the sample receipt area. Once the samples have been placed on a shelf, or shelves, record the location(s) in the Sample Receipt and Tracking Logbook . The

person putting the samples onto the rack must put their initials in the logbook beside the location entries.

Standards must be stored in separate freezers or refrigerators isolated from samples and sample extracts.

8.3 Storage and Location of Extracts:

Extracts for semivolatile analyses must be stored, shielded from light, at $4^{o} \pm 2^{o}C$ in a separate refrigerator stored either in the laboratory or in Unit 3. Extracts for Pest/PCB are stored in refrigerators in the same manner.

Extracts must be stored separately from standards.

Extracts for semivolatiles and Pest/PCB must be stored until the proper time to dispose of them per client approval. Mitkem normally retains sample extracts for a period of three months from the date of delivery of the final report to the client

US EPA CLP and New York State ASP extracts must be stored for 365 days after delivery of a complete data package to the client.

8.4 Temperature Monitoring:

The temperature of the storage areas must be monitored on a daily basis, including weekends and holidays. This temperature must be entered in the Temperature Logbook. If any refrigerator fails, first investigate the problem. Was the door ajar? Is something preventing the door from shutting fully? If the situation can be rectified, do so and record the temperature again after a sufficient period of time. If the deviation occurred at the end of the day, re-record the temp as soon as possible the following morning. When the temperature meets criteria, document the issue and note that the refrigerator/freezer has been "*returned to control*". If there is no obvious issue with the refrigerator/freezer, or the refrigerator does not maintain the correct temperature, the QA Director or Lab Director must be notified immediately to correct the problem. Fill out a report in the LIMS Omega Corrective Action Report option. Acceptable temperature ranges are $2^{o} - 6^{o}C$ for refrigerators and $-10^{o}C$ to $-20^{o}C$ for freezers. The Sample Receiving supervisor or his/her designee will check and record the storage area temperatures daily.

8.5 Tracking of Samples and Extracts:

8.5.1 Samples:

8.5.1.1 Sample Log-out:

When samples are taken from their storage areas for extraction, they must be signed out using the appropriate Sample Receipt Logbook. The log-out procedure is a two-person procedure that requires samples to be relinquished by either the Sample Custodian or Authorized Laboratory Personnel

The analyst retrieves the samples from the walk-in cooler and the Custodian or Authorized Laboratory Personnel checks the sample numbers. The Mitkem sample numbers as well as the bottle # are recorded (i.e. E0140-02B#2). Both people initial and date the Receiving Logbook in the appropriate places. When the sample is logged-out by an analyst, it is considered to be in the custody of that analyst until he/she returns the sample to its storage area.

Upon the sample's return to the storage area the samples are signed into Receiving using the same procedure. This time the analyst relinquishes the samples and the Custodian or Authorized Laboratory Personnel checks the sample numbers to be returned. Each person signs and dates in the appropriate places in the Receiving Logbook.

Authorized laboratory personnel are employees who are knowledgeable in regard to the receipt and log-in of samples. A list of Authorized Laboratory Personnel is posted on the Receiving bulletin board. (See **Attachment 5**).

8.5.1.2 Sample Extraction:

If a sample is signed out for extraction, the sample is logged into the lab by entering the Lab ID into the appropriate extraction logbook. After extraction, any remaining sample volume is returned to the storage area and signed back into the Receiving area for storage as noted in **Section 8.5.1.1**.

When working with samples in the preparation laboratories, the following procedures must be adhered to:

- All activities performed on the sample must be recorded.
- Entries in the logbooks must be signed and dated (mm/dd/yy).
- All entries must be made in ink.
- Corrections and additions must be made by drawing a single line through the errors, entering the correct information, and initializing and dating the new information.
- Unused portions of the logbooks must be lined-out or "Z-ed" out.
- Logbook entries must be made in chronological order.
- For US EPA/CLP samples, entries are recorded for only one SDG on a page, except in the event where SDGs share quality control samples.
- Information inserted in the logbooks must be permanently affixed, signed, and dated across the insert.
- Copies of all pertinent logbook pages must be placed in the workorder file.

° Proper subsampling techniques can be located in the Subsampling SOP, 110.0039.

8.5.1.3 Extracts/Digestates:

The organic sample extracts, once completed by the preparation laboratory, are transferred to the appropriate instrumentation lab and signed into the extract transfer logbook. The analyst will sign for the extracts and enter storage location information. Inorganic metals and mercury digestates are transferred to the instrumentation lab. The analyst signs off on the preparation logbook at time of transfer.

When the time period for organic extract storage has expired, extracts may be disposed of in the same manner as would used/expired standards. CLP extracts must be stored for one year. The transfer and disposal for these extracts must be documented in the Extract Disposal Logbook.

When the time period for inorganic digestate storage has expired, digestates are disposed in the same manner as would used/expired inorganic standards.

See Mitkem SOP No. 30.0024 Sample and Waste Disposal for details on the actual disposal of above extracts/digestates.

8.5.1.4 Sample Disposal:

The unused portion of sample is returned to the Receiving area for long term storage. Such portions must be stored for a certain length of time as required by client contract and then properly disposed. Unused sample is disposed with the use a licensed hazardous waste contractor, currently Univar. Routinely, one of the sample custodians runs the LIMS Omega Disposal program to produce a list of samples ready for disposal. See Mitkem SOP No. 30.0024 Sample and Waste Disposal for details on the different wastestreams and disposal options.

All soil samples received from outside of the 48 contiguous United States must be disposed of following special procedures outlined by the USDA, as detailed in Mitkem SOP No. 30.0024 Sample and Waste Disposal section 8.1.4 Lab Solids, Broken Glass, Methylene Chloride, Acetone.

9. Data Reduction and Calculations

Not applicable.

10. Quality Assurance/Quality Control

10.1 The Sample Custodian will calibrate the temperature gun using an NIST calibrated thermometer on a quarterly basis. The correction factor will be noted on the temperature gun and recorded in the NIST Thermometer Calibration Logbook. The serial number of the NIST thermometer will also be recorded in the logbook.

10.2 On a daily basis, the Project Managers will review that the Sample Condition Forms are filled out correctly.

10.3 Twice daily (typically early morning and mid-day) the temperatures of the refrigerators and freezers will be checked and the temperatures recorded. Deviations will be noted in the logbook. If after 36 hours the temperature problem cannot be corrected with manual adjustments, the refrigerator or freezer will be replaced.

10.4 The Hazardous Waste Inspection Logbook will be completed weekly, after an inspection of the Hazardous Waste shed by a Sample Custodian. Major problems will be reported to the Hazardous Waste Coordinator.

11. Data Validation and Reporting

A copy of the chain of custody and Sample Condition Notification form accompanies the data reports to the client. Also any communication records are to be included in the data package (telephone conversations, e-mail communication, etc.).

12. Corrective Action Procedures

Corrective actions to be implemented in the event QC results are outside of the acceptance range. Notification reports (orange sheets) are generated in the event of an out-of-control situation occurs at sample log-in that cannot be corrected. Project Managers contact the client in order to ensure what type, if any, corrective action needs to be taken. Other corrective actions concerning the Receiving Area are recorded using the Omega LIMS Corrective Action Report.

13. Health and Safety

The sample custodian must wear a lab coat, safety glasses, and gloves when handling samples and preservative chemicals. Samples coolers should be opened under a hood. All samples should be handled as though they are potentially hazardous. The outside of sample containers should also be handled as though they are contaminated. Any broken sample containers must be handled very carefully to prevent exposure to the sample.

14. Pollution Prevention, Waste Management, and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

US EPA CLP SOW SOM01.2
US EPA CLP SOW ILM04.3
US EPA CLP SOW ILM05.4
US ACOE Shell for Chemical Analytical Requirements, Appendix H

Attachments:

1. **Attachment 1**: Mitkem Sample Condition Form.
2. **Attachment 2**: EPA Sample Condition Form (DC-1).
3. **Attachment 3**: Sample Condition Notification Form.
4. **Attachment 4**: Instructions for the use of pH paper.
5. **Attachment 5**: Example Authorized Personnel list.
6. **Attachment 6**: Sample Receipt and Tracking Logbook.
7. **Attachment 7**: VOA Receiving Logbook

Attachment 1
Mitkem Sample Condition Form

MITKEM LABORATORIES
Sample Condition Form

Received By:	Reviewed By:	Date:	MITKEM Workorder #:
Client Project:		Client:	

		Lab Sample ID	Preservation (pH) HNO_3	H_2SO_4	HCl	NaOH	H_3PO_4	VOA Matrix	Soil Headspace or Air Bubbles ≥ 1/4"
1) Cooler Sealed	Yes / No								
2) Custody Seal(s)	Present / Absent								
	Coolers / Bottles								
	Intact / Broken								
3) Custody Seal Number(s)									
4) Chain-of-Custody	Present / Absent								
5) Cooler Temperature									
Coolant Condition									
6) Airbill(s)	Present / Absent								
Airbill Number(s)									
7) Sample Bottles	Intact/Broken/Leaking								
8) Date Received									
9) Time Received									

Preservative Name/Lot No:

VOA Matrix Key:

US = Unpreserved Soil	**A** = Air
UA = Unpreserved Aqu.	**H** = HCl
M= MeOH	**E** = Encore
N = $NaHSO_4$	**F** = Freeze

See Sample Condition Notification/Corrective Action Form yes / no

Rad OK yes/ no

Attachment 2

EPA Sample Condition Form (DC-1)

SAMPLE LOG-IN SHEET
FORM DC-1

Lab Name				Page 21 of 32
Received By (Print Name)				Log-in Date
Received By (Signature)				
Case Number		Sample Delivery Group No.		Mod. Ref. No.

Remarks:			Corresponding		
		EPA Sample #	Sample Tag #	Assigned Lab #	Remarks: Condition of Sample Shipment, etc.
1. Custody Seal(s)	Present/Absent* Intact/Broken				
2. Custody Seal Nos.	_____ _____				
3. Traffic Reports/ Chain of Custody Records (TR/COCs) or Packing Lists	Present/Absent*				
4. Airbill	Airbill/Sticker Present/Absent*				
5. Airbill No.	_____ _____				
6. Sample Tags	Present/Absent*				
Sample Tag Numbers	Listed/Not Listed on Chain-of-Custody				
7. Sample Condition	Intact/Broken*/ Leaking				
8. Cooler Temperature Indicator Bottle	Present/Absent				
9. Cooler Temperature	_____				
10. Does information on TR/COCs and sample tags agree?	Yes/No*				
11. Date Received at Laboratory	_____				
12. Time Received	_____				
Sample Transfer					
Fraction	Fraction				
Area #	Area #				
By	By				
On	On				

* Contact SMO and attach record of resolution.

Reviewed By	Logbook No.
Date	Logbook Page No.

SAMPLE LOG-IN SHEET

Lab Name	Page 22 of 32
Received By (Print Name)	Log-in Date
Received By (Signature)	

Case Number	Sample Delivery Group No.	SAS Number

Remarks:		EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc.
1. Custody Seal(s)	Present/Absent* Intact/Broken				
2. Custody Seal Nos.	_____ _____				
3. Chain of Custody Records	Present/Absent*				
4. Traffic Reports or Packing Lists	Present/Absent*				
5. Airbill	Airbill/Sticker Present/Absent*				
6. Airbill No.	_____ _____				
7. Sample Tags	Present/Absent*				
Sample Tag Numbers	Listed/Not Listed on Chain-of-Custody				
8. Sample Condition	Intact/Broken*/ Leaking				
9. Cooler Temperature	_____				
10. Does information on custody records, traffic reports, and sample tags agree?	Yes/No*				
11. Date Received at Lab	_____				
12. Time Received	_____				
Sample Transfer					
Fraction	Fraction				
Area #	Area #				
By	By				
On	On				

* Contact SMO and attach record of resolution

Reviewed By	Logbook No.
Date	Logbook Page No.

Attachment 3
Sample Condition Notification Form

Sample Condition Notification

Mitkem Project#:_____ **Date of Receipt:**_____
Client:_____ **Received By:**_____
Client project #/name:_____

Unusual Occurance Description:

_____

_____

_____

_____

_____

_____

Client Contacted:

Contacted via: Phone/Fax/E-mail
Date:_____ **Time:**_____
Contacted By:_____
Name of person contacted:_____

Client Response:

Responded via: Phone/Fax/E-mail
Date:_____
Name of person responding:_____
Responding to:_____

_____

_____

_____

_____

_____

Mitkem Action Taken: _____

_____

_____

_____

_____

Attachment 4

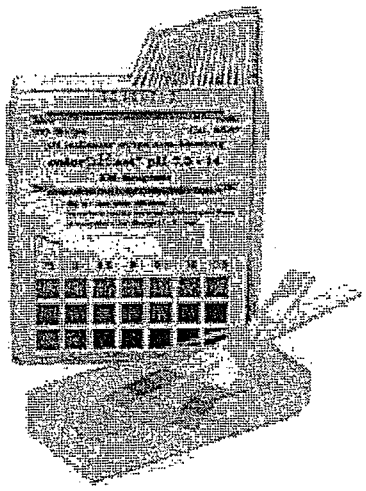
Instructions for use of pH paper

General Procedure for the Use of colorpHast® pH Test Strips

1. Remove a strip from the box.
2. Immerse the reaction zone of the strip into the solution for approximately 30 seconds to 1 minute, allowing enough time for the reaction to take place.
3. Remove the strip from the solution, wiping the strip along the edge of the vessel to remove excess liquid from the strip.
4. Compare the strip's reaction zones to the color chart on the box while holding the strip to the top of the box and the reaction zones to the bottom of the box.
5. Record the results of the closest matching color to the strip.

- *For additional application or product information, ordering information or other technical questions, please call our Technical Service Department at:*

  1-800-222-0342 *or* **1-856-423-6300**



EMD Chemicals Inc.
480 South Democrat Road
Gibbstown, NJ 08027

Phone: 856-423-6300
Fax: 856-423-4389
www.emdchemicals.com

Attachment 5

Example Authorized Personnel list

Sample log-in/out: **Authorized Personnel**		
Name	**Dept**	**Initials**
Anderson, Courtney	Inorganics	*CJA*
Badura, Karolina	PEST/PCB	*KB*
Chiu, Kin	Mitkem	*KC*
Cardoso, Antonio	Oprep	*AC*
Ding, Yihai	Mitkem	*YD*
Ding, Xiangdong	VOA	*XD*
Gaudreau, Veronica	Receiving	*VEG*
Jaffer, Nathan	Inorganics	*NJ*
Healey, Josh	Receiving	*JH*
Kaczorowski, Przemyslaw	Oprep	*PK*
Lawler, Andrew	Oprep	*AEL*
Lawler, Edward	Project Management	*EL*
Lawler, Sharyn	QA/QC	*SBL*
Leveillee, Roy	Oprep	*ROY*
Luo, Wei	VOA	*WL*
Lucas, Derek	PEST/PCB	*DL*
Maczewska, Beata	SVOA	*BM*
Marquis, Ashley	VOA	*ALM*
McGorty, Cassandra	Inorganics	*CJM*
McGovern, Kerri	Inorganics	*KLM*
Mosher, Cassie	SVOA	*CLM*
Montmarquet, Timothy	Mitkem	*TM*
Nadeau, Cory	Receiving	*CAN*
Ng, Agnes	Project Management	*ARN*
Ng, Shirley	Project Management	*SN*
Rosadzinski, Tomasz	Oprep	*TR*
Sawyer, Tom	Inorganics	*TS*
Smart, Dawne	Inorganics	*DES*
Wetherbee, John	Inorganics	*JRW*
Wortley, Stephen	SVOA	*SW*
Veilleux, Brian	Inorganics/Oprep	*BV*
Wieczorek, Agnieszka	PEST/PCB	*AW*
Zharkova, Sofya	PEST/PCB	*SZ*
Zhao-Anderson, Heather	VOA	*HZA*

Most common personnel using log-in/out

Attachment 6

Sample Receiving and Tracking Logbook

MITKEM LABORATORIES, A Division of Spectrum Analytical, Inc.

Sample Receiving Logbook

Workorder No. _____

Client Name: _____

Date Recv'd_____ **Sample #s**_____ **Storage Locations:**_____

Date Recv'd_____ **Sample #s**_____ **Storage Locations:**_____

Date Recv'd_____ **Sample #s**_____ **Storage Locations:**_____

Date Recv'd_____ **Sample #s**_____ **Storage Locations:**_____

Date Recv'd_____ **Sample #s**_____ **Storage Locations:**_____

OUT		IN	
Relinquished By	**Received By**	**Relinquished By**	**Received By**
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			
Date: Init:	Date: Init:	Date: Init:	Date: Init:
Samp. #s			

Comments: _____

_____

Please record analyst's initials, date, and sample #s removed. Add any comments if necessary (broken bottles, empty jars, etc.)
Include the abbreviated name of the test to be performed., ie: SVOA, PCB...near the "samp. #s".
Include bottle or jar number when more than one.

Reviewed:_____

Logbook ID: 30.0287-09/08

Attachment 7

Volatiles Receiving Logbook

MITKEM LABORATORIES: VOLATILE SAMPLES RECEIVING LOGBOOK

VOA Log-In Date	Workorder	Client ID	Sample Numbers	Relinquished by:	Received by:	Pres. Used	F/R	Returned to R1

Logbook ID 90.0191-06/08

Reviewed By:

"Preservative Used" Key

UA = Unpreserved Aqueous **H** = HCL **A** = Air **M** = MeOH **E** = *Encore

US = Unpreserved Soil **N** = $NaHSO_4$ **F** = Freeze **T** = Trace, HCL

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE

for

Sample and Waste Disposal

SOP No. 30.0024

Rev. 8

	Signature	Date
QA Director:		10/17/08
Lab Director:		10/21/08

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE

for

Sample and Waste Disposal

SOP 30.0024 Rev. 8

1. Scope and Application

This Standard Operating Procedure (SOP) outlines the procedures for the disposal of the unused portion of samples submitted for analysis, as well as solid and aqueous wastes and sample extracts to minimize the amount of waste in the lab and organize the manner in which it is handled.

2. Personnel Qualifications and Responsibilities

Personnel handling samples must be aware of the potential dangers posed by the samples, and handle them properly to minimize this danger. Personnel handling samples must also maintain the documented chain of custody of the samples from the time they are received at Mitkem until they become laboratory waste. Laboratory waste must be handled in a safe manner to minimize any exposure to this material.

3. Summary of Procedure

Waste stream manifest profiles have been identified by Mitkem and the waste-disposal company. These profiles dictate how to dispose of each individual waste, as described in this SOP. If any question arises regarding the disposal or classification of waste, the Waste Disposal Technician, or senior laboratory management should be consulted.

Once sample analyses are complete and a final report has been issued to the customer, samples are stored for a specified length of time before disposal. This timeframe is usually dictated by the client. Strict chain of custody documentation is maintained for these samples until samples are disposed into one of several waste streams. This waste is removed from Mitkem by a licensed waste-hauler for final disposal.

Safety equipment will be worn prior to and during any waste disposal. Proper gloves, safety glasses and lab coats or protective outerwear must be worn during all waste disposal activities.

4. Sample Preservation, Containers, Handling and Storage

Not applicable.

5. Interferences and Potential Problems

Not applicable.

6. Equipment and Apparatus

Waste drums. Polyethylene drums are used for liquids (acids or basic/spent CN solutions) and steel open top drums are used for waste solid materials.

Burp-free Ultra Funnel, various sizes, polyethylene funnel used to allow safe pouring of liquid wastes into drums. Product is vented and has locking lid.

Spill kits

Drum Pump

Drum Lift

Satellite Nalgene storage containers with lidded funnels for interim liquid waste storage in Wet Chem, Volatiles and Metals Labs.

Satellite storage containers (red metal Justrite Oily waste Can ,10G capacity) for interim solids storage in Organic Prep, Semivolatiles and Volatiles Labs.

Satellite storage container (Justrite Safety Disposal Can, 2G capacity) for solvent waste in Volatile Lab.

7. Reagents

Not applicable.

8. Procedure

8.1 Classification of Waste:

Laboratory waste products fall under one of the following categories:

8.1.1 Methylene Chloride, Methanol, Water:

Waste solvents are emptied into a solvent drum located in the organic sample preparation laboratory. This waste consists primarily of methylene

chloride with lesser portions of methanol and water. Trace amounts of other solvents may also be included from time to time. Due to the high proportion of methylene chloride in the waste, the material is flammable, and is classified as D001-type waste. Whenever a new drum is started, a Hazardous Waste label is attached to the outside.

When the drums are full the waste drum is taken to the Hazardous Waste storage shed. An accumulation date is added to the Hazardous Waste label on the drum.

Empty solvent bottles are evaporated to dryness and discarded into the general solid waste dumpster (garbage). Glass containers that present a risk of injury should be discarded into a broken glass container for disposal.

Any lab apparatus, gloves, paper towels, etc. exposed to methylene chloride must be discarded into the red solid waste drums in the Organic Prep Lab. The drum must be removed by the Waste Hauler within 90 days of the accumulation date.

8.1.2 Acids, Water:

Acid waste consists of approximately 98% water and 2% acid. This waste stream also includes the remainders of spent or expired metals standards, digested samples, TCLP and SPLP leachates and undigested aqueous samples preserved with acid. This waste is emptied into polyethylene acid waste drums in the hazardous waste area. Acidic waste from the Lachat analysis of nitrate/nitrite or chlorides are stored temporarily in Unit 3 in a small waste container equipped with a closing safety funnel. The container is routinely emptied into this same wastestream. A Hazardous Waste label is affixed to the side of the drum and an accumulation date is recorded on it the first time the drum is started. This waste is classified as D002 type waste. The drum must be removed by the Waste Hauler within 90 days of the accumulation date.

8.1.3 Scintillation Vials, Methylene Chloride, Hexane:

This waste stream consists of Organic analysis vials used for GC and GC/MS analyses. Spent or expired organic standards in solvent are also included in this wastestream. The vials are disposed of unopened. Vials are initially disposed in the GC Analysis Laboratory in a red metal drum. When this drum is full, the contents are removed to the Hazardous Waste Shed and dumped into a steel drum. A Hazardous Waste label is affixed and the drum removed by the Waste Hauler within 90 days of the accumulation date. This waste is classified as D001 waste.

8.1.4 Lab Solids, Broken Glass, Methylene Chloride, Acetone:

This waste stream contains the remainders of solid and soil samples. This waste stream also includes laboratory solid waste that has been stored in the red metal drums in the Organic Prep Lab. When full the laboratory red metal containers are taken to the Hazardous Waste shed and the contents dumped into the waste solids drum. A Hazardous Waste label with an accumulation date is affixed to the outside of the drum and is later removed by the Waste Hauler within 90 days of the accumulation date. This waste has no RCRA Characterization code.

Any solid matrix samples received from outside of the 48 contiguous United States, or from any other area identified by the client as a US Department of Agriculture Soil Quarantine Area must have special disposal in order to kill any quarantined organism. Samples identified as such, along with their entire container including jar cover, are placed in a disposable aluminum pan and placed in the kiln (in Unit 3) and heated to 400 degrees for 30 minutes. After the pan has cooled, the sample(s) and aluminum pan(s) are disposed in the waste soil/solid drum.See **Attachment 1** for incineration procedures.

8.1.5 Glass Vials, Methanol, Water, Soil:

This waste stream consists of primarily 40-ml organic analysis vials used for VOA analyses. The vials are disposed of unopened. Vials are initially disposed in the VOA Analysis Laboratory in a red metal drum. When this drum is full, the contents are removed to the Hazardous Waste Shed and dumped into a steel drum. A Hazardous Waste label is affixed and the drum removed by the Waste Hauler within 90 days of the accumulation date. This waste is classified as D001 waste.

8.1.6 Spent Carbon with Methylene Chloride:

This waste stream contains the remainders of Mitkem's discharge. Discharge is run through tanks of carbon material as a means of removing methylene chloride. When the tanks are fully deactivated, the carbon is removed and dumped into a steel drum. The tanks are then filled with activated carbon. A Hazardous Waste label with an accumulation date is affixed to the outside of the drum and the drum is later removed by the Waste Hauler within 90 days of the accumulation date. This waste stream is not associated with any RCRA Characterization code.

8.1.7 Electronic Device with Beryllium Oxide:

This waste stream contains the power tube of an ICP spectrophotometer. Because of beryllium in the tip of the tube, it cannot be disposed of with

ordinary trash. The tube is placed in a sealed cardboard box and a Hazardous Waste label with an accumulation date is affixed to the outside of the box. The box is later removed by the Waste Hauler. This waste stream is not associated with any RCRA Characterization code.

8.1.8 COD Vials:

This waste stream consists of glass tubes that contain a mixture of mercuric sulfate, silver sulfate, sulfuric acid, and chromic acid. The tubes are used for COD analyses and are disposed unopened in their entirety. Vials are initially disposed in the Wet Chemistry Laboratory in a covered cardboard box with a Hazardous Waste Label. When this box is full, the contents are removed to the Hazardous Waste Shed and dumped into a steel drum. A Hazardous Waste label is affixed and the drum removed by the Waste Hauler within 90 days of the accumulation date. This waste is classified as D002, D009, D011 waste.

8.1.9 Lab Pack Waste:

From time to time, waste or unused chemicals (non-solvents) will require disposal. These materials are segregated and placed in a lab pack container. An inventory of materials is maintained for the lab pack drum. The materials are stored in the laboratory in a closed cardboard box with a Hazardous Waste label attached. Consult the waste hauling company when sufficient volume of material is present in the laboratory to initiate a lab pack.

8.1.10 PCB Waste:

Any PCB-containing material (at a concentration of greater than 50 ppm) must be segregated and disposed according to PCB-specific procedures. This material would generally consist of any oil sample containing over 50 ug/g (ppm) of PCB. Samples containing this high concentration of total PCB will be identified by the GC Laboratory Manager or the Laboratory Director. The container for this sample will be prominently labeled "for return to client" when the holding period (as identified in **Section 8.2.1** below) is reached. The Mitkem project manager will be notified, as will the client, with a notation in the report Project Narrative or Cover Letter that the sample will be returned.

8.1.11 Water/Sodium Hydroxide/Pyridine:

This waste stream consists of sulfide and cyanide digestates and spent standards. Pyridine waste from the analysis of Cyanide (Lachat), and basic pH Ion Chromatography (IC1) wastes are stored temporarily in Unit 3 in several small waste containers equipped with closing safety funnels.

The containers are routinely emptied into a polyethylene Basic Waste drum in the hazardous waste area. This waste is classified as D002, D038 waste

8.2 Procedure for Disposal of Sample Remainders:

8.2.1 Determination of Disposal Date:

Samples are held for a period of time following receipt at the laboratory or release of the final report to the client. Mitkem's policy is to hold samples for a specified length of time. On a case-by-case basis, arrangements may be made between the client and Mitkem through discussion with the Mitkem Project Manager. This agreement is then saved in LIMS in the individual Client Project. Default values are used otherwise. To review the Sample Hold Times and Disposal Options on a particular workorder, go to the Report Option at the Workorder Main screen.

For CLP, samples are held for 60 days after delivery of the reconciled data package. Sample extracts must be stored at 4°C until 365 days after delivery of a complete, reconciled data package to EPA.

8.2.2. Documentation of Sample Disposal:

When the specified hold time has passed since the receipt date, the samples can be disposed. Sample receiving personnel select sample remainders from their storage locations and remove these to a designated location outside of the sample receiving area for disposal by Sample Receiving or laboratory personnel. Documentation that sample remainders have been disposed is maintained in the Mitkem Omega LIMS. When samples are removed from storage for disposal the person removing them enters the disposal date and their initials into LIMS.

8.2.3. Final Disposal and Record keeping:

All samples are to be disposed of according to **Section 8.1**.

Once waste drums are full, approximately bi-monthly, the waste hauling company is called to schedule a pick-up. Mitkem currently uses Univar to arrange for disposal of laboratory waste. Univar will remove the waste from the Mitkem storage area, and arrange with Pollution Control Industries (PCI) in Michigan for ultimate disposal of the waste material. Waste manifests are initiated by the hauler, signed by the QA Director or his designee when drums are loaded on the hauler's truck, signed and mailed back to Mitkem following final disposal. Manifests are filed

according to date in the QA office. Mitkem's Generator Number is **RI5000009621**.

9 Data Reduction and Calculations

Not applicable.

10 Quality Assurance/Quality Control

The Hazardous Waste Inspection Logbook will be completed weekly after an inspection of the Hazardous Waste shed by a Sample Custodian. Major problems will be reported to the Hazardous Waste Coordinator.

11 Data Validation and Reporting

After sample disposal, the disposal dates are entered into the LIMS for each workorder. In addition, the samples'storage location is changed to "disposed".

12 Corrective Action Procedures

Corrective actions concerning sample or waste disposal are recorded using the Omega LIMS Corrective Action Report under the Receiveing Department or another lab area involved in the issue. Corrective actions should implemented in the event of an out-of-control situation involving sample or waste disposal that cannot be easily corrected. The sample custodian should contact the Safety team, Hazardous Waste Coordinator or Lab Director for help determining what corrective action needs to be taken.

13 Health and Safety

Each employee is directly responsible for complete awareness of all health hazards associated with every chemical that he/she uses. The employee must be aware of these hazards and all associated protective wear and spill clean-up procedures PRIOR TO THE USE of any chemical. In all cases both the applicable MSDS and supervisor or Safety Officer should be consulted. The employee should comply with all safety policies as presented in the Mitkem Safety Manual. Bottle or container labels also provide important information that must be noted. Proper gloves, safety glasses and lab coats or protective outerwear must be worn during all waste disposal activities.

All laboratory employees who either sign a Hazardous Waste manifest or handle hazardous waste directly must attend an annual RCRA training class. At this time Summit Technologies of New Hampshire provides the necessary on-site training for Mitkem's laboratory personnel.

14 Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15 References

None.

Attachments:

1. **Attachment 1**: Instructions for the Kiln.

Attachment 1

Instructions for the Kiln

LABORATORIES
MITKEM ~~CORPORATION~~ 3/18/08
A Division of Spectrum Analytical, Inc
STANDARD OPERATING PROCEDURE

for

Sample Preparation of Aqueous Samples by Acid Digestion for ICP

SOP No. 100.0003

Rev. 6

	Signature	Date
QA Director:	[illegible]	5/23/06
Lab Director:	[illegible]	5/23/06

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE

for

Sample Preparation of Aqueous Samples by Acid Digestion for ICP

Rev. 6

1. Scope and Applications

This Standard Operating Procedure (SOP) deals with the preparation of aqueous samples for analysis by USEPA SW846 6010. Discussion includes sample extraction and sample concentration technique and analysis of dissolved metals or total/ total recoverable metals in aqueous samples using methods SW-846 SW3005/3010.

2. Personnel Qualifications and Responsibilities

This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method. Analysts are responsible for performing analyses in accordance with this SOP and documenting any variations in the protocol. Supervisors/lab managers are responsible for ensuring that this SOP is accurate and up to date, and that it is implemented appropriately. Supervisors/lab managers review the logbooks and data generated for this procedure and approve all reported results.

3. Summary of Procedure

A 50mL aliquot of an aqueous sample is digested with acid prior to metals analysis by Inductively Coupled Argon Plasma (ICAP).

4. Sample Preservation, Containers, Handling, and Storage

4.1 The hold time for ICAP analysis is 180 days from the date of sample collection.

4.2 Aqueous samples for Total metals analysis must be preserved with concentrated HNO_3 to a pH of less than 2 and stored in an amber glass or polyethylene bottle.

4.3 Aqueous samples for dissolved metals must be filtered through 0.45um filter paper prior to preservation with concentrated HNO_3 to a pH <2.

5. Interferences and Potential Problems

Possible contamination:

5.1 Hood fall-out.

5.2 Acid bath for glassware contaminated.

5.3 Acid dispensers.

5.4 DI water rinsing bottles contaminated.

5.5 Poor lab technique.

5.6 Cross-contamination from high-level samples.

5.7 Sample matrix effects: Extreme organic samples.

6. Equipment and Apparatus

Equipment used in this preparation method include:

6.1 10% HNO_3 acid bath, reagent grade acid.

6.2 50 mL Polyethylene centrifuge/digestion tubes with caps, Stockwell Scientific, Zefon Catalog # SS-3261.

6.3 Polyethylene ribbed Watch Glasses.

6.4 Whatman 41 filter paper (if necessary).

6.5 50 ml Plastic funnels (if necessary).

6.6 Thermometers- NIST Calibrated (0-100°C)

6.7 Hot plates with graphite tube holders for even heating.

6.8 Wide range pH paper, 0-14, Whatman ColorPHast.

6.9 Narrow range pH paper 0-2.5, Whatman ColorPHast.

6.10 Eppendorf and/or Wheaton pipettes.

6.11 Beckman GPR Centrifuge.

7. Reagents

The following reagents are used during sample preparation:

7.1 Concentrated HNO_3, Fisher, ACS trace metals grade.

7.2 Concentrated HCl, Fisher, ACS trace metals grade.

7.3 1:1 (v/v) HCl, Fisher, ACS trace metals grade.

7.4 Spiking solutions, High Purity Standards.

7.5 Laboratory Control Sample Solutions, High Purity Standards.

8. Procedure

8.1. Digestion of highly colored total water samples for ICAP Analysis **(Method 3010)**:

Enter Lab ID #'s of all the samples to be digested into the proper column in the Sample Digestion Logbook. All volumes of reagents added as well as the initial and final volumes must be entered in this Logbook.

8.1.1. The sample pH should have been checked at the time of reciept in sample Log-in. Prior to analysis, re-check the pH for aqueous samples using the wide range pH paper (pH should be <2). If the pH strip color is more red than magenta, or there is any doubt of the pH being less than 2, validate the pH with the narrow range pH paper which measures pH 0 to 2.5. -Enter observations in the appropriate column in the Logbook and adjust and note the pH if not less than 2. If pH adjustment needs to be done, be sure to notify the client first. Acidify the sample with concentrated HNO_3 to a pH <2. Document all pH adjustments. Shake sample well and let it sit for 24 hours before digestion.

8.1.2. Transfer 50 mL of sample into a plastic digestion tube using the graduated marking on the tube to reach volume.

8.1.3. Add 1.5mL conc. HNO_3 to the sample.

8.1.4. Cover with a ribbed watch glass.

8.1.5. Place the tubes in the graphite holders, on a hotplate, inside the inorganic hood (PVC ducting).

8.1.6. Heat at 95°C (90°C – 95°C is an acceptable temperature range) until the sample volume has been reduced to approx. 2.5 –5.0mL. Do not boil the sample or let it go dry.

8.1.7. Take tubes off the hotplate and allow them to cool to room temperature.

8.1.8. Add another 1.5mL of conc. HNO_3 to each sample.

8.1.9. Heat the sample again and reduce to 1.5 –3.0 mL, ensuring a reflux action occurs.

8.1.10. Continue to add HNO_3 in 1.5mL aliquots until digestate appears pale in color. (Add no more than 5mL conc. HNO_3.)

8.1.11. Cool the tube and add 5mL of 1:1 (v/v) HCl.

8.1.12. Heat for an additional 15 minutes.

8.1.13. Rinse the walls of tube with DI water.

8.1.13.1. If the sample is not to be filtered, volumize the sample back to 50 ml with DI water using the graduation on the tube to obtain the proper volume.

8.1.13.2. If sample needs to be filtered, volumize the sample to 50 ml and filter through Whatman 41 filter paper. Do not rinse filter.

8.1.14. All digestion information is documented in the Aqueous Metal Prep Logbook, **figure 1**.

8.1.15. Assign the samples to a preparation batch using Mitkem's LIMS system.

8.1.16. Transfer logbook and digestates to the Inorganic Instrument Lab.

8.2 Digestion of Dissolved or Total/Total Recoverable Aqueous Samples and Leachates for ICAP Analysis **(Method 3005)**:

Enter Lab ID# of all samples to be digested into the proper column in the Sample Digestion Logbook. All volumes of reagents added as well as the initial and final volumes must be entered in the Logbook.

8.2.1 Dissolved samples must be filtered first through 0.45um filter paper and preserved with conc. HNO_3. Typically this is done in the field however, if

samples arrive at Mitkem requiring filtration, it should be done ASAP. Our general goal is within 24 hours of receipt.

8.2.2 Transfer a 50mL aliquot of the sample to a plastic digestion tube using the graduated marking on the tube to reach volume.

8.2.3 Add 1mL of conc. HNO_3 and 2.5mL of conc. HCL.

8.2.4 Heat to 90-95°C in graphite holders on hotplates in the hood. Cover each tube with a ribbed watch glass and evaporate until the sample volume equals 7.5-10ml.

8.2.5 Remove tube and allow to cool.

8.2.6 Rinse the walls of the beaker with DI water and volumize to 50mL with DI water.

8.2.7 If insoluble material remains, volumize sample to 50 ml and filter through Whatman 41 filter paper, or centrifuge.

8.2.8 Record all digestion information in the Aqueous Metal Prep Logbook, see **figure 1**.

8.2.9 Assign the samples to a preparation batch using Mitkem's LIMS system.

8.2.10 Transfer logbook and digestates to the Inorganic Instrument Lab.

9. Data Reduction and Calculations

Not applicable.

10. Quality Assurance/Quality Control

Quality assurance and quality control (QA/QC) procedures are established to ensure generation of data of known quality. QA/QC procedures associated with the Inorganic Prep Lab include preparation of Method Blanks, Lab Control Samples, matrix spikes and sample duplicates.

10.1 Method blanks:

A method blank must be run with every discrete batch of samples that is prepped. The number of samples per batch may not exceed 20.

10.1.1 Use 50mL of DI water as the method blank for aqueous sample preparation. Prep this sample as described in **Section 8**. Label appropriately (see **Section 10.4**)

10.2 Laboratory Control Samples:

A laboratory control sample containing all target analytes must be prepped and analyzed for each batch of samples. The number of samples per batch may not exceed 20.

10.2.1 For water samples: measure approximately 40 ml of DI water as if it were a sample and add High Purity Standard CLP-CV-1 at 455µL; CLP-CV-2 and CLP-CV-3 at 45.5 µL each. Prep this sample as described in **Section 8**. Label appropriately (see **Section 10.4**)

10.3 Matrix Spikes and Duplicate Samples:

10.3.1 With at least every 20 samples a sample duplicate and sample spike (containing all target analytes)must be prepped and analyzed by the laboratory. Prepare 3 digestion tubes to be used for the same aqueous sample. Designate one tube as the sample, one as the duplicate of that sample, and the other as a spiked portion of the sample. Into each tube, measure 50mL of sample (the same sample).

Spike Sample:

Add three spiking standards; High Purity Standard CLP-CV-1 at 455µL; CLP-CV-2 and CLP-CV-3 at 45.5µL each to the sample. Label this sample: "LabID"'MS'.

Sample Duplicate:

Label the other additional 50mL of sample as "LabID"'D'. This is an exact duplicate of the original sample. Digest the sample duplicate as described in **Section 8**.

10.4 Standard Preparation

10.4.1 All standards made from a primary standard expire on or before the primary standard's expiration date. For standards without manufacturer-designated expiration dates, the expiration date will be 1 year from receipt.

10.5 Digestion Tubes

10.5.1 All lots of digestion tubes must be tested for conformance. A group of 10 tubes are measured for volume by weight. The weights are recorded and the average weight is calculated. If the average weight is less than or equal to 3 % of the true value, the lot of tubes are considered valid.

10.6 Pipettes: Two sizes of pipettes are used in the method.

10.6.1 0 to 1000ul: Five replicate weights are recorded. The average of the five replicates is calculated. If the average weight is less than or equal to 3 % of the true value, the pipette is acceptable for use.

10.6.2 0 to 100ul: Five replicate weights are recorded. The average of the five replicates is calculated. If the average weight is less than or equal to 1 % of the true value, the pipette is acceptable for use.

11. Data Validation and Reporting

Data generated in the inorganic preparation laboratory will be reviewed and signed by a peer, the supervisor or the manager.

12. Corrective Action Procedures

12.1 If the method blank concentration for any analyte is greater than the established method criteria, the samples will be scheduled for re-prep by the metals analyst/supervisor.

12.2 If the LCS is outside of control limits, the samples will be scheduled for re-prep by the metals analyst/supervisor for those elements that failed.

12.3 If a Spike sample was not spiked, the sample will be scheduled for re-prep by the metals analyst/supervisor.

13. Health and Saftey

Health and safety hazards in the Inorganic Preparation Laboratory (prep lab) include exposure to concentrated acids, their fumes and toxic metals standards. Labcoats, gloves and safety glasses must be worn in the prep lab at all times.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. Reference

1. U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Update 3 Method 3005.

2. U.S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, Update 3 Method 3010.

Attachments

Figure 1: Aqueous Metal Prep Logbook

Figure 1
Aqueous Metal Prep Logbook

MITKEM LABORATORIES: Aqueous Metals Preparation Logbook

Date	Sample ID		Client ID	Sample Vol (ml)	pH	Sample Color Before	Clarity Before	Conc. HNO_3 (ml)	Conc. HCl (ml)	1:1 HCl (ml)	Sample Color After	Sample Clarity After	Final Volume (ml)	Comments	Analyst

HCI Lot# _____

HNO3 Lot# _____

Method: _____

Digestion Temp: _____ **oC**

LCSS/Spike ID: _____

_____

_____

SOP#: _____

Digestate Relinquished to: _____

Logbook ID 100.0125 -01/08

REVIEWED BY: _____

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MITKEM LABORATORIES,
A Division of Spectrum Analytical, Inc.

STANDARD OPERATING PROCEDURES

for

Mercury Analysis in Aqueous and Soil Samples by Flow Injection Mercury System (FIMS) for Atomic Absorption

by

SW846 Method 7470A/7471B

Rev. 9

	Signature	Date
QA Director:		11/6/08
Lab Director:		11/6/08

MITKEM LABORATORIES,
A Division of Spectrum Analytical, Inc.

STANDARD OPERATING PROCEDURE

for

Mercury Analysis in Aqueous and Soil Samples
by Flow Injection Analysis System
for Atomic Analysis

by

SW846 Method 7470Aand 7471B

Rev. 9

1. Scope and Application

This SOP describes the procedures applicable to the preparation and analysis of mercury in aqueous and soil samples. Matrices include ground waters, aqueous samples, soils, sediments, sludges, and TCLP. All samples require digestion prior to analysis.

2. Personnel Qualifications and Responsibilities

Personnel must be qualified according to the requirements of their job descriptions and trained for this procedure prior to analyzing samples. **Analysts and technicians** are responsible for performing analyses in accordance with the SOP and documenting any variations in the protocol. **Supervisors/Managers** are responsible for ensuring that SOPs are accurate and up-to-date, and that they are implemented appropriately. **Supervisors/Managers** review the logbooks and data generated from this procedure and approve all reported results.

3. Summary of Procedure

3.1 The aqueous samples are digested with concentrated HNO_3, concentrated H_2SO_4, potassium permanganate and potassium persulfate at 95°C. The procedure converts various organically bound compounds and inorganic forms

of mercury into mercuric ions, which can be analyzed with a Flow Injection Analysis System (FIAS) for atomic spectroscopy. The soil/sediment samples are digested using aqua regia and potassium permanganate at 95±3°C and analyzed same as the aqueous samples.

3.2 The mercury ions formed during the digestion step are reduced to the elemental state and aerated into an absorption cell. Absorbance is measured at 253.7nm and is a function of mercury concentration.

4. Sample Preservation, Containers, Handling and Storage

4.1 Samples are collected by the client and submitted for analysis in pre-cleaned sample containers provided by the laboratory. For mercury analysis by SW 846 method 7470A water samples are collected in one-liter plastic containers and preserved (acidified) with nitric acid to a pH of less than 2. Sample volume requirements depend upon the number of different preparation procedures necessary for the analyses requested. Additional sample volume may also be required for the analysis of laboratory QC samples.

4.2 All samples are stored at room temperature until analyzed.

4.3 Sample hold time for mercury analysis by SW 846 methods 7470A and 7471B is 28 days from date of sample collection.

5. Interferences and Potential Problems

5.1 Sulfides at levels above 20 mg/L or 20mg/Kg interfere. Potassium permanganate is added to the samples to eliminate possible interference of sulfides.

5.2 Copper at levels above 10 mg/L or 10mg/Kg interfere.

5.3 Seawaters, brines and industrial effluents high in chlorides interfere and require additional potassium permanganate for conversion to free chlorine. Free chlorine also absorbs radiation at 253.7nm. Therefore, the free chlorine is removed by addition of hydroxylamine sulfate reagent. In addition, the dead air space in the BOD bottle must be purged before adding the stannous sulfate.

5.4 Some volatile organic materials absorb at 253.7nm and may interfere.

6. Equipment and Apparatus

Equipment and instrumentation used in this analysis method include:

6.1 Equipment:

6.1.1 Perkin-Elmer FIMS 100.

6.1.2 Printer.

6.1.3 Wheaton BOD bottles.

6.1.4 Top loading balance - capable of accurate measurement to 0.01gram.

6.1.5 Hot Plate with graphite block digestor

6.2 Preventative Maintenance:

6.2.1 Pump tubing is replaced every 48 hours of instrument run time.

6.2.2 The windows of the optical cell are cleaned whenever the cell is replaced.

6.2.3 The inside of the optical cell is cleaned once every 48 hours of instrument run time.

6.3 Troubleshooting - Refer to the FIMS Analysis manual.

6.4 Glassware

6.4.1 100mL Class "A" volumetric flasks.

6.4.2 Class "A" volumetric pipettes ranging from 10µL to 1.0mL.

6.4.3 100 and 250mL Class "A" graduated cylinder or equivalent.

7. Reagents

7.1 Sulfuric Acid: Ultra Trace Grade

7.2 Nitric Acid: Ultra Trace Grade

7.3 Reagent water (ASTM Type I water). Mitkem's water system consists of a Culligan high volume, 1 Megohm feed water system, combined with a Millipore Milli-Q, four bowl, high purity system. Reagent water is also referred to as DI water.

7.4 Stannous chloride solution:
15 g $SnCl_2$ to 1000mLs of 3% HCl solution.

7.5 Sodium chloride-hydroxylamine sulfate solution:
12 g NaCl and 12g hydroxylamine sulfate to 100mLs of reagent water.

7.6 5% Potassium permanganate solution:
Dissolve 50g of $KMnO_4$ in 1000mLs of DI H_2O.

7.7 5% Potassium persulfate solution:
Dissolve 50g of $K_2S_2O_8$ in 1000mL of DI H_2O.

7.8 Stock mercury solution(Primary):
1000 mg/L purchased commercially.

7.9 Stock mercury solution(Independent Source):
1000 mg/L purchased commercially.

7.10 Mercury standards are stored in Wet Chem cupboards. Expiration dates for the standards are either the date one year from date of receipt or that designated by the manufacturer whichever comes first. Reagents and intermediate standards have a 28-day hold time.

7.11 3% HCl: 30mL concentrated HCl diluted to 1L with DI H_2O.

7.12 HCl: conc., Ultra Trace grade.

7.13 Aqua Regia: prepare immediately before use by carefully adding three volumes of conc. HCl to one volume HNO_3.

8. Procedure

8.1 Preparation

8.1.1 Aqueous Samples: Transfer 100mL of sample or an aliquot diluted to 100mL to a reagent water-rinsed BOD bottle with a graduated cylinder. Add 5mL concentrated H_2SO_4 and 2.5mL concentrated HNO_3, mix. Add 15mL of potassium permanganate solution. Additional permanganate may be required until the purple color persists for at least 15 minutes. Add 8mL potassium persulfate solution; mix. Heat for 2 hours at 95°C on hot plate with graphite holders. Cool samples and add 6mL sodium chloride-hydroxylamine sulfate solution to reduce the excess permanganate. **CAUTION**: do this addition under the hood, Cl_2 could be evolved.

Record all volumes and reagents in the Mercury Digestion logbook , **Attachment 1**. Immediately prepare for analysis.

8.1.2 Soil Samples: Weigh a 0.50 – 0.60g portion of a well homogenized untreated sample and place in the bottom of a BOD bottle. See SOP 110.0039 for sub-sampling techniques. Add 5mL of reagent water and 5mL of aqua regia. Heat 2 minutes on hot plate with graphite holders at 95±3°C. Cool; then add 50mL reagent water and 15mL of the potassium permanganate solution to each sample bottle. Mix thoroughly and place on hot plate with graphite holders for 30 minutes at 95±3°C. Cool and add 6mL of the sodium chloride – hydroxylamine sulfate solution to reduce the excess permanganate. **CAUTION**: do this addition under the hood, Cl_2 could be evolved. Add reagent water to a final volume of 100mL. Pour an aliquot into a polyethylene tube for analysis. Be careful to avoid pouring the sediment into the tube. Record all volumes and reagents in the Mercury Digestion logbook, **Attachment 1**.

8.2. Calibration Standards

8.2.1 Working Calibration standards are prepared from a mercury intermediate standard at 500µg/L. The intermediate is prepared by pipetting 50µL of 1000mg/L Primary stock standard into a 100mL volumetric flask. Bring up to volume with 3% HCl.

Label standard as IIyymmdd#, where:

I I = Inorganic Intermediate
yy = year of preparation
mm = month of preparation
dd = day of preparation and
# = Sequential letter of intermediate standards prepped on this day.

All standard preparation information is documented in the Metals Standard Receipt/Preparation Logbooks (Primary, Intermediate and Working).

Into BOD bottles containing approximately 10mL DI H_2O, pipet the following volumes of intermediate standard in order to achieve the corresponding final working standard concentrations:

Volume	Concentration (µg/L Hg)	Standard ID
40µL	0.2	S1
200µL	1.0	S2
400µL	2.0	S3

1mL	5.0	S4
2mL	10.0	S5
0mL	0.0	S0

8.2.2 Depending on the matrix of samples being prepared, follow the digestion as follows:

8.2.2.1 Soil Calibration standards, add 5mL of aqua regia. Heat 2 minutes on hot plate with graphite holders at 95±3°C. Cool; then add 50 mL reagent water and 15 mL of the potassium permanganate solution to each sample bottle. Mix thoroughly and place on hot plate with graphite holders for 30 minutes at 95±3°C. Cool, transfer to the Mercury Analysis Lab where 6mLs of the sodium chloride – hydroxylamine sulfate solution will be added to reduce the excess permanganate. **CAUTION**: do this addition under the hood, Cl_2 could be evolved. Calibration working standards are prepped with each batch of samples and undergo a digestion of at least 30 minutes. Soil standards are brought up to 100mL final volume with DI H_2O prior to analysis.

8.2.2.2 Aqueous Calibration standards, add approximately 90 mL DI H_2O to each BOD bottle. Add 5mL concentrated H_2SO_4 and 2.5mL concentrated HNO_3, mix. Add 15mL of potassium permanganate solution. Additional permanganate may be required until the purple color persists for at least 15 minutes. Add 8mL potassium persulfate solution; mix. Heat for 2 hours at 95°C on hot plate with graphite holders. Cool, transfer to the Mercury Analysis Lab where 6mLs of the sodium chloride – hydroxylamine sulfate solution will be added to reduce the excess permanganate. Do not volumize to 100 mL with DI H_2O prior to analysis. **CAUTION**: do this addition under the hood, Cl_2 could be evolved

8.2.3 A Calibration Blank, ICB/CCB, is prepared as the S0 calibration standard.

Sample concentrations are not reported below the lowest calibration standard of 0.2ug/L (aqueous samples, or 0.033 mg/Kg for soils) without method modification. This effectively becomes the method reporting limit (MRL) also referred to as Project Quantitation Limits (PQL).

8.2.4 ICV/CCV Intermediate standards are prepared at 5.0µg/L from an **Independent Source** Hg Primary stock standard. The intermediate

Hg CCV standard is prepared by pipetting 50µL of 1000mg/L Hg into a 100mL volumetric flask. The standard is brought to volume with 3%HCl for a final concentration of 500ug/L.

8.2.5 The working ICV/CCV is prepared by pipetting 1mL of the above intermediate standard into a BOD bottle and digesting as in **section 8.2.2.** An ICV/CCV is prepped with each batch of samples. Final concentration is 5µg/L and the standard is labeled as a mercury working calibration standard:

Label standard as IWyymmdd#, where:

I W = Inorganic Working
yy = year of preparation
mm = month of preparation
dd = day of preparation and
# = Sequential letter of intermediate standards prepped on this day.

8.2.6 LCS/Matrix spike standard is also an intermediate concentration standard that is prepared by combining 45.5 uL of the **Independent Source** Hg Primary stock standard into a 100 mL volumetric flask and volumized to 100 mL with 3% HCl. The standard is labeled as for Hg working standards, as in **section 8.3**.

8.2.7 1mL of the above LCS/Matrix spike is added into 100 mL of DI H_2O and digested as an aqueous sample for the LCS-Water (LSCW) as in **section 8.1.1** . The true value of the LCS = 4.55µg/L at the instrument level.

8.2.8 1mL of the LCS/spike working spike is added to 0.6 g of acid-washed Teflon chips used to simulate a soil matrix for the LCS-Soil (LCSS). The true value of the LCS = 4.55µg/L at the instrument level.

8.2.9 1mL of the LCS/spike working spike is added to a chosen sample, and digested as per the sample matrix. This is the Matrix Spike. At the time of analysis, the spike = 4.55µg/L at the instrument level, times any sample dilution factor.

8.3 Instrumental Analysis

8.3.1 Adjust the argon pressure to 44psi for FIMS analysis. Turn on the FIMS system with the auto-sampler. Turn on the computer, printer. Allow the lamp to stabilize for 35-45 minutes.

8.3.2 Prepare the reductant solution, stannous chloride in **section 7.4**, and the carrier solution, 3% HCl in **section 7.11**.

8.3.3 Bring up the appropriate element file (Hg comm).

8.3.4 Set up the sample info file to coincide with the locations and sample identifications that will be analyzed in the run.

8.3.5 Fill out the Automated Control Window:

8.3.5.1 Type in a data file name.

8.3.5.2 Type in the name of the sample info file.

8.3.6 Load the auto-sampler tray.

8.3.7 Place the carrier tubing inlet into the carrier solution, and the reductant tubing inlet in the reductant solution. The reductant solution tubing has a red tab on it, and the carrier solution a yellow tab. Remove the cap from the gas chamber and start the pump to ensure it is working properly. Turn off the pump and replace the cap.

8.3.8 Hg lamp intensity, measured as absorbance for the 10ug/L mercury standard, is recorded daily in the instrument run logbook.

8.3.9 On the AS-90 control window either click on "Run All" to run both standards and samples or "Calibrate" to run only the standards. If you choose only to calibrate at this time, you will need to click on "Reset Sampler" and "Run Samples" when calibration is complete. Analyze standards and samples. Samples that exceed the upper calibration range must be diluted and reanalyzed.

8.3.10 When analysis is complete place both carrier tubing inlet and the reductant tubing inlet with the auto-sampler probe in a beaker of DI water. Allow the water to pump through the system. Continue to flush all the water through until no more bubbles appear in the waste tubing. Turn off the pump.

8.3.11 Turn off the FIMS unit.

8.3.12 No rinse between samples is necessary per manufacturer's instructions.

8.3.13 The following Analytical Sequence should be used.

1. Calibration Blank(S0)
2. Standard #1 (S1)
3. Standard #2 (S2)
4. Standard #3 (S3)
5. Standard #4 (S4)
6. Standard #5 (S5)
7. ICV
8. ICB
9. Method blank
10. LCS
11. Samples (≤6)
12. CCV
13. CCB
14. MS
15. Sample Duplicate
16. Serial dilution
17. Samples (<5)
18. CCV
19. CCB

8.3.14 All information including the analytical sequence is documented in the FIMS 100 Run Logbook, **Attachment 2.**

9. Data Reduction and Calculations

9.1 Sample data should be reported in units of ug/L for aqueous samples, and ug/Kg dry weight for soils/solids. Results are reported to two significant figures.

9.1.1 For aqueous results, report the data generated directly from the instrument with allowance for sample dilution. Upload the data from the FIMS directly into the Omega LIMS system for reporting.

9.1.2 For soil/solid samples, upload the data as for aqueous samples. The LIMS will calculate the final results in soil units, with allowance for dilution, sample weight and percent moisture.

9.2 Recovery calculations - the recovery of a spiked analyte is calculated as follows:

% Recovery (%R) = 100 x (SSR-SR)/(SA)

where: SSR = spiked sample result
SR = sample concentration

SA = spike added

9.3 Relative percent difference calculations - the relative percent difference (RPD) between replicate determinations is calculated as follows:

$$RPD = \frac{(D1-D2)}{(D1+D2)/2} \times 100$$

where: RPD = relative percent difference
D1 = first sample value
D2 = second sample value

10 Quality Assurance/Quality Control

10.1 Personnel - Use of this method is restricted to analysts who are knowledgeable in the operation of this instrumentation and have performed a proficiency test with acceptable accuracy and precision results.

10.2 Linear correlation for the standard curve must be **≥0.995**. The Calibration curve must not be forced to go through the origin zero point.

10.3 Method blanks - A preparation blank is prepped and analyzed with every batch not to exceed 20 samples. Method Blanks must not contain Mercury at a concentration ≥ the MRL. If mercury is present in the Method Blank and the lowest sample concentration in the batch exceeds 10 times the blank concentration, no corrective action is needed. Otherwise, corrective action for method blank contamination involves determining the source of the contamination and re-prepping the entire batch.

DoD QSM - Method blank concentrations must be less than 1/2 RL.

10.4 Calibration verification – A second source ICV prepped with the associated samples is analyzed immediately after the curve and must be within 90-110% of its true value. The ICV concentration is at the mid-level of the calibration curve.

10.5 CCVs are analyzed at least every 10 samples with 80-120% recovery requirements.

10.6 An ICB/CCB is run immediately after the ICV/CCV set; the mercury value in the ICB/CCB is not to exceed the MRL.

DoD – Mercury is not to exceed 2 times MDL in the ICB/CCB.

10.7 A matrix spike and a matrix duplicate are prepped and analyzed with every batch not to exceed 20 samples. The RPD for duplicates is 20% and the Aqueous spike recovery control limit is 75-125%. The soil spike recovery control limit is 80-120%.

DoD – Spike recoveries must be within 80-120% for both water and soil

10.8 Laboratory Control Sample (LCS) -An LCS is prepped with a minimum of every 20 samples of the same matrix. Control limits are 80-120% of the true value for mercury. If the LCS is outside the acceptance limits, the corresponding samples are re-prepped and reanalyzed. Corrective action includes re-digestion/reanalysis for all samples and QC in the batch.

10.9 Dilution test (serial dilution) - A dilution test is performed once for each analytical run or if a unique sample matrix is encountered. If the analyte concentration is at least 25 times the MDL, an analysis of a 5 times dilution should agree within ±10% of the original determination. If not, a chemical or physical interference effect should be suspected.

DoD- Serial Dilution is required once per preparation batch.

10.10 Sample concentrations that exceed the highest calibration are diluted and rerun so that their concentration fall within the calibration range.

10.11 The Inorganic Laboratory Supervisor/Manager authorizes any method deviations.

10.12 The intermediate standard is stable for 28 days. All standards made from a primary standard expire on or before the primary standard's expiration date.

10.13 Method detection limits (MDLs) are established once a year. The MDL is obtained by multiplying the standard deviation of seven or eight analyses by the appropriate one-sided 99% t-statistic. The value of this statistic equals 3.143 if the number of analyses is seven. The concentration of the analyte in the analyzed solution should be between three to five times the expected MDL. An MDL verification check is performed immediately following MDL study, and quarterly each year in lieu of the annual MDL study if desired. An MDL verification check sample is spiked at approximately 2 times the current MDL.

10.14 Hg lamp intensity, measured as absorbance for the 10ug/L mercury standard, is recorded daily in the maintenance logbook. Trends are to be monitored to show the instrument is within the optimal absorbance range. The normal/optimal absorbance range is from 0.17-0.24.

11. Data Validation and Reporting

11.1 Sample preparation logs, notebooks, and instrument logs are reviewed and signed daily by the Supervisor/Lab Manager. The Supervisor/Lab Manager reviews 100% of the data prior to report generation. The QA Director randomly reviews 10% of the data reported by the laboratory. After each review, the appropriate section of the Data Review Checklist is checked off, **Attachment 3**.

11.2 Reports are generated by the data reporting group. The data submitted for report preparation is dependent on project requirements.

11.3 Data is always reported to the MRL. If clients require reporting limits different from the MRL/PQL, the data will need to be reported using a special form set through the Omega LIMS system depending on project needs.

11.4 Electronic files (EDD) are generated by the Data Management Department and are stored in the server until downloaded to tapes by the server backup system.

12. Corrective Action Procedures

12.1 Corrective Action to be implemented in the event QC results are outside of the acceptance range are covered in **section 10**.

12.2 Corrective Action reports are generated in the event of an out-of-control situation that cannot be corrected by the analyst. The procedure for submitting a corrective action report for the purpose of identifying the appropriate corrective action is covered in SOP No. 80.0007.

13. Health and Safety

13.1 The toxicity or carcinogenicity of each reagent used in the method has not been fully established. However, each chemical should be regarded as a potential health hazard, and exposure to these compounds should be as low as reasonably achievable. A reference file of material safety data sheets (MSDS) is available to all laboratory personnel. These sheets are stored in the Health & Safety Officer's office. In addition, laboratory personnel

should follow the precautions outlined in the laboratory's Chemical Hygiene Plan. In general, use gloves, a lab coat, and goggles when handling these reagents and work in a hood whenever possible.

13.2 Concentrated nitric, sulfuric and hydrochloric acids are moderately toxic and extremely irritating to skin and mucus membranes. Always wear safety goggles or a face shield for eye protection when working with acids. If eye or skin contact occurs, flush with large volumes of water.

13.3 The cell-heating compartment maintains a temperature of 100°C throughout the analysis. Care should be taken to avoid burns from the cell-heating compartment.

13.4 Basic good housekeeping practices, such as the wiping up of spills immediately and regular cleaning of counters and hoods, will help reduce the potential for cross-contamination and create a safe working environment.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

1. U.S. Environmental Protection Agency: Test Methods for Evaluating Solid Waste, Update IIB, SW-846 Method 7470A and Update IV SW-846 Method 7471B.
2. Department of Defense, Quality Manual for Environmental Laboratories. Final Version 3, January 2006.

Attachments:

Attachment 1: Mercury Digestion Logbook
Attachment 2: FIMS Instrument Logbook
Attachment 3: Data Review Checklist Form

Attachment 1
Mercury Digestion Logbook

MITKEM LABORATORIES

Mercury Digestion Logbook

						Reagents Added							
Date	Bottle No.	Sample ID		Client ID	Sample Vol (ml)/ Wt (g)	Conc. H_2SO_4 (ml)	Conc. HNO_3 (ml)	5% $KMnO_4$ (ml)	5% K_2SO_4 (ml)	Aqua-regia (ml)	Final Volume (ml)	Comments	Analyst

Waters
In: _____
Out: _____
Matrix: Aqueous

Soils
In: _____ Out: _____
In: _____ Out: _____
Matrix: Soil/Solid

LCSS ID _____
LCSS volume: _____
Spike ID _____
Spike volume: _____

Temp: _____ °C
H_2SO_4 Lot # _____
HNO_3 Lot # _____
HCl Lot # _____
KMnO4 ID # _____
K2S2O8 ID# _____
Method # _____

RELINQUISHED TO: _____

Reviewed by: _____

Attachment 2
FIMS Instrument Logbook

MITKEM LABORATORIES: FIMS 100 RUN LOGBOOK

Date: **Analyst:**

Analysis:				Analysis:				Analysis:				Analysis:			
SEQ#	**Bottle ID**	**LAB ID**		**SEQ#**	**Bottle ID**	**LAB ID**		**SEQ#**	**Bottle ID**	**LAB ID**		**SEQ#**	**Bottle ID**	**LAB ID**	
1				**26**				**51**				**76**			
2				**27**				**52**				**77**			
3				**28**				**53**				**78**			
4				**29**				**54**				**79**			
5				**30**				**55**				**80**			
6				**31**				**56**				**81**			
7				**32**				**57**				**82**			
8				**33**				**58**				**83**			
9				**34**				**59**				**84**			
10				**35**				**60**				**85**			
11				**36**				**61**				**86**			
12				**37**				**62**				**87**			
13				**38**				**63**				**88**			
14				**39**				**64**				**89**			
15				**40**				**65**				**90**			
16				**41**				**66**				**91**			
17				**42**				**67**				**92**			
18				**43**				**68**				**93**			
19				**44**				**69**				**94**			
20				**45**				**70**				**95**			
21				**46**				**71**				**96**			
22				**47**				**72**				**97**			
23				**48**				**73**				**98**			
24				**49**				**74**				**99**			
25				**50**				**75**				**100**			

Calibration/ICV Prep Date:_____ SnCl2 _____ HCl: _____

Reviewed By: _____ NaCl: _____ Hydroxylamine Sulfate: _____

Logbook ID: 100.0164-05/08

Attachment 3
Data Review Checklist Form

Mitkem Laboratories,
A Division of Spectrum Analytical, Inc.
Batch Data Review Checklist - Inorganics

Analysis:_____

Level 1 (Analyst) Review:_____ Level 2 (Technical) Review:_____

Workorder:_____

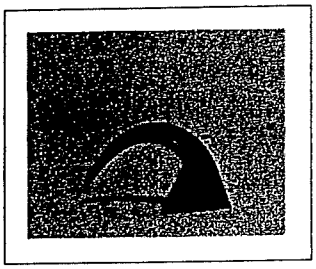
	Yes	No --List/Explain any Unusual Occurrences or Nonconformances
Calibration Acceptable *ICAL / CCAL*		*List all non-conforming project analytes*
LCS Acceptable		*List all non-conforming project analytes*
Blank Acceptable		*List all non-conforming project analytes*
Spike Acceptable		*Reasonable recovery / Matrix effect / Spike to sample concentration ratio*
Dup Acceptable		*Reasonable precision / Sample non-homogeneity?*
Serial Dilution		*List all non-conforming analytes, Matrix effect?*
Post-Digestion Spike		*Matrix effect?*
Within Holding Time		*List runs/re-runs out of holding time; Explain*
Within Analysis Range		*Dilutions properly noted; Explain any "E" flag analytes or dilutions with no target hit*
Calc/Data Xfer Check		*Including proper significant figures, rounding*
Reasonableness Check:		*Compared to historic or on-going trends, or for this analysis in general?*

Notes:

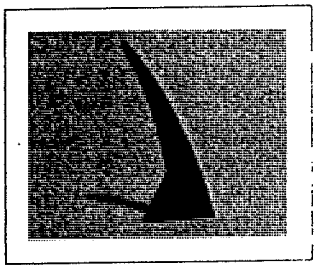
To use Cone-Fire Tuning, **IdLE** must display. Press **ENTER**, then **1. ConE** will appear. Press **999, ENTER. rSLt** (for result) will display alternating with the current Tuning number. Enter the new number, then press **ENTER. ConE** will appear. Continue entering the values for the Cone-Fire program in the usual way. Once you change the Tuning number, Cone-Fire will remain adjusted to that number until you change it again.

The large cone on the kiln shelf should be visible through a peephole. Avoid exposure to cool air by keeping the cone at least 3" away from the peephole. Program the DTC 800C for the cone on the shelf and fire. After cooling, check the cone:

The cone bent to 6 o'clock: In this case, the controller is matched to your kiln.

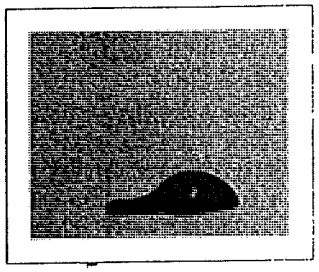


The cone did not bend far enough: Use a lower Tuning number for the next firing.



The cone bent too far: Use a higher Tuning number for the next firing.

Do not be overly concerned with achieving an exact 6 o'clock bend. The difference between a 3 o'clock and a 6 o'clock bend is only a few degrees. Cones, even from the same box, also vary slightly.



Ramp-Hold Mode

Ramp-Hold is available on both the DTC 800C and DTC 800.

In Ramp-Hold, the kiln fires in segments, or stages. Each segment has a firing rate, firing temperature, and hold (or soak) time. Ramp-Hold includes eight segments. Use only the number of segments you need per firing, from one to eight.

Rate is degrees of temperature change per hour, from 1° to 9999°F. (e.g., to increase temperature by 500° per hour, enter a rate of 500).

To control cooling, set the segment to a lower temperature than that of the preceding segment.

Storing User Programs in Ramp-Hold

A user program is a set of firing instructions to run the kiln in Ramp-Hold. A user program includes number of segments needed; firing rate, temperature, and hold (if any) for each segment; and an alarm temperature (if any).

Ramp-Hold Programming

As the program prompts you for segments, rate, temperature, etc., you will see values from the last firing. To use these again, just touch **ENTER**.

To fire without the Delay feature: Follow steps 1 through 9. Then press **START** twice.

1 Turn controller safety switch ON.

2 If controller displays **ErrP** or a flashing temperature, touch **ENTER. IdLE** will appear.

3 Touch **ENTER** then **4. USEr** will appear. Enter a number from 1 to 6 for the stored program desired. ENTER 1

4 Touch **ENTER. SEGS** will appear. Enter number of segments you will use. ENTER 1.

5 Touch **ENTER. rA 1** will appear. Enter firing rate for segment 1 (temperature change per hour: any temperature from 1° to 9999° F.). ENTER 400°C.

6 Touch **ENTER. °F 1** will appear. Enter the temperature you will be firing to in segment 1. ENTER 250°C

7 Touch **ENTER. HLd1** will appear. Enter segment 1 hold (soak) time in hours and minutes (e.g. 12 hours and 30 minutes = 12.30). ENTER 00.20

8 Touch **ENTER**. Continue entering values for all segments.

9 Touch **ENTER. AlAr** will appear. Enter alarm temperature. (Enter 9999 to turn alarm off.) Then touch **ENTER**.

IdLE will appear.

10 To set Delay Fire, touch **ENTER** then **3. dELA** will appear. Enter delay time in hours and minutes (e.g. 12 hours and 30 minutes = 12.30). Then touch **ENTER**. (Delay zeroes out after each completed firing.) NO DELAY

11 To start program, touch **ENTER** twice. **-On-** will appear, then kiln temperature. If a delay was programmed, **-On-** will appear, then time remaining until start.

To stop the program during the firing cycle, touch **STOP** or turn the safety switch OFF. When program fires to completion, **CPLt** will appear alternating with total firing time in hours and minutes. Turn safety switch OFF when **CPLt** appears. To shut off the alarm when it sounds during a firing, press **ENTER**. When Temp decreases after the 20 minutes @ 250°C, hit STOP. LET COOL DOWN ON ITS OWN.

Ramp-Hold can store up to six user programs even when the kiln is unplugged. Potters may want to store a program for crystalline glaze, another for a favorite red glaze, etc. Glass artists might want to store several programs for fusing their favorite types of glass and another for slumping.

When you enter Ramp-Hold mode, the first prompt to appear is **USEr**. The **USEr** prompt means, "Select a stored user program for this firing". If you are using Ramp-Hold for the first time, press 1. Then enter num-

ADDENDUM TO COMPLIANCE AGREEMENT WITH MITKEM CORPORATION
DECEMBER 18, 1996
CONTINUED

7. "USDA" soil samples may not be shipped to other facilities unless such facility has a valid permit and compliance agreement for imported soil or a valid compliance agreement for domestic soil. (See Item No. 3 for a list of such facilities)

8. "USDA" soil samples may not be used as a growing medium for plants and for the isolation and/or culture of organisms imported with the soil.

9. It is further agreed that the PPQ Officer may conduct an inspection of the laboratory facility and records concerning soil shipments at any time during normal working hours. All reasonable recommendations of the PPQ Officer to eliminate the spread of plant pests will be followed. Failure to comply with any of the stipulations of this Compliance Agreement may result in its revocation and the facility's authority to handle foreign and domestic regulated soil.

ALL SOIL RESIDUES, THEIR STORAGE CONTAINERS, FILTERS, ETC. SHALL BE TREATED WITH ONE OF THE FOLLOWING SCHEDULES:

Used soil storage containers may be treated by incineration.

DRY HEAT: Soil to be spread in layers 0.5 inches in depth to ensure uniform heat penetration.

TEMPERATURE		EXPOSURE PERIOD
110 - 120.5 C	(230 - 249 F)	16 HOURS *
121 - 154 C	(250 - 309 F)	2 HOURS *
154.5 - 192.5 C	(310 - 379 F)	30 MINUTES *
193 - 220 C	(380 - 429 F)	4 MINUTES *
221 - 232 C	(430 - 450 F)	2 MINUTES *

* Do not start counting time until the mass reaches the required temperature.

STEAM HEAT: 250 F at 15 lbs. pressure for 30 minutes.

Preheat laboratory autoclaves. Do not start counting time until pressure reaches 15 lbs.. Restrict soil depth to 2 inches when treating quantities of soil in trays. Restrict each package weight to 5 pounds or less when treating individual packages. Load with adequate spacing. Large commercial steam facilities which operate at pressures up to 60 lbs. psi will permit treatment of greater soil depth.

For large filter & soil — use 250° for 2 hours

MITKEM CORPORATION

STANDARD OPERATING PROCEDURE

for

Handling Evidentiary Materials

SOP No. 110.0026
Rev. 6

	Signature	Date
QA Officer:	Sharon Lauk	2/23/06
Lab Director:	William D.	2/23/06

MITKEM CORPORATION

STANDARD OPERATING PROCEDURE

for

Handling Evidentiary Materials

SOP 110.0026
Rev. 6

1. Scope and Application

This Standard Operating Procedure (SOP) pertains to the procedures for handling all evidentiary materials associated with a sample delivery group, including air bills, SMO or client traffic report and chain-of-custody forms.

2. Personnel Qualifications and Responsibilities

All employees handling client information should have read and understood this SOP. All information in this SOP must be followed.

3. Summary of Procedure

All paperwork pertaining to the sample delivery group(s) of a case or project must be kept confidential.

4. Sample Preservation, Containers, Handling and Storage

Not applicable.

5. Interferences and Potential Problems

Not applicable.

6. Equipment and Apparatus

Not applicable.

7. Reagents

Not applicable.

8. Procedure

All documents received with a sample delivery group (SDG) and/or generated in the course of the analyses of these samples must be kept confidential. Standard Business Confidentiality practices shall apply.

7.1 Documents specifically marked "Confidential" which may accompany an SDG, must be treated separately from other case-related documents.

7.2 Procedures for handling documents marked "Confidential"

7.2.1 Contact Sample Management Office (SMO) for EPA cases or the client to assure that receipt of these documents is correct and necessary for analysis of the samples. If not required for analysis, return the documents following SMO or client instructions.

7.2.2 If the documents are necessary for sample analysis, place them in a secure file separate from the regular files and under control of the Document Control Officer (DCO) or his/her designee. The DCO will keep this file of confidential documents secure at all times and only allow authorized personnel access on an as needed basis.

7.2.3 Receipt of confidential documentation, its use, duplication and ultimate disposition must be documented in a Confidential Document Log. Duplication of confidential documents must be kept to a minimum and done with concurrence of the Project Officer or his/her designee.

7.2.4 The DCO shall remove and retain for one year the cover sheet of any confidential material disposed of and note the disposition in the Confidential Document Log. Disposal of confidential documents should only be done at the direction of the EPA or client Project Manager and/or the EPA Contracting Officer.

8.4 Test results or data transmitted electronically or by electromagnetic means will be sent in such a way as to preserve client confidentiality. Confidentiality statements are included on Fax forms and e-mail transmissions. Confirmation of client address and/or individual personnel is required prior to transmission.

9. Data Reduction and Calculations

Not applicable.

10. Quality Assurance/Quality Control

Not applicable.

11. Data Validation and Reporting

Not applicable.

12. Corrective Action Procedures

Not applicable.

13. Health and Safety

Not applicable.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

Not applicable.

LABORATORIES
MITKEM ~~CORPORATION~~ 3/20/08
A Division of Spectrum Analytical, Inc
STANDARD OPERATING PROCEDURE

for

Preparation of Soil Samples by Acid Digestion for ICP Analysis

by

SW846 Method 3050B

SOP No. 100.0104

Rev. 6

	Signature	Date
QA Director:	[illegible]	4/7/06
Lab Director:	[illegible]	4/10/06

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL, INC.

STANDARD OPERATING PROCEDURE

for

Preparation of Soil Samples by Acid Digestion for ICP Analysis

by

SW846 Method 3050B

Rev. 6

1. Scope and Application

This Standard Operating Procedure (SOP) deals with the preparation of soil samples utilizing USEPA SW846 Method SW3050B for analysis by Method SW6010. Discussion includes sample digestion and sample concentration technique for the analysis of metals in soil samples.

2. Personnel Qualifications and Responsibilities

This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method. Analysts are responsible for performing analyses in accordance with this SOP and documenting any variations in the protocol. Supervisors/lab managers are responsible for ensuring that this SOP is accurate and up to date and that it is implemented appropriately. Supervisors/lab managers review logbooks and data generated for this procedure and approve all reported results.

3. Summary of Procedure

A 1.00 to 2.00 gram soil/solid sample is digested with the addition of acids and hydrogen peroxide for metals analysis by Inductively Coupled Argon Plasma (ICAP). This method has been adapted to utilize polyethylene digestion tubes and a final 50 ml digestate volume, rather than the 100 ml volume noted in the original method. The reagent volumes have been reduced to accommodate the method as well.

4. Sample Preservation, Containers, Handling, and Storage

4.1 Hold time for ICP analysis is 180 days from date collected.

4.2 Samples are stored at 4°C in amber glass jars with Teflon lined caps.

5. Interferences and Potential Problems

Possible sources of contamination:

5.1 Hood fall-out.

5.2 Acid bath for glassware.

5.3 Acid dispensers.

5.4 Sample matrix effects: Extreme organic samples.

6. Equipment and Apparatus

Equipment used in this preparation method include:

6.1 10% HNO_3 acid bath.

6.2 50 ml polyethylene tubes.

6.3 Watch Glasses.

6.4 Hot plates.

6.5 Centrifuge.

7. Reagents

The following reagents are used during sample preparation:

7.1 Concentrated HNO_3, Fisher, ACS trace metals grade.

7.2 1:1 (v/v) HNO_3, Fisher, ACS trace metals grade.

7.3 Concentrated HCl, Fisher, ACS trace metals grade.

7.4 30% Hydrogen peroxide (H_2O_2), Fisher, ACS certified.

7.5 Spiking solutions, High Purity Standards.

7.6 Laboratory Control Sample Solutions, High Purity Standards.

7.7 Teflon chips, Chemware Ultra PTFE Boiling Stones.

8. Procedure

See SOP 110.0039 for sub-sampling procedures.

8.1 Digestion of soil samples for ICAP analysis:

8.1.1 Note in Soil/Solid Sample Preparation Logbook the presence of any artifacts (see **Figure 1**).

8.1.2 Mix the sample thoroughly so that a homogenous representative aliquot can be taken. Weigh an approximate1.00 to 2.00 gram (wet weight) or 1.00 gram (dry weight) aliquot of the sample to the nearest 0.01g and transfer it to a 50 mL digestion tube.

8.1.3 Add 5 mL of 1:1 (v/v) HNO_3, mix well. Cover the tube with a ribbed watch glass. Heat to 95°C ± 5 °C in graphite holders on hotplates in the hood, and reflux for 10 minutes without boiling.

8.1.4 Remove from hotplate and allow to cool.

8.1.5 Add 2.5mL of conc. HNO_3. Replace on hotplate and reflux for 30 minutes. If brown fumes are generated at this step repeat the addition of 2.5mL conc. HNO_3 with heating steps until no more brown fumes are given off. Do not allow the volume to fall below 5mL.

8.1.6 Allow the sample to cool and add 1mL of DI water and 1.5 mL of 30% H_20_2. Return the tube to hotplate to start peroxide reaction, making sure no losses occur due to excessive effervescence action. Heat until effervescence subsides and then allow tube to cool

8.1.7 Continue adding 30% H_2O_2 in 0.5mL aliquots with warming until minimal effervescence occurs, the appearance of the sample remains unchanged, or 5mL have been added. If the blank or a sample no longer have effervescence, set them aside, do not continue to add H_2O_2. When all are done proceed to next step.

Note: do not add more than a total of 5mL H_2O_2

8.1.8 Add 5mL of concentrated HCl and return to the hotplate and reflux for an additional 15 minutes.

8.1.9 Take tube off the hotplate and cool to room temp.

8.1.10 Volumize to 50mL with DI Water.

8.1.11 Centrifuge sample for approximately 5 minutes at 3000 rpm to settle any insoluble material.

8.1.12 Label the tube properly. Transfer digestate to Inorganic Instrument Lab. All digestion information is documented in the Soil/Solid Sample Preparation Logbook.

9. Data Reduction and Calculations

Not applicable.

10. Quality Assurance/Quality Control

Quality assurance and quality control (QA/QC) procedures are established to ensure generation of data of known quality. QA/QC procedures associated with the Inorganic prep lab include preparation of Method Blanks, Lab Control Samples, matrix spikes and sample duplicates.

10.1 Preparation Blanks:

A method blank must be run with every discrete batch of samples that is being prepped. A batch of samples cannot exceed 20 samples.

10.1.1 Use 1.0 ±.01 g acid washed Teflon chips as a "soil blank" and treat it as if it were a regular sample. Label appropriately.

10.2 Laboratory Control Samples:

A laboratory control sample containing all target analytes must be prepped and analyzed for each batch of samples. The number of samples per batch cannot exceed 20.

10.2.1 For soil samples measure 1.0 ±.01 g acid washed Teflon chips into a 50mL -digestion tube. Spike 455 uL of CV-1 and 45.5 uL each of CV-2 and CV-3 into the tube and digest as described in **Section 8**. Label appropriately.

10.3 Matrix Spikes and Duplicate Samples:

Prepare 3 digestion tubes to be used for the same aqueous sample. Designate one tube as the sample, one as the duplicate of that sample, and the other as a spiked portion of the sample. Into each tube, measure 1.00-2.00 g (wet weight) or 1 gram (dry weight) of sample (the same sample).

10.3.1 To one aliquot add three spiking standards containing all target analytes; High Purity Standard CLP-CV-1 at 455 uL; CLP-CV-2 and CLP-CV-3 at 45.5 uL each. Label this sample with an "MS" suffix, and digest as described in **Section 8**.

10.3.2 Label the tube designated for the sample duplicate with a "D" suffix and digest as described in **Section 8**.

10.4 Standard Preparation

All standards made from a primary standard expire on or before the primary standard's expiration date.

11. Data Validation and Reporting

Data (logbook entries) generated in the inorganic preparation laboratory will be reviewed and signed by a peer, the supervisor or the department manager.

12. Corrective Action Procedures

All corrective action will stem from the analytical results in the Metals Laboratory. See the specific SOP for details on QC requirements.

12.1 If any method blank shows contamination, associated samples are scheduled for reprep by the department supervisor or manager.

12.2 If any spike recovery or duplicate RPD is outside of control limits, samples are scheduled for reprep by the department supervisor or manager.

12.3 If a Spike sample was not spiked, it will be re-prepped and re-analyzed with the appropriate sample and duplicate.

13. Health and Safety

Health and safety hazards in the Inorganic Preparation Laboratory (prep lab) include exposure to concentrated acids, their fumes and toxic metals standards. Labcoats, gloves and safety glasses must be worn in the prep lab at all times.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

U. S. Environmental Protection Agency. Test Methods for Evaluating Solid Waste, SW-846, Update III, Revision 2, December 1996, Method 3050B.

Attachments:

Figure 1: Soil/Solid Sample Preparation Logbook

Figure 1

Soil/Solid Sample Preparation Logbook

MITKEM LABORATORIES: Soil/Solid Metals Prep Logbook

Date	Sample ID		Client ID	Sample Wt. (g)	Sample Color Before	Texture	1:1 HNO_3 ml	Conc. HNO_3 ml	30% H_2O_2 ml	Conc. HCl ml	Sample Color After	Sample Clarity After	Final Volume ml	Comments	Analyst

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HCl Lot# _____

HNO3 Lot# _____

H2O2 Lot# _____

Method: _____

SOP#: _____

Digestion Temp: _____ **oC**

LCS/Spike Lot No.: _____

_____

_____

RELINQUISHED TO: _____

Reviewed By: _____

Logbook ID 100.0124-12/07

MITKEM LABORATORIES,
A Division of Spectrum Analytical, Inc.

STANDARD OPERATING PROCEDURE

for

Determination of Metals in Water and Soil by Inductively Coupled Argon Plasma Atomic Emission Spectrometry using Method SW846 6010C

Rev. 10

	Signature	Date
QA Director:	Sharyn B Lauh	11/21/08
Lab Director:	John D G	11/21/08

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1. Scope and Application

This SOP describes the procedures applicable to the analysis of the elements listed in **Attachment 1**. All matrices, including ground water, aqueous samples, TCLP and EP extracts, industrial and organic wastes, soils, sludges, sediments, and other solid wastes, require digestion prior to analysis. **Section 8.1** provides the Method references for sample digestion procedures. See **LIMS Test Information/ Test/Limits** for analytes and their associated MDL/PQLs.

2. Personnel Qualifications and Responsibilities

Personnel must be qualified according to the requirements of their job descriptions and trained for this procedure prior to analyzing samples. **Analysts and technicians** are responsible for performing analyses in accordance with the SOP and documenting any variations in the protocol. **Supervisors/Managers** are responsible for ensuring that SOPs are accurate and up-to-date, and that they are implemented appropriately. **Supervisors/Managers** review the logbooks and data generated from this procedure and approve all reported results.

3. Summary of Procedure

3.1 Prior to analysis, samples must be digested using appropriate sample preparation methods.

3.2 The method measures element specific emitted light by optical spectrometry. The samples are nebulized and the resulting aerosol is transported to the plasma torch. The metals pass through the hot zone of the plasma, where they take up energy. Subsequently the metals pass through the cold zone (relatively) of the plasma where they give up the excess energy at element specific wavelength. The spectra are dispersed by a grating spectrometer, and the intensity of the emitted light is measured by a solid state photomultiplier. Background correction is required for trace element determination. The position selected for the background-intensity measurement, on either or both sides of the analytical line, will be determined by the complexity of the spectrum adjacent to the

analyte line. The position used must be free of spectral interferences and reflect the same change in background intensity as occurs at the analyte wavelength measured.

4. Sample Preservation, Containers, Handling, and Storage

4.1 Samples are collected by the client and submitted for analysis in pre-cleaned sample containers provided by the laboratory. For metals analysis by Method 6010C, water samples are collected in 500 ml plastic containers and preserved (acidified) with nitric acid to a pH of less than 2. Soils are collected in 8-ounce glass containers. Sample volume requirements depend upon the number of different preparation procedures necessary for the analyses requested. Additional sample volume may also be required for the analysis of laboratory QC samples.

4.2 Soil samples are stored at 4°C ± 2°C until analyzed.

4.3 Sample holding time for metals analysis by method 6010C is 180 days from the date of sample collection for both water and soil.

5. Interferences and Potential Problems

Several types of interference effects may contribute to inaccuracies in the determination of an analyte by ICAP-AES.

5.1 Spectral interferences - Can be categorized as (1) overlap of a spectral line from another element; (2) unresolved overlap of molecular band spectra; (3) background contribution from continuous or recombination phenomena. The first of these can be compensated for by utilizing a computer correction of raw data, requiring monitoring and measurement of the interfering element. The second effect may require selection of an alternative wavelength. In addition one could select an alternate wavelength where interference is minimal or absent. The 4300DV and the 3100XL used at Mitkem have many spectral lines from which to choose. The third effect can usually be compensated by a background correction adjacent to the analyte line.

5.2 Physical interferences are effects associated with the sample nebulization and transport processes. Changes in viscosity and surface tension can cause significant inaccuracies, especially in samples containing high dissolved salts or high acid concentrations. If physical interferences are present, they must be reduced by such means as a high-salts nebulizer, diluting the sample, using a peristaltic pump, or using an appropriate internal standard element. Another problem that can occur with high dissolved salts is a salt buildup at the tip of the nebulizer, which affects aerosol flow rate and causes instrumental drift. This problem can be controlled by a high-salts nebulizer, wetting the argon prior to nebulization, using a tip washer, or by diluting the samples. A mass flow controller is used to control the argon gas flow rate.

5.3 Chemical interferences include molecular-compound formation, ionization effects, and solute-vaporization effects. These effects can be minimized by careful selection of

operating conditions, by buffering of the sample, by matrix matching, and by standard-addition procedures.

5.4 Memory interferences result when analytes in a previous sample contribute to the signals measured in a new sample. Memory effects can result from sample deposition on the uptake tubing to the nebulizer, or from the buildup of sample material in the plasma torch and spray chamber. The site where these effects occur is dependent on the element and can be minimized by flushing the system with the rinse solution between samples. This method requires a rinse period of at least 60 seconds between samples and standards. If memory interference is suspected, the sample must be reanalyzed using a longer rinse period.

5.5 Physical, chemical and spectral interferences are primarily attributed to the sample matrix. If interference caused by a particular sample matrix is known, in many cases it can be circumvented. However, when the nature of the sample is unknown, following tests can be used to ensure the analyst that neither positive nor negative interference effects are operative on any of the analyte elements thereby distorting the accuracy of the reported values.

5.5.1 Dilution Test -If the analyte concentration is sufficiently high (minimally a factor of 10x above the method detection limit (MDL)), an analysis of a 1:5 dilution should agree within ±10% of the original determination. If not, a chemical or physical interference effect could be suspected.

5.5.2 Post Digestion Spike Addition - If the matrix spike (pre-digestion) recovery falls outside of the control limits (75% - 125%), matrix interference is suggested. In this case an analyte spike is added to a portion of a prepared sample or its dilution at a level just below the mid-point of the calibration curve. Post digestion spikes should be recovered to within 80% - 120% of the known value. If not, a matrix effect should be suspected.

5.5.3 Comparison with alternative method analysis-when investigating a sample matrix, comparison tests may be performed with other analytical techniques, such as atomic absorption spectrometry, or ICP-mass spectrometry. This should only be done after consultation with the client.

5.5.4 Internal Standard Addition technique can be used (Refer to Section 4.4.2 of Method 6010C.)

6. Equipment and Apparatus

6.1 Inductively coupled argon plasma emission spectrophotometer (ICAP).

The ICAPs used at Mitkem are a Perkin-Elmer Model 4300DV and a 3100XL. The 4300DV is outfitted with an AS-93plus, 157-position autosampler and a high precision, three channel, peristaltic pump. The 3100XL is outfitted with an AS-91, 160-position

autosampler and a high precision, three channel peristaltic pump. Both ICPs have axial viewing capability, as compared to the more traditional radial viewing ICAP. Axial viewing provides greater sensitivity for all elements analyzed. The solid state detector is capable of analyzing at approximately 6000 wavelengths.

The built-in radio-frequency generator is FCC compliant.

The systems are computer controlled through a 32-Bit, Microsoft Windows NT operating system. This system allows for great flexibility in controlling the instrument.

The required high purity argon gas is piped in from a main storage tank that is located in the rear of the building. The gas is stored in liquid form, drawn-off as a gas and then piped into the building for distribution to the instruments. The liquid argon supply is monitored remotely by the supplier, and resupplied on an automatic-delivery basis.

6.1.1 Operating conditions - The analyst should follow the instructions provided by the instrument manufacturer. Instrument detection limits, linear dynamic ranges, and interference effects are established for each analyte line used. All measurements must be in the instrument linear range where spectral interference correction factors are valid. The analyst must (1) verify that the instrument configuration and operating conditions satisfy the analytical requirements and (2) maintain quality control data confirming instrument performance and analytical results.

6.1.2 Daily emissions of the highest standard for arsenic, copper, lead and selenium are recorded as a means to ensure the plasma is stable before analysis and also to chart potential problems especially with the power tube, sample introduction system, or RF generator. The normal range of the four analytes above are (the unit is intensity generated by instruments):

Optima 2 (3100 XL)	Optima 3 (4300 DV)
As 2,000 - 3,000	As 2,000 - 2,500
Cu 600,000 - 900,000	Cu 400,000 - 600,000
Pb 12,000 - 20,000	Pb 4,000 - 8,000
Se 2,000 - 4,000	Se 1,800 - 2,400

6.1.3 For analysis of normal environmental samples use the following standard operating conditions:

Wattage: 1450 – 1500
Argon flow rate (L/min): 15
Nebulizer flow rate (L/min): 0.55
Sample flow rate (mL/min): 2
Rinse time (sec): 60
Read delay (sec): 60

6.1.4 For regular day-to-day ICAP measurements, the plasma need not be optimized prior to analysis. The plasma needs to be optimized each time a major change occurs in instrument configuration, such as replacement of the torch and/or maintenance, unless response is still within normal ranges. Responses and alignment are routinely checked after torch cleaning or replacement with the analysis of a 1 mg/L Mn solution for axial view calibration and 10 mg/L Mn solution for radial view calibration. "Optimization" is a function of a series of procedures; refer to the Mitkem SOP 100.0006 for additional information on how to perform general maintenance and troubleshooting procedures.

6.1.5 To optimize the plasma, follow the instructions in the Optima Software Guide.

6.2 ICAP Instrument Maintenance:

6.2.1 Preventative Maintenance:

- Peristaltic pump tubing will be replaced every 16 hours of instrument time or sooner if memory effects are manifested.
- The plasma torch is cleaned using concentrated HNO_3 when torch and sample injector buildup is noted.
- The spray chamber and nebulizer are cleaned approximately every month as needed. Replacement is done when needed.
- Air filters are cleaned once every two weeks or as needed upon visual inspection.
- The RF coil, window and cone are cleaned every 2-3 weeks.
- The instrument undergoes extensive maintenance by a manufacturer's service engineer as needed.

6.2.2 Troubleshooting:

6.2.2.1 Sudden drop in CCV concentration occurs in a run:

- Check to see that sample introduction system (tubing) has not become disconnected.
- Check to see if a clog has occurred in the sample introduction system.
- Check CCV Standard to ensure it is not empty.
- Check room temperature to see if a fluctuation has occurred.

- Recalibrate and rerun if necessary.

6.2.2.2 CCVs drift up and down:

- Remake the CCV standard.
- Check room temperature to see if a fluctuation has occurred.
- If problem persists, call Perkin-Elmer. The problem is usually indicative of a power tube failure.

6.2.2.3 Plasma goes out during analysis:

- Sample is not reaching spray chamber (tubing came apart or there is a clog)
- High levels of salt in the sample caused plasma temperature changes.
- The sample injector is coated with high salt material and needs to be changed.
- The power tube is going (after all others fail repeatedly) and Perkin-Elmer must be called for service.

6.3 Glassware:

6.3.1 Class A volumetric flasks: 100 mL and 50 mL.

6.3.2 Class A volumetric pipettes:

6.3.3 10-100µL adjustable Eppendorf.

6.3.4 100-1000 µL adjustable Eppendorf.

6.3.5 5mL adjustable Fisher Scientific.

6.3.6 100µL and 1mL fixed Wheaton.

6.3.7 10 mL Wheaton ICP tubes.

7. Reagents and Standards

All standard solutions (multi-, and single element), and second source QC solutions are purchased from outside vendors (Perkin-Elmer, Accustandard, Inorganic Ventures, ERA, and High Purity Standards, Inc.). All these solutions are traceable and meet with Mitkem's high purity requirements. ***Please note that standards and reagents from other vendors could be***

used as long as the standards are of high purity (>96%0 and traceable to reference materials. All standards are labeled as instructed in Mitkem SOP # 80.0001 Standard Preparation, Equivalency and Traceability.

7.1 Hydrochloric acid (conc.), HCl, Trace Grade, Fisher Scientific.

7.2 Nitric acid (conc.), HNO_3, Trace Grade, Fisher Scientific.

7.3 Reagent water (ASTM Type I water). Mitkem's water system consists of a Culligan high volume, 1 Megohm feed water system, combined with a Millipore Milli-Q, four bowl, high purity system. Reagent water is also referred to as DI water.

7.4 Mixed calibration standard solutions. Mixed calibration standards, obtained from High Purity Standards, come in three stock solutions. Calibration standards and QC solutions are made up on a daily basis.

7.4.1 CLP CAL 1 consists of two solutions:

- CLP CAL 1B contains silver only.
- CLP CAL 1A contains all other elements other than antimony, arsenic, cadmium, lead, thallium, and selenium.

7.4.2 CLP CAL 2 contains antimony only.

7.4.3 CLP CAL 3 contains arsenic, cadmium, lead, thallium, and selenium.

7.5 High standard (**ICP Standard 1**):

- Pipet 1mL HNO_3 (conc) and 1.5mL HCl (conc) into a 100mL volumetric flask.
- Pipet 1mL each of CLP CAL 1A & 1B stock solution and 0.1mL each of intermediate CLP CAL 2 and 3 into the flask.
- Pipet 0.1mL of Titanium single element standard into the flask.
- Bring to volume with DI water.

7.6 Second (middle) standard (**ICP Standard 2**):

- Pipet 5mL of a 1% HNO_3 and 1.5% HCl acid mixture into a 10 mL ICP tube.
- Add 5mL of the ICP Standard 1.

7.7 Third (low) standard (**ICP standard 3**):

- Pipet 10mL of 1% HNO_3 and 1.5% HCl solution into a 10 mL ICP tube.
- Withdraw 100µL.
- Add 100µL of ICP Standard 1 and mix well.

See **LIMS Test Information/ Test/SPEC** for concentrations of the Initial Calibration Standards.

7.8 **Second source** ICV/CCV standards (CCV100XCONC and Antimony (Sb) Stock solutions) are obtained from Accustandard.

- Pipet 1mL of HNO_3 (conc.) and 1.5mL HCl (conc.) into a 100mL volumetric flask.
- Pipet 1.5mL (for ICV)of CCV100XCONC stock solution into the flask.
- Pipet 0.15mL of Antimony (Sb) Stock solution into the flask.
- Bring to volume with DI water.
- Transfer the solution to a 50mL plastic ICP tube.
- This standard is prepared as needed (in amounts consistent with the ratios above) usually every 1 – 2 days.

See **LIMS Test Information/ Test/SPEC** for analytes, concentrations and recovery limits for the ICV/CCV.

7.9 QC Standards ICSA and ICSB solutions are obtained from High Purity Standards.

ICSAB solution: In addition to the normal element composition of the ICSA solution, sodium, potassium, lead and selenium are added to the ICSAB solution. These stock solutions are also obtained from High Purity Standards.

7.9.1 Pipet 1mL of HNO_3 (conc.) and 1.5mL HCl into a 100mL volumetric flask.

7.9.2 Pipet 1mL of ICSB stock solution (ANALCS-R) into the flask.

7.9.3 Pipet 10mL of ICSA (CLP-INF-1) stock solution into the flask.

7.9.4 Pipet 0.5mL of the sodium/potassium stock solution (INFCS-5) into the flask.

7.9.5 Pipet 1mL of 45mg/L Pb intermediate standard solution into the flask.

7.9.5.1 The intermediate is prepared by adding 4.5mL of Pb at 1000mg/L (#100028-1) up to 100mL with 1%HNO_3 and 1.5% HCL acid solution in a volumetric flask.

7.9.6 Pipet 1mL of 45mg/L Se intermediate solution into the flask.

7.9.6.1 The Selenium intermediate standard is prepared by adding 4.5mL of Se at 1000mg/L (#031) up to 100mL with 1% HNO_3 and 1.5% HCl acid solution in a volumetric flask

7.9.7 Bring to volume with DI water.

7.9.8 Transfer the solution to a 10 mL ICP tube.

See **LIMS Test Information/ Test/SPEC** for concentrations of the ICSA and ICSAB.

7.10 Laboratory control samples (LCS) and Matrix spikes: The LCS standards for soils and waters are obtained from High Purity Standards.

- LCS/Spike standard 1 is prepared by adding 455uL of CLP-CV-1 to the digestion tube.
- LCS/Spike standard 2 and 3 are prepared by adding 45.5uL each of CLP-CV-2 and CLP-CV-3 to the digestion tube.

See **LIMS Test Information/ Test/SPEC** for final concentrations of the LCS/MS.

7.11 Linear Dynamic Range

The stock linear dynamic range (LDR) standards are purchased from Ultra Scientific, Inorganic Ventures and High Purity. The LDR is determined as the highest concentration of standard in which the determined value is within 10% of the true value.

- *LDR Standard I* is prepared by addition of 1 mL of Pb at 1000 mg/L, volumized to 10 ml with 1% HNO3 and 1.5% HCl. Final concentration 100mg/L.
- *LDR Standard II* is prepared by addition of 5 mL of mix QCS-19 and 0.5mL of Ba at 1000 mg/L, volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 50 mg/L.

- *LDR Standard III* is prepared by addition of 2.5 mL of mix QCS-19 and 0.25 mL of Ba at 1000 mg/L, volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 25 mg/L.

- *LDR Standard IV* is prepared by addition of 1.0 mL of mix QCS-19 and 0.1 mL of Ba at 1000 mg/L, volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 10mg/L.

- *LDR Standard V* is prepared by addition of 0.5 mL of mix QCS-19 and 0.05ml of Ba at 1000 mg/L, volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 5mg/L.

- *LDR Standard VI* is prepared by addition of 0.5 mL of Al and 0.5ml of Mg at 10,000 mg/L, volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 500mg/L.

- *LDR Standard VII* is prepared by addition of 3.0 mL of Fe at 1000 mg/L, volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 300mg/L.

- *LDR Standard VIII* is prepared by addition of 0.5 mL of Ca at 10,000 mg/L, volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 500mg/L.

- *LDR Standard IX* is prepared by addition of 0.5 mL of mix INFCS-5 (High Purity) and volumized to 10 mL with 1% HNO3 and 1.5% HCl. Final concentration 250mg/L.

8. Procedure

8.1 The methods in SW-846 for sample digestion or preparation are as follows:

8.1.1 Method 3005 , SOP No.100.0003, prepares ground water and surface water samples for total recoverable and dissolved metals determination by ICP. The unfiltered or filtered sample is heated with hydrochloric and nitric acids prior to metal determination.

8.1.2 Method 3010 , SOP No.100.0003, prepares aqueous samples, mobility-procedure extracts and waste samples that contain suspended solids for total metal determination by ICP. The samples are vigorously digested with nitric acid followed by dilution with hydrochloric acid.

8.1.3 Method 3050 , SOP No.100.0104, prepares solid waste samples for total metals determination by ICP. The samples are vigorously digested in nitric acid and hydrochloric acid.

8.2 The wavelengths and background correction locations in the reference method can be substituted if they can provide the needed sensitivity and are corrected for spectral interferences. The analyst should follow the instrument manufacturer's instructions, and if possible, approximate the recommended operating conditions.

For each analyte there are a number of possible wavelengths at which analyses could be made. The wavelengths used were selected based on consultations with the ICP specialists at Perkin-Elmer and our own experience.

8.3 Background correction factors are obtained by aspirating a concentrated solution, usually about 200-500ppm, of the interfering element, and measuring the resulting concentrations at the wavelength used. The background correction factors for that interfering element are obtained by dividing the measured concentrations by the actual concentration. For example: by aspirating a 500ppm solution of aluminum, one measures a cadmium concentration 0f 0.010ppm. The aluminum correction factor for cadmium is (0.010)/500 = 0.000020. This means that if the aluminum concentration in a sample is, say, 120ppm, one must subtract 120*0.000020 = 0.0024ppm from the measured cadmium concentration in that sample.

8.4 Interelement Correction (IEC) factors are established quarterly (or biannually at a minimum), for the major salts: aluminum, calcium, iron, magnesium, and also for chromium, copper, manganese, nickel, thallium, titanium and vanadium. Correction factors should not exceed 20% difference from the previous IEC values.

8.5 Linear Dynamic Range is performed quarterly (or biannually at a minimum). Following instrument calibration, solutions with varying concentrations (**section 7.5.13**) of each analyte (LDR standards) are analyzed. The highest concentration, within ±10 % of the true value, establishes the linear range.

8.6 Allow the plasma to become thermally stable before beginning the analyses. This usually requires at least 30 minutes. If the plasma is (for whatever reason) extinguished and needs to be re-lit, subsequent re-stabilization of the plasma takes only 15 minutes provided the plasma is re-lit immediately after it is extinguished.

8.7 The nebulizer flow rate used is constant for all aqueous sample extracts and needs not be reset prior to analysis.

8.8 The instrument operating conditions finally selected as being optimum should provide the lowest reliable instrument detection limits (IDL). (See **Section 10** for IDL calculation)

8.9 The calibration curve consists of a blank (S0) and at least 3 calibration standards. The low concentration calibration standard concentration is less than or equal to the method reporting limit (MRL). Sample concentrations less than the lowest standard can only be reported after method modifications have taken place, or with estimated results flagging.

The highest concentration must be within the instrument's linear dynamic range. The standards are run in a sequence from high concentration to low concentration.

8.10 The minimum correlation coefficient for the calibration curve is 0.998. If a correlation coefficient less than 0.998 is obtained, the calibration must be repeated.

8.11 A mid-range ICV (Initial Calibration Verification) Standard from an independent source than the calibration standards) precedes the analysis of the samples. Recovery limits for the ICV are ± 10% of the true value. If the ICV recoveries do not meet acceptance criteria, corrective action must be taken and/or the calibration must be repeated. An ICV can be reanalyzed only once prior to corrective action.

8.12 A CCV (Continuing Calibration Verification Standard) is analyzed after at least every tenth sample and at the end of the sample run. Recovery limits for the CCV are ±10% and in the case of failure for a particular element, all samples following the last acceptable CCV must be reanalyzed for that element. A CCV can be reanalyzed only once prior to corrective action.

8.13 The ICB is analyzed after the ICV and is of the same source as the calibration blank. The CCB (Continuing Calibration Blank) is analyzed after each CCV. Concentrations of any analytes detected must not exceed the MRL or corrective action, such as a single reanalysis and evaluation, must be taken. If the ICB/CCB still fails, reanalysis of all samples since the last valid ICB/CCB for that element is required.

DoD QSM: The acceptable absolute value of the ICB and CCB must be < 2x MDL.

8.14 The ICS (ICSA and ICSAB) standards must be run at the beginning, every 8 hours and at the end of each analytical run.

8.14.1 The ICSA solution, containing the Al, Ca and Mg at 500mg/L, and Fe at 200mg/L, must be run at all wavelengths used for each analyte reported. The analytical results for those target analytes with MRLs ≤ 10ug/L shall fall within ± 2x MRL of the analyte's true value (the true value shall be zero unless otherwise stated). If the results for these analytes fall outside the ± 2x MRL window, check that the background correction factors are appropriate, and readjust if necessary. Recalibration may be necessary. For analytes with a MRL > 10 ug/L, the ICSA results shall fall with ± one MRL of the analytes true value (0).

DoD QSM: the absolute value of all non-spiked analytes < 2x MDL

8.14.2 The ICSAB contains Al, Ca, Mg and Fe at the same concentrations as the ICSA as well as all other analytes of interest. Recovery limits for the ICSAB must be within ± 20% of the true value. If the ICSAB recoveries do not meet acceptance criteria, corrective action must be taken. Check that the background correction factors are appropriate, and readjust if necessary. Recalibration may be

necessary. If the ICSAB at the end of an analytical sequence fails for a particular element, all samples must be reanalyzed for that element.

8.15 After completion of the initial requirements of this method, samples should be analyzed in the same operational manner used in the calibration routine. A 60 second rinse (rinse solution: 1% HNO_3 and 1.5% HCl) is conducted between all sample solutions, quality control samples, method blanks, and standards.

Analytical Sequence: The following QC protocol should be employed.

1. Standard S0
2. Standard S1
3. Standard S2
4. Standard S3
5. mid-range ICV(second source)
6. low-range ICV (either source, optional)
7. ICB
8. ICSA
9. ICSAB
10. Sample 1
11. *
12. *
13. *
14. *
15. *
16. *
17. Sample 8
18. CCV
19. CCB
20. Sample 9
21. *
22. *
23. *
24. *
25. Sample 16
26. ICSA
27. ICSAB
28. CCV
29. CCB

Note: The ICSA and ICSAB sample count as analytical samples between CCV/CCBs.

Any deviations must be approved by the Inorganic Laboratory Manager or the Operations Manager before they can be implemented.

All analyses are documented in the Instrument Run Log (**Attachment 3**) .

9. Data Reduction and Calculations

9.1 Sample data should be reported in units of mg/L for aqueous samples and mg/Kg dry weight for solid samples. Results are reported to two or three significant figures.

9.2 For dissolved aqueous analytes, report the data generated directly from the instrument with allowance for sample dilution. Do not report analyte concentrations below the reporting limit (RL) unless specifically requested by the client.

9.3 Soil concentrations are calculated using the equation below:

$$\text{Sample Conc. (mg/Kg)} = \frac{C \times V \times Df}{W}$$

Where: C = Concentration in extract (µg/L)
V = Volume of extract (L, 100mL = 0.1L)
Df = Dilution factor (undiluted =1)
W= Dry weight of sample aliquot extracted (g)

9.4 Recovery Calculations:

The recovery of a spiked analyte is calculated as follows:

$$\text{\% Recovery (\%R)} = 100 \times (SSR-SR)/(SA)$$

Where: SSR = spiked sample result
SR = sample concentration
SA = spike added

9.5 Relative Percent Difference Calculations:

The relative percent difference (RPD) between replicate determinations is calculated as follows:

$$RPD = \frac{D1 - D2}{(D1 + D2)/2} \times 100\%$$

$$RPD = \frac{(D1-D2)}{(D1+D2)/2} \times 100$$

Where: RPD = relative percent difference
D1 = first sample value
D2 = second sample value (replicate)

10. Quality Assurance/Quality Control

10.1 Personnel - Use of this method is restricted to analysts who are knowledgeable in the operation of this instrumentation and have performed a proficiency test with acceptable accuracy and precision results.

10.2 Method blanks - A preparation blank is prepped and analyzed with every batch not to exceed 20 samples. Method blank concentration must be less than or equal to reporting limits unless the sample concentration is at least 20 times greater than the blank concentration or less than reporting limits. Corrective action for method blank contamination involves determining the source of the contamination and re-prepping the affected samples in the batch. The analyst may rerun the method blank once as the first step of corrective action.

DoD QSM -Method blank concentrations must be less than or equal to one-half the reporting limit. For common contamination analytes, method blank concentration must be less than or equal the reporting limit.

10.3 Calibration verification –

10.3.1 A mid-range ICV analyzed immediately after standards must be within ±10% of the true value. The ICV is an independent source standard purchased from a different vendor than the calibration standards.

10.3.1.1 Method 6010C recommends an additional calibration verification using a low-level ICV with a 70-130% criteria, however only the mid-level ICV is required <u>when performing multi point calibrations. This low-level ICV is not required to be second source. In lieu of a second analysis, the response from the S3 standard can be entered back into the curve for verification.</u>

10.3.2 The CCV is analyzed a minimum of every 10 samples in the analysis and at the end of the analytical sequence. If the closing CCV does not meet the criteria, the CCV and all analyses from the opening CCV must be re-analyzed after the problem has been eliminated.

10.3.3 The ICV and CCV analyses are followed by the ICB and CCB analyses, respectively. The ICV and CCV must pass the ±10% criteria or be re-analyzed.

10.4 Use of all standards made from a primary standard must not exceed the primary standard's expiration date.

10.5 Matrix spike (MS) samples - A matrix spike is processed with each batch of samples. Spike recoveries must be within 75-125% of the expected value. If the native sample results exceed 4x the spike added, no further action is needed. Note in narrative. Unless

superceded by project requirements, it is not necessary to spike Na, K, Ca, and Mg for waters; or Na, K, Ca, Mg, Fe, Al and Mn for soil.

DoD QSM: Spike recoveries must be within 80-120%. Precision requirements are ≤ 20 % RPD for both aqueous and soil matrices. There is no corrective action for MS recoveries outside the acceptance range other than data qualification.

10.6 Matrix duplicate (DUP) or matrix spike duplicate (MSD) samples (Both options are allowed in method SW6010)- Duplicates are prepped and analyzed with every batch not to exceed 20 samples. Relative Percent Difference (RPD) is calculated for the results of duplicate samples.

10.6.1 A limit of 20% RPD shall be used for sample values greater than 5x the MRL

.

10.6.2 A control limit of (±) the MRL level must be used if either the sample or the duplicate value is less than 5x MRL.

10.6.3 If one result is above 5x MRL and one below, use the ± MRL criteria.

10.6.4 If both values are below the MRL, no RPD is calculated.

DoD QSM- DUP precision is evaluated for all analytes. Precision requirements are ≤ 20 % RPD for both water and soil. There is no corrective action for MS/MD precision outside the acceptance range other than data qualification.

10.7 Laboratory Control Sample (LCS) - is prepped with a minimum of every 20 samples of the same matrix.

10.7.1 For an aqueous LCS sample, mixed standards are spiked into a beaker of DI water resulting in concentrations approximately ½ the concentration of the high calibration standard and prepped as an aqueous sample. Recoveries must be within the established control limits. The ID of the aqueous LCS sample is LCSW.

10.7.2 For soils, approximately 1g of Teflon Chips (Chemware Ultra-pure PTFE boiling stones, acid washed) used to simulate solid matrix is spiked with standards at the approximate mid-point of the calibration curve. The LCS is then prepped as a soil. The ID for the solid LCS sample is LCSS.

DoD QSM –The acceptance range for both water and soil is 80-120% except silver which has a 75-120% range for soils. When Mitkem in-house LCS limit fall within DoD limit, in-house limits may be reported. If Mitkem in-house limits are wider than DoD limits, the 80-120 % limits must be used.

Laboratory control sample acceptance limits are based on control charts, which are established at Mitkem. These are referred to as in-house limits. Mitkem may also adopt limits from outside agencies when necessary.

10.8 Post digestion spike (PDS) addition - An analyte spike added to a portion of the sample digestate. A PDS is analyzed with each preparation batch of samples (PDS spiking of the same sample as used for matrix spiking is recommended) and is suggested when a new or unusual matrix is encountered within a batch. The acceptance criteria for PDS is 80-120%. The PDS is spiked at the same concentrations as the matrix spike. The PDS concentration should be >10 times the MRL, but < 100 times. If the PDS is not recovered within the specified limits, a matrix effect is confirmed.

DoD QSM: A PDS is required when a new or unusual matrix is encountered within a batch; or when the serial dilution test fails. In addition, a PDS is recommended for projects where all samples are below 50X MDL. The acceptance window is 75-125%.

Corrective action should be taken if the spike concentration is at least 2x the native sample concentration:

(a) If the MS fails for any analyte but the PDS passes, the sample may be redigested and analyzed, except when low MS recovery can be explained as a historically poor performer (example:Antimony (Sb) for soils) in that matrix. In these instances the analyst may want to discuss the outliers with the project manager or department supervisor. When redigestion is warranted, and the MS fails in the redigestate, a matrix issue is confirmed. If the MS passes for the redigestate, the initial results were due to human error during digestion or spiking.

(b) If both the MS and PDS fail, the laboratory will perform a dilution test, or may make a reasonable effort to address the matrix interference by performing the method of standard additions (MSA) or internal standard addition.

10.9 Dilution test (Serial Dilution) – should be performed with each preparation batch. If the analyte concentration is sufficiently high (minimally, a factor of 10 above the MDL), an analysis of a 5X dilution should agree within ±10% of the original determination. If not, a chemical or physical interference effect is confirmed. A serial dilution should be run whenever the PDS fails, to confirm matrix effect.

DoD QSM: A Serial Dilution is required once per preparation batch or when an unusual sample matrix is present. If the SD fails, a PDS must be run.

As a general rule, Mitkem performs a PDS and SD with each preparation batch of samples.

10.10 Instrument detection limits (IDLs) are established at the time the instrument is set up and every six months thereafter. Ten solutions of diluted acid (1% HNO3 and 1.5% HCl) are

analyzed on three non-consecutive days. The IDL for a particular element is three times the average standard deviation of the measured concentration for that element. An IDL is valid in the condition that IDL on both instruments are less than MDL currently reported.

DoD QSM: IDLs are established at the time the instrument is set up and whenever significant changes are made

10.11 Method detection limits (MDLs) may be established once a year. Mandatory MDL determination has been removed from the SW846 6010C method however until regulatory agencies are in agreement, Mitkem will continue to perform MDL studies. The MDL is obtained by multiplying the standard deviation of seven analyses by the appropriate one-sided 99% t-statistic. The value of this statistic equals 3.143 if the number of analyses is seven. The concentration of the analyte in the analyzed solution should be between three to five times the calculated MDL. An MDL verification check is performed immediately following the MDL study. In lieu of an annual MDL study, the MDL verification can be run quarterly on each instrument. The MDL verification check sample is spiked at approximately 1-4 times the current MDL and prepared as if it were a sample.

10.12 Sample Dilutions: When analytes exceed the established linear dynamic range, the sample must be diluted sufficiently to bring those elements into the linear range. The dilution factor (Df) must be integrated into the final concentration calculation.

11. Data Validation and Reporting

11.1 All raw data, including calibrations, QC results, and sample results, are peer reviewed for technical accuracy and completeness. Sample preparation logs, notebooks, and instrument logs are reviewed and signed daily by the supervisor. The laboratory manager reviews 100% of the data prior to report generation. The QA Director or designee randomly reviews 10% of the data reported by the laboratory. Refer to Section 11 of the QAP for details.

11.2 Electronic files are validated by the analyst and transferred to the report generation group via the LIMS. Once data is in LIMS it is reviewed and validated again by the supervisor or his/her designee. The data are then locked and forms may be generated.

11.3 Reports are generated by the reporting group in conjunction with the metals lab. The data submitted for report preparation is dependent on project requirements.

12. Corrective Action Procedures

12.1 Corrective action to be implemented in the event QC results are outside of the acceptance range are covered in **Section 10**.

12.2 Corrective action reports (CARs) are initiated through the LIMS in the event of an out-of -control situation that cannot be corrected by the analyst. The procedure for initiating a CAR for the purpose of identifying the appropriate corrective action is covered in SOP No. 80.0007.

13. Health and Safety

13.1 The toxicity or carcinogenicity of each reagent used in the method has not been fully established. However, each chemical should be regarded as a potential health hazard, and exposure to these compounds should be as low as reasonably achievable. A reference file of material safety data sheets (MSDS) is available to all laboratory personnel on the bookcase between the GC/MS and OPrep labs. In addition, laboratory personnel should follow the precautions outlined in the laboratory's Chemical Hygiene Plan, and have read the Mitkem Contingency Plan.

In general, use gloves, a lab coat, and goggles when handling these reagents and work in a hood whenever possible.

13.2 Concentrated nitric and hydrochloric acids are moderately toxic and extremely irritating to skin and mucus membranes. Always wear safety goggles or a face shield for eye protection when working with acids. If eye or skin contact occurs, flush with large volumes of water.

13.3 Many metal salts are extremely toxic if inhaled or swallowed. Use good housekeeping practices in areas where metal salts are being used and wash hands thoroughly after handling.

13.4 Inductively coupled plasma sources emit radio frequency radiation and intense UV radiation.

13.5 Basic good housekeeping practices such as the wiping up of spills immediately and regular cleaning of counters and hoods, will help reduce the potential for cross-contamination and create a safe working environment.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's Quality Assurance Plan.

15. References

Fassel, V.A. et al. Simultaneous Determination of wear metals in lubricating oils by Inductively-Coupled Plasma Atomic Emission Spectrometry . Anal. Chem. 48: 516-519, 1976.

Patel, B.K.; Raab, G.A.; et al. Report on a single laboratory evaluation of

Inductively coupled optical emission Method 6010; EPA contract No. 68-03-3050, December 1984.

U.S. Environmental Protection Agency. I*nductively Coupled Plasma Atomic Emission Spectroscopy* Method 6010C, SW-846 test methods for evaluating solids waste, Revision 3, Final Update IV, February 2007.

U.S. Environmental Protection Agency. Inductively Coupled Plasma-Atomic Emission Spectrometry Method for the Analysis of Waters and solids, EMMC, July 1992.

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Department of Defense Quality Systems Manual for Environmental Laboratories, Final Version 3, January 2006.

Attachments:

1. **Attachment 1**: Analytes of Interest (Table 1 from SW-846 6010C)
2. **Attachment 2:** DoD QC Requirements, Table B-6,D-18, D-19
3. **Attachment 3**: Standard Preparation Logs
4. **Attachment 4**: Instrument Run Logbook

Attachment 1
Analytes of Interest

TABLE 1

RECOMMENDED WAVELENGTHS AND ESTIMATED INSTRUMENTAL DETECTION LIMITS

Element	Wavelength[a] (nm)	Estimated IDL[b] (µg/L)
Aluminum	308.215	30
Antimony	206.833	21
Arsenic	193.696	35
Barium	455.403	0.87
Beryllium	313.042	0.18
Boron	249.678 x2	3.8
Cadmium	226.502	2.3
Calcium	317.933	6.7
Chromium	267.716	4.7
Cobalt	228.616	4.7
Copper	324.754	3.6
Iron	259.940	4.1
Lead	220.353	28
Lithium	670.784	2.8
Magnesium	279.079	20
Manganese	257.610	0.93
Mercury	194.227 x2	17
Molybdenum	202.030	5.3
Nickel	231.604 x2	10
Phosphorus	213.618	51
Potassium	766.491	See note c
Selenium	196.026	50
Silica (SiO_2)	251.611	17
Silver	328.068	4.7
Sodium	588.995	19
Strontium	407.771	0.28
Thallium	190.864	27
Tin	189.980 x2	17
Titanium	334.941	5.0
Vanadium	292.402	5.0
Zinc	213.856 x2	1.2

TABLE 1
(continued)

[a] The wavelengths listed (where x2 indicates second order) are recommended because of their sensitivity. Other wavelengths may be substituted (e.g., in the case of an interference) if they provide the needed sensitivity and are treated with the same corrective techniques for spectral interference.

[b] The estimated instrumental detection limits shown are provided for illustrative purposes only. Each laboratory must determine IDLs and MDLs, as necessary, for their specific application of the method. These IDLs represent radial plasma data and axial plasma IDLs may be lower.

[c] Highly dependent on operating conditions and plasma position.

Attachment 2:
DoD QC Requirements, Table B-6,D-18, D-19

APPENDIX DOD-B – QUALITY CONTROL REQUIREMENTS

The quality control (QC) protocols specified by the method shall be followed. In some cases the method may be ambiguous or provide insufficient detail. The specific manner in which methods commonly used by DoD should be implemented is detailed in the following tables. Modifications to the following requirements need project-specific approval by DoD personnel.

The tables describe specific quality assurance and quality control requirements for analytical methods (SW-846) commonly used when investigating DoD sites. The tables specify the method requirements, when available, as well as additional clarification and/or requirements from DoD. If possible, the actual requirement from the method is listed, although in some cases the description in the method is so lengthy that only a reference to the appropriate section is made. The methods should always be referenced, however, for clarification purposes. DoD has done its best to interpret the methods, providing clarification where there are inconsistencies between existing guidance documents, and stating DoD preferences when multiple options are acceptable. If there is a contradiction between the method and the following tables, the requirements specified in the tables shall be followed.

SW-846 Methods

This appendix is based on the method versions current at the time of publication, regardless of status (promulgated, draft, proposed, etc.). As methods are revised, subsequent versions of this manual may incorporate the changes. If the requirements in this appendix do not yet correspond with the most recent version of the SW-846 method, or a new method that analyzes for the same group of analytes becomes available, the requirements in the method shall be followed where appropriate.

Table B-1 below presents a summary of the definition, purpose, and evaluation of the major QC checks required in the subsequent QC tables (B-2 through B-10) for the various methods. The *definition* column describes generally what the QC check is and/or how it is performed. The *purpose* column describes why the check is important for assessing and measuring the quality of the data being generated. The *evaluation* column describes how to interpret the results of the QC check, particularly in the context of the results of other QC checks. This table should be used in conjunction with the instrument- and method-specific requirement tables to properly implement the methods for DoD projects. In addition, a supplementary list of acronyms and a glossary relevant to this appendix follows Table B-10.

TABLE B-1. SUMMARY OF QUALITY CONTROL CHECK DEFINITIONS, PURPOSE, AND EVALUATION

QC Check	Definition	Purpose	Evaluation
Breakdown check (Endrin - Method 8081 only, DDT - Methods 8081 and 8270)	Analysis of a standard solution containing Endrin and DDT. Area counts of these compounds and their breakdown products are evaluated to assess instrument conditions.	To verify the inertness of the injection port because DDT and Endrin are easily degraded in the injection port.	If degradation of either DDT or Endrin exceeds method-specified criteria, corrective action must be taken before proceeding with calibration.
Calibration blank (metals only)	Reagent water containing no analytes of interest, but acidified to the same pH as all samples.	To determine the zero point of the calibration curve for all initial and continuing calibrations.	This is a required QC procedure. Continuing calibration blank responses above two times the MDL require corrective action.
Confirmation of positive results (organics only)	Use of alternative analytical techniques (another method, dissimilar column, or different detector such as MS detector) to validate the presence of target analytes identified.	To verify the identification of an analyte.	This is a required QC procedure. All positive results must be confirmed.

TABLE B-6. INORGANIC ANALYSIS BY INDUCTIVELY COUPLED PLASMA (ICP) ATOMIC EMISSION SPECTROMETRY AND ATOMIC ABSORPTION SPECTROPHOTOMETRY (AA) (METHODS 6010 AND 7000 SERIES)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Demonstrate acceptable analyst capability	Prior to using any test method and at any time there is a significant change in instrument type, personnel, or test method (see Appendix C)	QC acceptance criteria published by DoD, if available; otherwise method-specified criteria	Recalculate results; locate and fix problem, then rerun demonstration for those analytes that did not meet criteria (see section C.1.f).	NA	This is a demonstration of analyst ability to generate acceptable accuracy and precision using four replicate analyses of a QC check sample (e.g., LCS or PT sample). No analysis shall be allowed by analyst until successful demonstration of capability is complete.
MDL study	At initial set-up and subsequently once per 12 months; otherwise quarterly MDL verification checks shall be performed (see box D-18).	See 40 CFR 136B. MDL verification checks must produce a signal at least 3 times the instrument noise level.	Run MDL verification check at higher level and set MDL higher or reconduct MDL study (see box D-18).	NA	Samples cannot be analyzed without a valid MDL.
Instrument detection limit (IDL) study (ICP only)	At initial set-up and after significant change	Detection limits established shall be ≤ MDL.	NA	NA	Samples cannot be analyzed without a valid IDL.
Linear dynamic range or high-level check standard (ICP only)	Every 6 months	Within ± 10% of expected value	NA	NA	

TABLE B-6. INORGANIC ANALYSIS BY INDUCTIVELY COUPLED PLASMA (ICP) ATOMIC EMISSION SPECTROMETRY AND ATOMIC ABSORPTION SPECTROPHOTOMETRY (AA) (METHODS 6010 AND 7000 SERIES) (CONTINUED)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial calibration for all analytes (ICAL) (ICP: minimum one high standard and a calibration blank; GFAA: minimum three standards and a calibration blank; CVAA: minimum 5 standards and a calibration blank)	Daily initial calibration prior to sample analysis	ICP: No acceptance criteria unless more than one standard is used, in which case $r \geq 0.995$. GFAA: $r \geq 0.995$ CVAA: $r \geq 0.995$	Correct problem and repeat initial calibration.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until ICAL has passed.
Second source calibration verification (ICV)	Once after each initial calibration, prior to sample analysis	Value of second source for all analyte(s) within ± 10% of expected value (initial source)	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat initial calibration.	Flagging criteria are not appropriate.	Problem must be corrected. No samples may be run until calibration has been verified.
Continuing calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence	ICP: within ± 10% of expected value GFAA: within ± 20% of expected value CVAA: within ± 20% of expected value	Correct problem, rerun calibration verification. If that fails, then repeat initial calibration. Reanalyze all samples since the last successful calibration verification.	Flagging criteria are not appropriate.	Problem must be corrected. Results may not be reported without a valid CCV.
Low-level calibration check standard (ICP only)	Daily, after one-point initial calibration	Within ±20% of expected value	Correct problem, then reanalyze.	Flagging criteria are not appropriate.	No samples may be analyzed without a valid low-level calibration check standard. Low-level calibration check standard should be less than or equal to the reporting limit.

TABLE B-6. INORGANIC ANALYSIS BY INDUCTIVELY COUPLED PLASMA (ICP) ATOMIC EMISSION SPECTROMETRY AND ATOMIC ABSORPTION SPECTROPHOTOMETRY (AA) (METHODS 6010 AND 7000 SERIES) (CONTINUED)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method blank	One per preparatory batch	No analytes detected > ½ RL For common laboratory contaminants, no analytes detected > RL	Correct problem, then see criteria in box D-5. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	
Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence	No analytes detected > 2 x MDL	Correct problem, then reprep and reanalyze calibration blank and previous 10 samples	Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	
Interference check solutions (ICS) (ICP only)	At the beginning of an analytical run	ICS-A: Absolute value of concentration for all non-spiked analytes < 2 x MDL (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ± 20% of expected value	Terminate analysis; locate and correct problem; reanalyze ICS.	Flagging criteria are not appropriate.	No samples may be analyzed without a valid ICS.
LCS containing all analytes required to be reported	One LCS per preparatory batch	QC acceptance criteria specified by DoD, if available; see box D-7 and Appendix DoD-D.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. (See full explanation in Appendix DoD-D.)	If corrective action fails, apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	
Dilution test Serial dilution	Each preparatory batch or when a new or unusual matrix is encountered	Five-fold dilution must agree within ± 10% of the original determination	ICP: Perform post-digestion spike (PDS) addition GFAA: Perform recovery test CVAA: Perform matrix spike	Flagging criteria are not appropriate.	Only applicable for samples with concentrations > 50 x MDL (ICP) or > 25 x MDL (GFAA and CVAA).
Post-digestion spike (PDS) addition (ICP only)	When dilution test fails or analyte concentration in all samples < 50 x MDL	Recovery within 75-125% of expected result.	Run samples by method of standard additions (MSA) or see flagging criteria.	Apply J-flag to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post-digestion spike addition.	The spike addition should produce a level between 10 - 100 x MDL.

TABLE B-6. INORGANIC ANALYSIS BY INDUCTIVELY COUPLED PLASMA (ICP) ATOMIC EMISSION SPECTROMETRY AND ATOMIC ABSORPTION SPECTROPHOTOMETRY (AA) (METHODS 6010 AND 7000 SERIES) (CONTINUED)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Recovery test (GFAA only)	When dilution test fails or analyte concentration in all samples < 25 x MDL	Recovery within 85-115% of expected result.	Run samples by method of standard addition (MSA) or see flagging criteria.	Apply J-flag to all sample results (for same matrix) in which MSA was not run when recovery is outside of 85-115% range.	
Method of standard additions (MSA) or internal standard calibration	When matrix interference is suspected	NA	NA	NA	Document use of MSA in the case narrative.
MS	One MS per preparatory batch per matrix (see box D-15)	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.
MSD or sample duplicate	One per preparatory batch per matrix	RPD ≤ 20% (between MS and MSD or sample and sample duplicate)	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	The data shall be evaluated to determine the source of difference.
Results reported between LOD and LOQ	NA	NA	NA	Apply J-flag to all results between LOD and LOQ	

TABLE D-18. LCS CONTROL LIMITS FOR METALS SW-846 METHODS 6010 AND 7470 WATER MATRIX[28]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Aluminum	97	5	80	120	80	120
Antimony	98	4	80	120	80	120
Arsenic	98	4	80	120	80	120
Barium	99	4	80	120	80	120
Beryllium	99	4	80	120	80	120
Cadmium	100	4	80	120	80	120
Calcium	98	4	80	120	80	120
Chromium	100	4	80	120	80	120
Cobalt	99	3	80	120	80	120
Copper	99	3	80	120	80	120
Iron	102	4	80	120	80	120
Lead	99	4	80	120	80	120
Magnesium	98	4	80	120	80	120
Manganese	100	4	80	120	80	120
Mercury	100	5	80	120	No ME	No ME
Molybdenum	95	5	80	120	75	120
Nickel	100	4	80	120	80	120
Potassium	98	4	80	120	80	120
Selenium	98	6	80	120	75	120
Silver	97	5	80	120	75	120
Sodium	99	4	80	120	80	120
Thallium	97	4	80	120	80	120
Vanadium	99	4	80	120	80	120
Zinc	100	4	80	120	80	120

[28] The as-generated limits have been adjusted to reflect method requirements and acceptable calibration uncertainty. A number of sporadic marginal exceedances of the control limits are allowed for method 6010, depending on the number of analytes spiked in the LCS. Refer to section D.2 and Table D-1 for guidance on the appropriate application of control and ME limits.

TABLE D-19. LCS CONTROL LIMITS FOR METALS SW-846 METHODS 6010 AND 7471 SOLID MATRIX[29]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Aluminum	95	5	80	120	75	120
Antimony	96	5	80	120	75	120
Arsenic	95	4	80	120	80	120
Barium	98	3	80	120	80	120
Beryllium	99	4	80	120	80	120
Cadmium	97	4	80	120	80	120
Calcium	97	4	80	120	80	120
Chromium	99	5	80	120	80	120
Cobalt	98	4	80	120	80	120
Copper	97	3	80	120	80	120
Iron	100	4	80	120	80	120
Lead	95	4	80	120	80	120
Magnesium	96	3	80	120	80	120
Manganese	97	4	80	120	80	120
Mercury	100	6	80	120	No ME	No ME
Molybdenum	96	5	80	120	75	120
Nickel	97	4	80	120	80	120
Potassium	96	4	80	120	80	120
Selenium	93	4	80	120	75	120
Silver	96	7	75	120	70	125
Sodium	96	4	80	120	80	120
Thallium	94	4	80	120	80	120
Vanadium	99	3	80	120	80	120
Zinc	95	5	80	120	75	120

SOIL

[29] Some as-generated limits have been adjusted to reflect method requirements and acceptable calibration uncertainty. A number of sporadic marginal exceedances of the control limits are allowed for method 6010, depending on the number of analytes spiked in the LCS. Refer to section D.2 and Table D-1 for guidance on the appropriate application of control and ME limits.

Attachment 3:
Standard Preparation Logs

MITKEM LABORATORIES **METALS PRIMARY STD RECEIPT LOGBOOK:INSTRUMENT LAB**

DATE REC	PRIMARY STD ID	VENDOR	CATALOG#	LOT #	ANALYTE(S)	REC BY	DATE OPENED	EXPIR. DATE	MITKEM ID

100.0038-01/08

Page: _____

MITKEM LABORATORIES, A Division of Spectrum Analytical Inc.

METALS INTERMEDIATE STANDARD LOGBOOK

Prep Date	Analyte(s)	Primary/Intermediate STD ID	Initial Conc.(mg/L)	Amt. Added (ml)	Final Volume (ml)	Final Conc.(mg/L)	Diluent Used	Intermediate STD ID	Analyst	Exp. Date

Logbook ID: 100.0041 -01/08

Reviewed By: _____

MITKEM LABORATORIES

METALS WORKING STANDARD LOGBOOK

Prep Date	Analyte(s)	Primary/Intermediate STD ID	Initial Conc.(mg/L)	Amt. Added (ml)	Final Volume (ml)	Final Conc.(mg/L)	Diluent Used	Working STD ID	Analyst	Exp. Date

Logbook ID: 100.0036 -12/07

Reviewed By: _____

Attachment 4:
Instrument Run Logbook

MITKEM LABORATORIES **SAMPLE RUN LOG: ICAP/4300DV**

Date: Analyst:

Spray Chamber: Minicone

POS	Lab ID		POS	Lab ID		POS	Lab ID		POS	Lab ID		POS	Lab ID	
1			21			41			61			81		
2			22			42			62			82		
3			23			43			63			83		
4			24			44			64			84		
5			25			45			65			85		
6			26			46			66			86		
7			27			47			67			87		
8			28			48			68			88		
9			29			49			69			89		
10			30			50			70			90		
11			31			51			71			91		
12			32			52			72			92		
13			33			53			73			93		
14			34			54			74			94		
15			35			55			75			95		
16			36			56			76			96		
17			37			57			77			97		
18			38			58			78			98		
19			39			59			79			99		
20			40			60			80			100		
												101		
												102		
												103		

Comments:

Lot #s

HNO3: _____

HCL: _____

CRI: _____

Logbook 100.0129-05/08

STANDARD: _____

ICV/CCV: _____

ICSA/ICSAB: _____

Reviewed by: _____

MITKEM LABORATORIES **SAMPLE RUN LOG: ICAP/3100XL**

Date: Analyst:

Spray Chamber: Minicone

POS	Lab ID		POS	Lab ID		POS	Lab ID		POS	Lab ID		POS	Lab ID	
1			21			41			61			81		
2			22			42			62			82		
3			23			43			63			83		
4			24			44			64			84		
5			25			45			65			85		
6			26			46			66			86		
7			27			47			67			87		
8			28			48			68			88		
9			29			49			69			89		
10			30			50			70			90		
11			31			51			71			91		
12			32			52			72			92		
13			33			53			73			93		
14			34			54			74			94		
15			35			55			75			95		
16			36			56			76			96		
17			37			57			77			97		
18			38			58			78			98		
19			39			59			79			99		
20			40			60			80			100		
												101		
												102		
												103		

Comments:

Lot #s

HNO3: _____

HCL: _____

CRI: _____

Logbook 00.0126-04/08

STANDARD: _____

ICV/CCV: _____

ICSA/ICSAB: _____

Reviewed by: _____

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL INC.

STANDARD OPERATING PROCEDURE

For

Sample Data Control for Inorganic CLP/ILM

SOP No. 110.0034

	Signature	Date
QA Director:	[illegible]	1/23/08
Lab Director:	[illegible]	1/25/08

This is a controlled document and may not be copied or written in. Additional copies may be obtained from the QA Department.

MITKEM LABORATORIES,

A DIVISION OF SPECTRUM ANALYTICAL INC

STANDARD OPERATING PROCEDURE

for

Sample Data Control for Inorganic CLP/ILM

1. Scope and Application

This Standard Operating Procedure (SOP) outlines the data management procedures used in support of report generation for CLP samples using the protocols described in ILM04.1 and ILM05.3

2. Personnel Qualifications and Responsibilities

Personnel responsible for inorganic data management must be familiar with the protocols outlined in this SOP and are required to follow these procedures.

3. Summary of Procedure

CLP forms 1 – 14 are generated from raw instrument data using the protocols outlined in the CLP Statement of Work (SOW) ILM04.1 or ILM05.3 and **section 8** of this SOP, in preparation for use in the final data package.

4. Sample Preservation, Containers, Handling, and Storage

NA

5. Interferences and Potential Problems

NA

6. Equipment and Apparatus

6.1 Intel Based Workstation, operating in a Microsoft Windows 05.

6.2 Omega LIMS CLP ILM module

7. Reagents

NA

8. Procedure

8.1 Perkin-Elmer WinLab Software is used for data acquisition of all ICP analyses performed in the laboratory. Once a run has been completed, the data file associated with the run is assigned a filename that describes the instrument, date of run, and the daily run sequence (e.g. A091402 denotes the second data file generated by the Optima 3100 XL (ICP 2) on 9/14). This (CSV) file is loaded onto the file server Avogadro. Path = \\Avogadro\ \inorganic\CLPfiles\

8.2 Subsequent file translation and data processing is done using the Omega ILM Module, Mitkem owns a site license. Currently a copy of the software is kept on three workstations. The workstations are connected to the file server via the Local Area Network (LAN). The server has a mass storage device consisting of five 9GB hard drives arrayed as a level 5 RAID. This drive is mirrored via a dedicated point to point Ethernet node to a backup server. The backup server has two 50GB ADR tape drives, and runs the Veritas backup EXEC for Windows NT. Daily, weekly, and monthly backups are performed by the network administrator. The servers are located in a secure area accessible by key code entry only to authorized personnel.

8.3 Once all inorganic data for a Sample Delivery Group (SDG) are generated, a folder containing instrument printouts of all raw data associated with the SDG are delivered to a data report analyst for processing. ICP, Mercury, and Cyanide runs are captured and saved for direct upload by the report generation software.

8.4 The first step in generating a final report begins with the uploading of all runs into Omega LIMS. Before doing this the runs need to be uploaded into Omega Upload Tool so that they can be edited for any problems associated with the run, such as typographical errors, or the "z-ing" out of unwanted data points.

8.5 Enter the runs into Omega LIMS. This is done by opening the Omega LIMS program. At the main menu screen click on the DATA ENTRY button. this will bring up a new screen called Analytical Runs. In this screen enter in new runs, and update or revise any previous analytical runs.

8.6 To enter analytical runs press the Add key in the top tool bar so that there will be a blank screen. Enter the Instrument ID, Run Start Date, Analyst, and any comments. In the comments space enter any information that is important to the run and who uploaded it.

8.7 Once this information is entered press the Data Import button to bring the runs into LIMS. Once the run is uploaded it can be further edited for items such as ID's, turning off analysts

that are not reported with the SDG, etc. Then the sequence can be calculated to get the final results.

8.8 The next step is to have the runs that were uploaded into Omega LIMS QA validated by an analyst who has QA authority. ***All runs that are entered into Omega LIMS have to be QA validated before entering them into the CLP ILM module.***

8.9 After the runs have been QA'd by a senior analyst they can be uploaded into the CLP ILM module.

8.10 Open the ILM module and enter an SDG number. Press return after the software has completed some querying

8.11 Select the protocol that will be used. If the protocol is SW6010 select SW846 from the protocol drop down list. If the protocol is ILM, select ILM04.1 or ILM05.3 from the protocol drop down list.

8.12 The next step for ILM04.1 SDGs is to select the IDL set that will be used. To do this left click in the blank IDL Key and a dropdown list will appear. Select the instruments that were used. Once the instruments for the IDLs have been selected, edit the IDLs to the analytes that are associated with the SDG that is being generated.

8.13 Click the "Get LIMS Data" button. This will do many calculations and put all the data on the correct CLP forms.

8.14 Now go to the "Review Data " tab and click on "Update Forms" This will update all the forms that were generated. In this screen the runs can be edited further by deleting the samples that are not needed in the SDG that is being worked on. The analytes that are not needed for the QC samples can be turned off. After all the runs have been edited click the "Update Forms" button again. This icon should be clicked after edits to the run have been made.

8.15 Now go to the tab "Report Options". This lists all the CLP forms that are generated through the module. Click on the icon "Edit Cover Letter" this will update the SDG cover page. Go through all of the forms to make sure that they look right and all the concentrations and percent recoveries appear to meet criteria. To view the forms click in the box next to the form that you want to view then press the "Preview Report". Form 11 ICP Interelement Correction should not be opened with the "Preview Report" icon. The reason for not opening this form is because it will not display properly so just go to "Generate Report" to print it out. After reviewing all the forms go back to the "SETUP: IDL and ICF" tab to import the IEC's. Click on the "Import from Excel" icon this will bring you to a directory where you can navigate to where IEC files are stored. The file is called "zzzzz6010_ICF". Next open the IEC table by clicking on "View Export" button and edit the list by choosing the instruments that are being used. The IEC's can also be uploaded after choosing the IDL's. ILM0.41 SDG's Form 1's need to have the color, clarity, and comments added to then you click on the button "Forms 1 Color, Clarity and Comments".

8.16 Now the report can be generated. Click on the button "Select All". This checks off all the forms that will be printed. If you do not need a form just click off the checkmark then press the "Generate Report" button. This will print out the entire SDG.

8.17 Initial Report Assembly:

Once all data forms have been generated, the entire data package is assembled for final review and contains all the required supporting forms including: all raw instrument data runs, copies of each preparatory log sheets, percent moisture log sheet (if required), a current revision of the laboratory work order that documents the EPA sample names, analyses required and other pertinent SDG related information, appropriate separator pages, and the "CLP/CLP-Like delivery checklist for inorganic analyses". All deliverables shall be presented to the EPA as described in **Exhibit B, Section II, Parts C and D** of the SOW.

8.18 Final Data Report Review:

Upon receipt of the data package and other supporting documents required in the complete SDG file (CSF), a designated data analyst reviews the final report. This review ensures that all required QA/QC operations as specified in **Exhibit E, Section V** of the SOW have been followed. Errors in the format or content of the final data report are noted and the report is returned to the analyst who originally processed the data for correction.

8.19 Package Assembly:

When the Review/Corrections to the data report have been completed, and approved, the package with all the supporting documentation is delivered to data management for assembly onto the final CSF with the reports (if required) from the organic laboratories. This procedure is described in Mitkem Laboratories's SOP # 110.0029, Data Management for CLP Analysis for EPA SOWs.

8.20 Software and Hardware systems are maintained on a daily basis. The network administrator, in addition to maintaining security and the integrity of all data on the main servers, also assists data technicians in the maintenance of each Windows based workstation, as outlined in **Exhibit F, Section 2.6** of the SOW.

8.21 Software Updates:

Omega LIMS periodically updates the software.

9. Data Reduction and Calculations

NA

10. Quality Assurance/Quality Control

NA

11. Data Validation and Reporting

See **Section 8** of this SOP.

12. Corrective Action Procedures

All out-of-control situations must be corrected or qualified prior to submission of the final report. Any initial deviations should be noted in the prep/analysis notes section of the "CLP/CLP-Like Deliverable Checklist for Inorganic Analysis" so that corrections may be documented and returned to the laboratory for final correction.

13. Health and Safety

All employees must read and be familiar with the Mitkem Safety Manual and Chemical Hygiene Plan, and are required to comply with the safety practices described therein.

14. Pollution Prevention, Waste Management, and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

1. The Mitkem Quality Assurance Plan
2. US EPA CLP Statement of Work (SOW), for Inorganics Analysis, Multi-Media/Multi-Concentration, ILM04.0/4.1
3. US EPA CLP Statement of Work (SOW), for Inorganics Analysis, Multi-Media/Multi-Concentration, ILM05.3.
4. Omega LIMS user manuals

Attachments:

1. **Figure 1**: CLP/CLP-Like Deliverable Checklist for Inorganic Analysis.

Figure 1

CLP/CLP-Like Deliverable Checklist for Inorganic Analysis

MITKEM CORPORATION

CLP/CLP-like Deliverable Check List for Inorganic Analysis

Project Number:_____
Client_____
Input by/date:_____
Forms generated on/date:_____

Analysis:_____
Category:_____
Reviewer:_____
(1) Date Reviewed:_____
(2) Date Reviewed:_____
Corrections by:_____

Elements Required:

Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Ni	K	Se	Ag	Na	Tl	V	Zn	Sn	CN	Hg

Items:	Pages	Check	OK/Unusual Observation
Sample Log-In Sheet	_____	_____	_____
Prep Log Sheet (AQ/SL)	_____	_____	_____
% Solid Bench Sheet	_____	_____	_____
Tumbling Log (TCLP/SPLP)	_____	_____	_____

	Check	Lab ID	OK/Unusual Observation/Deviation/Flags
ICV / CCV	_____	_____	_____
Matrix Spike (N)	_____	_____	_____
Duplicate Samples (*)	_____	_____	_____
Serial Dilutions (E)	_____	_____	_____
Post Digestion Spike	_____	_____	_____
LCS	_____	_____	_____
ICP Interference	_____	_____	_____
CRA / CRI	_____	_____	_____

Prep/Analysis Notes:

	Yes	No
Client ID Check:	_____	_____
ID Truncation:	_____	_____
Special Request:	_____	_____

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL, INC.

STANDARD OPERATING PROCEDURE

For

Sample Data Control for CLP (SOM01.2)

SOP No. 110.0035

Rev. 1

	Signature	Date
QA Director:		4/8/08
Lab Director:		4/9/08

MITKEM LABORATORIES,
A DIVISION OF SPECTRUM ANALYTICAL, INC.

STANDARD OPERATING PROCEDURE

for

Sample Data Control for CLP (SOM01.2)

SOP 110.0035 Rev. 1

1. Scope and Application

This Standard Operating Procedure (SOP) outlines the data management procedures used in support of forms generation for CLP samples using the protocols in SOM01.2.

2. Personnel Qualifications and Responsibilities

The personnel responsible for the data management must be familiar with the protocols outlined in this SOP and follow these procedures.

3. Summary of Procedure

The CLP forms are generated using the **instructions, procedures and/or** protocols outlined in the **USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis Multi-Media, Multi-Concentration SOM01.2 (April 2007)** and **section 8** of this SOP.

4. Sample Preservation, Containers, Handling, and Storage

N/A

5. Interferences and Potential Problems

N/A

6. Eqnipment and Apparatus

6.1 Intel based workstation, operating in a Windows OS.

6.2 Target Software from ThruPut.

7. Reagents

N/A

8. Procedure

HP EnviroQuant Software is used for data acquisition for all of the organic CLP analyses performed in the laboratory. The software is resident in each of the PCs (as part of a company wide network) that are password accessible Analysts are assigned different security levels depending on the job requirement.

8.1 Upon completion of each data acquisition, the raw data are copied directly to the primary file server. The data are then evaluated using Target. The Target reviewed data will then be uploaded into LIMS. The data in LIMS will need to be QA'd for forms generation (**Forms I through VIII for volatiles and semivolatile, Forms I through X for pesticides and Aroclors**) and supporting documents including chromatograms, quantitation reports, **tentatively identified compounds (TIC)** library search and spectra generation.

8.2 The laboratory owns several copies of the data processing software Target that is installed on individual workstations. The workstations are connected to a file server via the company's local area network (LAN). For more details, see SOP No. 110.0029, Electronic Data Management.

8.3 Target data and methods reside on a system with name "Organics". The system is configured as follows:

8.3.1 Volatiles analysis:

Organic/VOA/Vi/Batch/File, where i = 1,2,5,or 6.

8.3.2 Semivolatile Analysis:

Organic/SVOA/Sj/Batch/File, where j = 1,2,3 or 4

8.3.3 Pesticide and/or Aroclor Analysis:

Organic/SVOA/Ek/Batch/File, where k = 1,2, 3, 4 or 5.

Where Vi is the instrument that is used in the volatile lab; Sj is the instrument that is used in the semivolatile lab; and Ek is the instrument that is used in the Pesticide/PCB lab.
Batch is the batch of runs that are generated within the analytical batch. This is typically the date the mass spectrometric analysis is acquired. For pesticides/PCB, the batch is the date the analytical sequence was initiated.

Under the subdirectory **File** are the raw data files that are uploaded from the Hewlett Packard EnviroQuant Software. This subdirectory also contains the various method files that are used to process data including tunes, initial calibration, continuing calibration and sample analysis for mass spectral based analysis, and initial calibration, calibration verification and sample analysis for GC based analysis. These method files are as follows:

8.3.4 Volatiles (Trace and Low/Medium)Analysis:

Vi_BFB_SOM.m for evaluating BFB tunes for Vi.
Vi_TVOA_1.2.m for evaluating analysis of blanks and samples by trace volatiles or Vi_SOM1.2_LS for low/medium volatiles, where i = 1,2,5, or 6.

8.3.5 Semivolatile Analysis:

Sj_dftppSOM.m for evaluating DFTPP tunes for Sj.
Sj_SOM m for evaluating analysis of blanks and samples, where j = 1,2, or 3.

8.3.6 Pesticide/PCB Analysis:

Ek_somPEST-F.m for evaluating sample analysis (including all standards) for Ek front column;Ek_somPEST-R.m for evaluating sample analysis (including all standards) for the rear column, where k = 1,2, 3, 4, or 5.

Once the data are processed, the analyst will evaluate the data to ascertain that all of the peaks of interest are properly integrated. If needed, manual integration will be performed to improve data quality. The analyst who performs the manual integration will initialize and date all such changes. In addition, hardcopy of the changes are generated as part of the audit trail. Most of the time, hardcopies of the re-integrations are self-evident and the analyst does not need to further justify the re-integrations. The lab supervisor or his/her designee will review and sign off the changes. See Mitkem SOP # 110.0008.

8.4 Procedures for Setting up Mass Spectral Based Analysis:

8.4.1 Mass spectral based analyses including the volatile and semivolatile organic analyses are similar and will be discussed together.

8.4.2 As discussed earlier, the various mass spectral processing methods are provided by the vendor and modified by the laboratory. On the day the samples are **to be** analyzed, the method file is created by going into Target/Edit/Copy to copy the methods from the previous batch of samples that were processed using the SOM01.2 approach.

8.4.3 **Make sure that both the tune and sample analysis methods are copied.** After the methods are copied, rename the methods to the date the actual batch of data are to be processed.

8.4.4 Use Target/Process/Select Method to select the tune method.
Use Target/Process/Process to process the tune analysis.
Use Target/Reports/Review Reports/Target Graphics to evaluate the tune analysis Whenever the ion abundance is outside the required criteria, it will be flagged with a qualifier "*". The analyst should re-analyze the tune sample. If the failure to meet tune criteria persists, the analyst should identify and resolve the problem by following the procedures outlined in the analytical SOP.

8.4.5 After the tune analysis passes criteria, proceed to the calibration standard analysis. Use Target/Process/Select Method to select the sample analysis method. Use Target/Process/Process to process the initial or continuing calibration standard(s). Use Target/Review/Target Review to evaluate the target analytes in the analysis for the initial or continuing calibration; use manual edition if needed.

8.4.6 For initial calibration, use Target/Process/Edit to open the method-editing window. Use View/Initial Calibration to evaluate the RRF and %RSD for each target analyte. An arrow qualifier will flag the target analyte(s) that does not meet criteria. Only up to two compounds may be flagged, and these compounds must have a RRF no less than 0.01 and a %RSD not greater than 40.0%. Corrections as noted in the analytical SOP should be taken to meet these criteria by re-analyzing one or more levels of the initial calibration.

8.4.7 For the continuing calibration, use Target/Reports/Review Reports/Target Sample to evaluate the RRF and %D for each target analyte. An arrow qualifier will flag the target analyte(s) that does not meet criteria. Only up to two compounds may be flagged, and these compounds must have a RRF no less than 0.01 and %D not greater than 40.0%. Corrections as noted in the analytical SOP should be taken to meet these criteria by re-analyzing the calibration standard. Once the daily calibration is processed, the RRF will automatically be updated in the method file. The same method file is then used to process the method blank, LCS, and samples run within the batch.

8.4.8 Use Target/Process/Select Method to select the sample analysis method. Use Target/Process/Process to process the method blank, LCS, and all samples. Use Target/Review/Target Review to evaluate the target analytes in the analyses for the method blank, LCS, and all samples; use manual edition if needed. Use Target/Reports/Review Reports/ISTD Monitor to evaluate the internal standard recovery. Use Target/Reports/Review Reports/Recovery Report to evaluate the recoveries for the system monitoring or surrogate compounds. For the LCS, the recoveries for the spiked compounds are listed as well. Use Target/Review/Target Review to evaluate the target analytes in the analyses for the method blank, LCS, and

samples. Some corrections as noted in the analytical SOP may be needed if the QC samples do not meet criteria.

8.4.9 After all the samples within the SDG, which may include several batches of samples, have been processed and reviewed, use Target/Reports/QuickForms to generate the required forms. The analyst should include all the files, which include all samples, tune, initial calibration, continuing calibration, method blank, LCS, and other necessary QC samples for the SDG using Add and Remove buttons.

8.4.10 Under the QuickForms Host: enter the case number and lab contract number into the appropriate boxes. Use Edit/Forms Control and then select SOM under Form Set. Make sure Fraction Type is set as VOA for volatile analysis or SV for semivolatile analysis; the analyst has the option of generation of all the required forms (**Forms I through VIII**) at once or one at a time. Use Edit/Edit SDG to evaluate all the files in the SDG. All the samples analyzed in the same batch will be organized into one QC group with their associated tune, initial calibration standard or continuing standards, and QC samples. Use Add Sample, Delete Sample, Delete QC Group, and New QC Group to rearrange samples or QC groups if needed. Use Edit/Blank Test to associate sample contamination with the corresponding method blanks. This step must be performed before producing any Form **I** to ensure that the compound has been flagged with a "B" qualifier if the same compound is also detected in the associated method blank. Use Generate/Generate Reports to produce all the form as selected. Use Generate/Review Reports to evaluate the forms.

8.5 Procedures for Setting Up Pesticides and/or Aroclor Analysis:

8.5.1 As discussed earlier, the Pesticides/PCB processing methods are provided by the vendor and modified by the laboratory. On the day the samples are to be analyzed, the method file is created by going into Target/Edit/Copy to copy the methods from the previous batch of samples that were processed using the SOM01.2 approach. **Make sure that both methods for the front and rear columns are copied.** After the methods are copied, rename the methods to the date the actual batch of data are to be processed.

8.5.2 Only the front column is discussed below, since the procedures are the same for the rear column.

8.5.3 Use Target/Process/Select Method to select the front column method. Use Target/Process/Process to process the initial calibration in the same order as the standards are analyzed, i.e. starting with the resolution check and ending with the INDABH. Use Target/Review/Target Review to evaluate the standard analyses to make sure they conform to method specifications as discussed in the Pesticide Analysis SOP. Some corrections, such as re-analysis of some of the levels of the calibration standards, may be needed to complete the initial calibration, as the method requires. Use manual edition if needed. Use Target/Process/Edit to open the method-

editing window, then use View/Initial Calibration to evaluate the %RSD for each target analyte in the initial calibration.

8.5.4 Once the initial calibration is processed, the CF will automatically be updated in the method file. The same method file is then used to process the method blanks, LCS, continuing calibration, and all samples run within the batch. Use Target/Process/Select Method to select the sample analysis method. Use Target/Process/Process to process the method blank, LCS, and all samples. Use Target/Review/Target Review to evaluate the target analytes in the analyses for the method blank, LCS, and all the samples; use manual edition if needed. Use Target/Reports/Review Reports/Target Sample to evaluate the CF and %D for each target analyte for the continuing calibration standard. Use Target/Reports/Review Reports/Recovery Report to evaluate the recoveries for the system monitoring compounds. For the LCS, the recoveries for the spiked compounds are listed as well.

8.5.5 After all of the samples within the SDG, which may include several batches of samples, have been processed and reviewed, use Target/Reports/Quick Forms to generate the required forms. The analyst should select all the files, that includes all samples, Resolution Check, PEM, instrument blank, initial calibration, continuing calibration, method blank, LCS, and other necessary QC samples for the SDG using Add and Remove buttons.

8.5.6 To generate Organics CLP forms, refer to the 'Organics Forms Reporting' document found in General Mitkem Omega Information on the Mitkem switchboard (http://switchboard.mitkem/docs.asp).

8.6 Data Package Assembly:

8.6.1 Once all of the required forms are generated; also generate all of the supporting documents. These include chromatograms and quantitation reports for the tune, initial calibration, continuing calibration, samples, blanks, LCS, TIC library search and spectra of positive hits for the mass spectral based analysis. For pesticides analysis, these include chromatograms, manual integration hard copies and quantitation reports for all initial calibration, calibration verification, florisil check, samples, blanks, LCS. All the information and documentation is forwarded to the document control officer with the following:

a. Copy of the extraction prep log.
b. Tracking log from sample receipt
c. Extraction transfer log.
d. Instrument run log.

The document control officer will assemble the data package per the SOW instructions.

8.7 Software Updates:

8.7.1 ThruPut is no longer updating the Target Software.

8.7.2 At Mitkem, the software and hardware systems are maintained on a daily basis. The laboratory has a full-time network specialist. This person is also responsible for monitoring the automatic copy/backup of all data each night.

8.7.3 At Mitkem, data base integrity (e.g. quantitation list, initial calibration and continuing calibration updates) is maintained by the analyst and his/her lab supervisor. Changes, if made, are reviewed by another analyst and/or supervisor.

9. Data Reduction and Calculations

N/A

10. Quality Assnrance/Quality Control

N/A

11. Data Validation and Reporting

N/A

12. Corrective Action Procedures

All out of control situations must be recorded in the corrective action logbook and documented returned to control as described in SOP No. 80.0007.

13. Health and Safety

All employees should read and be familiar with Mitkem's Safety Manual and Chemical Hygiene Plan, and comply with the safety practices described therein.

14. Pollution Prevention, Waste Management, Definitions and Acronyms

See sections 19.0 and 20.0 of Mitkem's current Quality Assurance Plan.

15. References

Quality Assurance Plan, Mitkem Laboratories.

USEPA. Statement of Work, Method SOM01.2.

STANDARD OPERATING PROCEDURE

for

PERCHLORATE IN WATER, SOILS AND SOLID WASTES USING HIGH PERFORMANCE LIQUID CHROMATOGRAPHY/ELECTROSPRAY IONIZATION/MASS SPECTROMETRY (HPLC/ESI/MS)

SOP No.: HPLC-6850
Revision: 3

June 12, 2007

Approved by: _____ _____
Supervisor Date

_____ _____
QA Coordinator Date

_____ _____
Laboratory Manager Date

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1 Mustard St. Suite 250
Rochester, NY 14609

Annual review of this SOP has been performed
and the SOP still reflects current practice.
Initials: _____ Date: _____
Initials: _____ Date: _____
Initials: _____ Date: _____

DOCUMENT CONTROL

NUMBER: _____

Initials: _____ Date:_____

1. SCOPE AND APPLICATION

1.1. This SOP uses the DoD Perchlorate Handbook (May 2007) and EPA SW-846 Method 6850 for the Analysis of Perchlorate in Water, Soils, and Solid Wastes using High Performance Liquid Chromatography/Electrospray Ionization/Mass Spectrometry (HPLC/ESI/MS). Although this method is entirely capable of analyzing drinking water, most regulatory agencies require the use of a drinking water method in the 300 series. This method is not equivalent to any current drinking water method.

1.2. This SOP is written to specifically address the additional requirements of the DoD, however it is also compliant with SW-846 6850. Samples which are not from the DoD may be analyzed with or without the additional DoD requirements and be compliant with 6850. If the samples are not from the DoD, samples may be reported if they meet the less stringent 6850 requirements listed in Table 2.

1.3. This method is for the determination of perchlorate in groundwater, surface water, wastewater, soil, sediment and sludge using reverse phase high performance liquid chromatography (HPLC) coupled with electrospray ionization (ESI) mass spectrometry (MS). This SOP also details the procedures for tissue samples using an FDA procedure for the extraction. Other matrices (example – biota) may be applicable to this method if the lab demonstrates the acceptability of the matrix.

1.4. The reporting limits listed below are for guidance only. Reporting Limits are highly matrix-dependent and not always achievable.

Matrix	Reporting Limit
Water	0.20 ug/L
Soil	2.0 ug/kg
Tissue	0.60 ug/kg
Biota	To be determined
Milk	To be determined

2. METHOD SUMMARY

Solids are first extracted prior to analysis with reagent water using an ultrasonic bath. Tissue samples are extracted with acetonitrile and acetic acid and passed through an SPE cartridge. Water samples are not extracted. Extracts and water samples are filtered, if needed. An appropriate volume of the sample or sample extract is introduced into a HPLC/MS instrument. Perchlorate is separated by HPLC from the sample matrix, partially fragmented via negative electrospray ionization and detected by MS using mass-to-charge (m/z) ratios 83, 85 and 89. Quantitation is performed using m/z 83 and internal standard calibration. Isotopically-labeled perchlorate ($Cl^{18}O_4^-$), m/z 89, serves as the internal standard. The 83/85 isotopic ratio reflects the isotopic ratio of naturally occurring $^{35}Cl/^{37}Cl$ and is used for additional confirmation of perchlorate identification.

3. DEFINITIONS

3.1. **Preparation Batch**: a group of 20 or fewer samples of the same matrix prepared together on the same day. See ADM-BATCH for more information.

3.2. **Analytical Batch**: a group of 20 or fewer samples analyzed together. See ADM-BATCH for more information.

3.3. **Internal Standards –** Internal standards are analytes which are similar to the analytes of interest but which are not found in the samples. The chosen internal standards are used to calibrate the instrument's response.

3.4. **Continuing Calibration Verification (CCV):** standard analyzed at a routine frequency throughout the sequence to establish the instrument is meeting calibration criteria.

3.5. **Independent Calibration Verification (ICV):** standard analyzed from a source that is different than that used to calibrate the instrument. The ICV is a check on the purity and accuracy of the calibration standards and can be used in preparing matrix spike solutions for spiking of QA/QC samples.

3.6. **Relative Percent Difference (RPD):** measure of the relative difference between two values. See QAM.

3.7. **Method Detection Limit (MDL) -** also called LoD (Limit of Detection): a statistically derived value representing the lowest level of target analyte that may be measured by the instrument with 99% confidence that the value is greater than zero.

3.8. **Method Reporting Limit (MRL):** The minimum amount of a target analyte that can be measured and reported quantitatively. The MRL is equivalent to Practical Quantitation Level (PQL), reporting limit, and Limit of Quantitation (LoQ).

3.9. **QA/QC Samples**: Samples added to a sample preparation batch, or an analytical batch to provide quality assurance checks on the analysis.

3.9.1. **Duplicate Sample (DUP):** a laboratory duplicate. The duplicate sample is a separate sample aliquot that is processed in an identical manner as the sample proper.

3.9.2. **Laboratory Control Sample (LCS):** a method blank that has been fortified with the analyte of interest. Used to verify laboratory performance.

3.9.3. **Method Blank (MB):** a laboratory blank that is used to check that reagents and equipment are free of target analytes. The Method Blank follows the same preparative techniques as samples. Unless stated in project specific data quality objectives, reagents are considered free of target analyte contamination if the level detected in the Method Blank is less than the ½ MRL.

3.9.4. **Matrix Spike Sample (MS):** a duplicate sample aliquot that has been fortified with the analyte of interest. Used to observe the effects of the sample matrix on target analyte recovery.

3.9.5. **Matrix Spike Sample/ Matrix Spike Duplicate Sample (MS/MSD):** matrix spike samples prepared in duplicate. It is used to evaluate method precision and matrix effects.

4. INTERFERENCES

4.1. Solvents, reagents, glassware, and other sample processing hardware may yield artifacts and/or interferences to sample analysis. All of these materials must be demonstrated to be free from interferences under the conditions of the analysis by analyzing method blanks.

4.2. Sample extracts with any visible particulates should be filtered through a minimum 0.45-µm nominal pore size membrane or frit to remove particulates and prevent damage to the instrument, columns and flow systems. Filters specifically designed for IC or HPLC applications should be used.

4.3. Hydrogen sulfate ion $H^{34}SO_4^-$, formed from a minor sulfur isotope, is commonly present in samples. $H^{34}SO_4^-$ elutes before perchlorate but at high concentrations can tail into the retention time of the perchlorate peak and elevate its baseline at m/z 99. Quantitation of perchlorate based on m/z 83 and 89 avoids this potential interference from $H^{34}SO_4^-$.

4.4. Glassware must be scrupulously cleaned. Glassware should be rinsed as soon as possible after use with the last solvent used. This should then be followed by detergent washing with hot water and rinses with tap water and organic-free reagent water. After washing, the glassware should then be drained, dried, and heated in a laboratory oven at 130°C for two to three hours before reuse. Solvent rinses with acetonitrile may be substituted for the oven heating. After drying and cooling, glassware should then be stored in a clean environment to prevent accumulation of dust or other contaminants

5. SAFETY

5.1. The toxicity or carcinogenicity of each reagent used in this procedure may not be precisely defined. Material safety data sheets (MSDS) are available on each solvent and standard and should be reviewed as part of employee training.

5.2. Personal protective clothing (safety glasses, gloves and lab coat) are recommended when prepping samples, handling standards, or performing maintenance on pressurized systems.

5.3. The use of pressurized gases is required for this procedure. Care should be taken when moving cylinders. All gas cylinders must be secured to a wall or an immovable counter with a chain or a cylinder clamp at all times. Sources of flammable gases (e.g., pressurized hydrogen) should be clearly labeled.

5.4. The proper use of syringes and glass pipettes should be part of employee training. Care should be taken to avoid personal injury as a result of improper handling techniques.

5.5. Refer to the Safety Manual for further discussion of general safety procedures and information.

6. SAMPLE COLLECTION, CONTAINERS, PRESERVATION, AND STORAGE

6.1. Water samples should be collected in purchased, pre-cleaned 125-mL polyethylene bottles.

6.2. For solids, collect samples in purchased clean, 4-oz amber glass jars.

6.3. Tissue samples should be frozen upon collection and kept frozen until just before analysis.

6.4. Prepare and analyze samples and extracts within 28 days of collection.

6.5. Care should be taken to avoid temperature extremes during shipment and storage

6.6. Samples will be refrigerated to 0-6°C upon sample login

6.7. For sample handling see SMO-GEN SOP.

7. APPARATUS AND EQUIPMENT

7.1. Volumetric flasks, 100-mL and other sizes as needed.

7.2. Automatic precision pipetters and disposable tips - 10-10,000 µL capacity or gas tight syringes.

7.3. Disposable autosampler vials, 2mL capacity.

7.4. Disposable plastic centrifuge tubes - 50 mL and 20 mL scintillation vials.

7.5. Disposable plastic micro-beakers.

7.6. Sample bottles - polyethylene or glass of sufficient volume to allow replicate analyses.

7.7. Disposable PTFE 0.45-µm, surfactant-free, membrane syringe filters.

7.8. Glass 5-mL luer-lock syringes or equivalent.

7.9. SPE Cartridges –

7.9.1. C_{18} (2000 mg) chromatography columns or equivalent for extract solution cleanup.

7.9.2. For tissue samples – Supelclean™, Envi™-carb SPE cartridges, 500 mg bed x 6 mL; P/N 57094; Supelco

7.10. High Performance Liquid Chromatograph/Mass Spectrometer - An analytical system combining a high performance liquid chromatograph for separation of the sample components, electrospray ionization interface and mass spectrometer for fragmentation and detection of sample components. Agilent LC/MS. See Appendix A of the Quality Assurance Manual for specific parts and serial numbers.

7.10.1. High Performance Liquid Chromatograph – The instrument contains a programmable solvent delivery system and all required accessories including injection loop, analytical columns, purging gases, etc. The chromatographic system must be capable of interfacing with a mass spectrometer.

7.10.2. Electrospray ionization (ESI) source – The ESI source generates gas phase ions of perchlorate from the liquid phase.

7.10.3. Mass Spectrometer – A quadrupole mass analyzer, Agilent 1100 LC/MS quadrupole mass spectrometer. Instrument tuning and instrument conditions are based on the manufacturer's instructions. Tuning is not required prior to daily analyses. Tuning parameters are available from the instrument manufacturer, along with mass tuning solutions and instructions on how to optimize the mass spectrometer.

7.10.4. Analytical column – 4 mm x 250 mm, peptides-impregnated, reverse-phase HPLC column. K' (Prime) Technologies, Inc. KP-RPPX250 column or equivalent.

7.10.5. Data system capable of performing analyte signal acquisition, peak integration, instrument calibration and analyte quantification

7.11. Analytical balance, capable of ±0.0001 g accuracy.

7.12. Centrifuge - capable of 5000 rpm and/or generating g-force of such strength as needed for providing adequate separation of a solid suspension and thus yielding a clear supernatant for sample injection and analysis.

8. PREVENTIVE MAINTENANCE

8.1. A maintenance log will be kept documenting maintenance performed on the analytical system. Log entries will include the date maintenance was performed, symptoms of the problem, serial numbers of major equipment upgrades or replacements (defined as any non-consumable part essential to operation), phone logs from technical support contacts, a description of the maintenance performed, a description of the check performed (attach standard data to logbook) to assure the system has returned to acceptable levels of operation, and the analyst's initials.

8.2. Any major maintenance performed on the instrument must be recorded in a maintenance log and must include the date, the person performing , the type and the outcome of the maintenance. Also include a data file number of a chromatogram exhibiting acceptable chromatography.

8.3. Routine maintenance such as changing columns, fresh mobile phase, changing guard columns or inlet filters is noted in the run log.

9. STANDARDS, REAGENTS, AND CONSUMABLE MATERIALS

9.1. Reagents – follow guidelines for storage and expiration in ADM-DATANTRY. Follow appropriate reagent check procedures in ADM-CTMN.

9.1.1. Acetonitrile, CH_3CN – HPLC grade or equivalent

9.1.2. Acetic acid (glacial), CH_3CO_2H

9.1.2.1. 1% Acetic Acid – dilute 10 mL of glacial acetic acid to 900 mL with UPDI water.

9.1.3. UPDI water-HPLC grade: prepared by taking Ultra-Pure-De-Ionized water from the VOA lab Millipore polishing system and filtering through a 0.45u nylon filter using a sidearm flask and vacuum. Used for preparing all reagents, mobile phases, standards, and blanks. May also use purchased HPLC grade water – Fisher W5-4.

9.2. **Standards Preparation General Information and Disclaimers**

9.2.1. All Standards for this analysis are prepared in UPDI-HPLC grade water.

9.2.2. All of the preparation instructions are general guidelines. Other technical recipes may be used to achieve the same results. Example – a 20 mg/L standard may be made by adding 1 mL of 200 mg/L to 10 mLs or may be made by adding 4 mL of 50 mg/L to 10 mLs. The preparation depends upon the final volume needed and the initial concentration of the stock. Reasonable dilution technique is used.

9.2.3. The initial calibration curve given is typical, but also subject to variation due to detection levels needed. A minimum of five calibration standards is recommended as well as a blank standard. The lowest concentration level shall be at the reporting level and at least three times the MDL. The remaining levels should define the working linear range of the analytical system.

9.2.4. Vendors and vendors' products are sometimes listed for the ease of the analyst using this SOP, but products and purchased concentrations are examples only and subject to change at any time. All purchased standards are certified by the vendor. Certificates of Analysis are kept in the department until the standards are no longer being used – at which time they are filed with QA. Certificates of Analysis are available upon request. Purchased standards are routinely checked against an independent source for both analyte identification and analyte concentration.

9.2.5. All Standards must be traceable using the CAS lot system (ADM-DATANTRY).

9.3. Stock standard solution (1000 mg/L ClO_4^-) - This solution is purchased commercially as a certified standard. Stock standards may be stored at room temperature for a period of up to 12 months. Expiration dates should be clearly specified on the label.

9.4. Intermediate Standard (1.0 mg/L ClO_4^-) – Dilute 100 uL of 1000 mg/L Intermediate standard solution to 100 mL with UPDI-HPLC water. Working standard may be stored at room temperature for up to 1 month. Expiration dates should be clearly specified on the label.

9.5. Calibration standards – Prepare by adding various amounts of the 1.0 mg/L intermediate standard solution to UPDI-HPLC water directly in scintillation vials. Spike each calibration standard with 10uL of internal standard spiking solution. The final internal standard concentration is exactly the same (i.e. 1.0 µg/L $Cl^{18}O_4^-$) for each calibration standard. Although the 0.10 ug/L standard is included in the curve, the lab uses 0.20 ug/L as the reporting limit (LoQ).

Calibration Concentration (ug/L)	Volume (uL) of 1.0 mg/L ClO_4^- working std	Final Volume (mL)
0.10	1.0	10
0.20	2.0	10
0.50	5.0	10
1.00	10.0	10
2.00	20.0	10
5.00	50.0	10

9.6. Internal standard spiking solution (approximately 1000 µg/L $Cl^{18}O_4^-$) - Purchased commercially. Store at room temperature. Expires per manufacturer's indications or 6 months if no other indication is given.

9.6.1. Each standard and sample is spiked with 10 µL of internal standard spiking solution per 10 mL of sample or standard to obtain a final internal standard concentration of approximately 1 µg/L $Cl^{18}O_4^-$. An alternate internal standard concentration may be used provided that it falls within the same concentration range as the external calibration curve.

9.7. HPLC Mobile Phase – Prepare by combining 500 mL acetonitrile, 500 mL reagent water and 5 mL acetic acid.

9.8. Second Source Standard – The second source standard is purchased at 1000 mg/L from a different manufacturer than the Stock standard solution. Expires per manufacturer's indications or 6 months if no other indication is given.

9.9. Independent Calibration Verification Standard (ICV): The ICV is prepared from the second source standard at a concentration level within the calibration range of the method. Prepare fresh each use.

9.10. Continuing Calibration Verification Standard (CCV): The CCV is prepared from the intermediate standard solution at a concentration level within the calibration range of the method. Prepare fresh each use.

9.11. LODV – A standard prepared at a concentration approximately 2 times the MDL.

9.12. LCS/MS Spiking Solution (1 mg/L) – Dilute 100 uL of the 1000 mg/L Second Source Perchlorate Standard to 100 mL with UPDI-HPLC. Use this to spike the MS and the LCS. Store at room temperature. Expires in 6 months.

9.13. Laboratory Control Sample (LCS) (0.2 ug/L) – Dilute 2.0 uL of 1 mg/L LCS/MS solution to 10 mL UPDI-HPLC water. Process as a sample.

9.14. Interference Check Sample (ICS) (0.2 ug/L) –

9.14.1. ICS Matrix preparation - 5000 mg/L each of chloride, sulfate, carbonate by dissolving 8.240g NaCl +7.395g Na_2SO_4 +5.294g Na_2CO_3 in DI and diluting to 1000ml.

9.14.2. ICS – prepared upon use – add 2.0 mL of ICS matrix to 8.0 mL HPLC water. Add 2.0 uL of 1 mg/L perchlorate standard (second source = LCS/MS Spiking Solution) and 10 uL internal standard. Prepare and process as a sample.

9.15. MS Water (0.2 ug/L) **–** Add 2.0 uL of 1.0 mg/L spiking solution to 10 mL of water sample or UPDI-HPLC. Process as a sample.

9.16. The LCS/MS for Soil (+2.0 ug/kg) - Add 2.0 uL of 1.0 mg/L spiking solution to 1 g of Ottawa sand or soil sample. Process as a sample

9.17. LCS/MS for tissue (+2.5 ug/kg) – add 25uL of 1.0 mg/L spiking solution to 10 g of Gerber Turkey &Gravy baby food or sample. Process as a sample.

9.18. The LCS/MS for biota, and milk is under development.

9.19. MB – Process an analyte-free matrix as a sample. Use DI for water samples, Ottawa sand for soil samples, and Gerber Turkey&Gravy baby food for tissue. The MB for biota and milk is under development.

9.20. Mass Calibration Standard – a proprietary mix from Agilent. Use, store, and discard as per manufacturer's instructions.

9.21. Tune Verification Standard – a standard containing 100 ug/L of target perchlorate and internal standard. Data is acquired in scan mode.

10. RESPONSIBILITIES

It is the responsibility of the analyst to perform the analysis according to this SOP and to complete all documentation required for data review. Analysis and interpretation of the results are performed by personnel in the laboratory who have demonstrated the ability to generate acceptable results utilizing this SOP. Final review and sign-off of the data is performed by the department supervisor or designee.

11. PROCEDURE

11.1. Be sure the analysts performing the test have a current IDC or CDC (see section 19). Be sure the instrument has a current MDL study (see section 14 and ADM-MDL).

11.2. Sample Preparation

11.2.1. Water Sample Preparation

11.2.1.1. Dispense 10.0 mL of sample or standard into a 20 mL disposable scintillation vial.

11.2.1.2. Add 10 µL of internal standard spiking solution to the sample tube, cap and shake until mixed well. The final concentration of internal standard in the sample must be exactly the same as that in the calibration standards

11.2.1.3. If needed, filter the sample solution using a plastic syringe fitted with a 0.45-µm PTFE membrane filter. Dispense the sample into an autosampler vial for analysis. If any of the samples in the prep batch are filtered, filter the entire prep batch, including QC.

11.2.2. Solid Sample Preparation

11.2.2.1. Weigh 1 g of solid sample, recording the weight to 0.01 g into a 20 mL disposable scintillation vial.

11.2.2.2. Add 10 mL of UPDI-HPLC water, 10 µL of internal standard spiking solution and 50 µL of acetic acid to the sample tube. Vortex the mixture, followed by sonication (ultrasonic bath) for a minimum of 10 minutes, followed by additional vortexing.

11.2.2.3. Centrifuge the sample for 5 minutes, if necessary, to separate the solids from the extract solution.

11.2.2.4. If needed, filter the supernatant extract solution using a plastic syringe fitted with a 0.45-µm PTFE membrane filter. Dispense the extract sample into an autosampler vial for analysis. If any of the samples in the prep batch are filtered, filter the entire prep batch, including QC. NOTE: The final concentration of internal standard in the sample extract must be exactly the same as that in the calibration standards.

11.2.2.5. If large quantities of organic contaminants are not believed to be present in the solid sample extract (i.e. supernatant extract is relatively clear and not highly colored), proceed to instrument analysis. If necessary, however, a cleanup step using a C_{18} column may be performed to remove organic contaminants from the supernatant extract solution.

11.2.2.5.1. Activate the C_{18} cartridge column by pushing approximately 5 mL of methanol through the column, followed by 5 mL of UPDI-HPLC water. A flow rate of approximately 0.5 mL/min is recommended. Care should be taken not to let the column become dry.

11.2.2.5.2. Pull approximately 6 mL of the supernatant extract solution through the activated column. Use vacuum, if necessary.

11.2.2.5.3. Discard the first 2 mL of eluted sample extract. The initially eluted sample extract is discarded because it is diluted by the solution remaining in the column following the activation process.

11.2.2.5.4. Collect the remaining eluted sample extract (approximately 4 mL) in a clean container. Filter the sample extract using a plastic syringe fitted with a 0.45-µm membrane filter. Dispense the extract sample into an autosampler vial for analysis. Quantitative recovery of the eluted extract sample is not necessary because there is no dilution or concentration of the sample.

11.2.3. Tissue Sample Preparation

11.2.3.1. Weigh a 10 g test portion of homogenized tissue sample into a 50 mL polypropylene conical centrifuge tube.

11.2.3.2. Using a 100 uL syringe, add 30 uL of 1000 ug/L labeled internal standard to the tube (Assume the total volume of the sample extract to be 30 mL. The final concentration will be 1 ug/L in the extract.)

11.2.3.3. Spike QC samples with target per section 9.

11.2.3.4. Add 15 mL of HPLC grade acetonitrile to each tube with tissue sample. Cap and shake by hand vigorously by hand for 1 minute.

11.2.3.5. Add 5 mL of 1% acetic acid and shake vigorously by hand for 2 minutes.

11.2.3.6. Centrifuge the tube for 15 minutes at setting 4.

11.2.3.7. Condition each Supelclean™, Envi™-carb SPE cartridge with 6mL of acetonitrile, allowing acetonitrile level to drop to frit, but not go dry. Add 6 mL of 1% acetic acid to cartridge and allow to elute. Turn up the vacuum and dry the cartridges for 30 seconds. Discard the aqueous portion used to prepare the cartridges.

11.2.3.8. Load conditioned Supelclean™, Envi™-carb SPE cartridges with approximately 5 mL of supernatant from the centrifuged samples. Allow to pass through the column quickly under vacuum while collecting eluent.

11.2.3.9. Passing the first 1 mL to waste, filter sample extract with 0.45 µm PTFE syringe filter directly into an autosampler vial.

11.3. Instrument Set-up

11.3.1. Instrument conditions for analysis are set to optimize response and separation of the analytes. Analysts are advised to adjust the HPLC systems to particular analytical needs. Once optimized, the same conditions are to be used for analysis of all standards, client samples, and QC samples. The current system uses the conditions in Table 1. Actual instrument conditions are optimized and recorded in the instrument daily run log.

11.3.2. Mass Calibration –

- Frequency – Upon instrument setup and as needed (QC failures, large ion mass deviations, major instrument maintenance, tune won't meet criteria)
- Acceptance Criteria – the calibration range must bracket the ion masses of interest without greatly exceeding the range. The most recent mass calibration must be used for an analytical run and the same mass calibration must be used for all data files in an analytical run. Mass calibration must be verified by acquiring a full scan continuum mass spectrum of a perchlorate stock standard. Perchlorate ions should be within ±0.3 *m/z* of mass 83, 85 and 89.
- Corrective action – Correct the problem and recalibrate if the mass calibration fails.

11.3.3. Retention Time

11.3.3.1. Due to the use of the internal standard, formal retention time studies are not needed. The retention time varies due to sample matrix conductivity, however the internal standard retention time varies at the same rate. It is the relative retention time between the sample and the internal standard which is most critical and must be monitored (see section 12). The retention times of the sample and internal standard are summarized and included in the report.

11.3.4. Interference Threshold study –

- Frequency – at initial setup and when major changes occur in the method's operating procedures (addition of cleanup procedure, column changes, mobile phase changes).

- Acceptance Criteria – Measure the threshold of common suppressors (chloride, sulfate, carbonate, bicarbonate) that can be present in the system without affecting the quantitation of perchlorate. The threshold is the concentration of the common suppressors where perchlorate recovery falls outside an 85-115% window.

11.4. Initial Calibration

11.4.1. Start up entire HPLC system and allow baseline response to settle.

11.4.2. All injections of standards and samples and associated QC are to be the same. 30 uL injections are used.

11.4.3. The first sample through the system should be an instrument blank. This blank is simply an injection of UPDI-HPLC and internal standard. As the first injection of the day, this helps to further settle the baseline and equilibrate the system.

11.4.4. A pre-curve blank is run to check for system and reagent cleanliness. Any potentially interfering peaks should be noted. This blank is prepared alongside the calibration standards.

11.4.5. Follow ADM-ICAL – if there are discrepancies between ADM-ICAL and this SOP, follow this SOP.

11.4.6. Process a minimum of 5 calibration standards and a blank (as described in Section 9). The calibration standards are pH adjusted, but not filtered. The lowest calibration standard must be at (or below) the reporting limit and the standard at the reporting limit must be at least three times the MDL.

11.4.7. Analyte responses are tabulated and recorded in the integration software.

11.4.8. Calibration Curve –

11.4.8.1. Response Factor - To obtain the average response factor, calculate the RF (as below) for each calibration point. Calculate the mean of the RFs to use for sample calculation. Calculate the Standard Deviation of the RFs and the Percent Relative Standard Deviation of the RFs to evaluate the linearity. The limit for the calibration is 20% RSD.

$$RF_s = \frac{(A_s)(C_{IS})}{(A_{IS})(C_s)}$$

Where:

A_x	=	Area of the characteristic quantitation ion for compound x.
A_{ISTD}	=	Area of the characteristic quantitation ion for the specified internal standard.
C_x	=	The concentration of the compound added (ppb).
C_{ISTD}	=	The concentration of the specified internal standard (ppb).

Calculate standard deviation (SD) and the percent relative standard deviations (%RSD) for each analyte from the mean with:

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(\overline{RF_i} - RF)^2}{N - 1}}$$

where:

$\underline{RF_i}$	=	RF for each of the calibration levels
RF	=	mean of initial RFs
N	=	Number of RF values (i.e., 5)

$$\%RSD = \frac{(SD)}{(\overline{RF_x})} 100.$$

where:

RSD	=	relative standard deviation.
RF	=	mean of 5 initial RFs for a compound.
SD	=	standard deviation of average RFs for a compound

11.4.9. The concentration corresponding to the absolute value of the calibration curve's Y-intercept must be ≤ LOD.

11.4.10. All of the ICAL criteria must be acceptable before samples may be analyzed.

11.4.11. Routinely, after the high point of the curve, a blank is run to prove that there is no carry-over from the autosampler. It should be noted if there are any target hits above ½ of the MRL.

11.4.12. Verify the calibration by analyzing an independent calibration verification standard. Acceptance criteria for the ICV is 85-115% recovery.

11.4.13. Samples immediately following an initial calibration and ICV may skip the system blank and the opening CCV. Set up the rest of the sequence to comply with the frequency requirements of the QC listed in section 12.

11.5. Daily Sample Analysis

11.5.1. When an ICAL is not run on the day of sample analysis, run blanks initially to warm up the system. Do not begin the sequence until the blanks are less than ½ the MRL. Analyze the tune verification and begin with a CCV. Set up the rest of the sequence to comply with the frequency requirements of the QC listed in section 12.

11.6. Evaluation of Sample Analysis

11.6.1. Examine solution concentrations of target analytes in the samples. If the concentration is greater than the high calibration standard, reanalyze the sample at a dilution. As a general rule, dilutions should be performed to keep target analytes in the upper half of the calibration range. See ADM-DIL.

11.6.2. Check for possible carryover. Pay particular attention to situations where samples containing low levels of target analyte were analyzed one or two injections after samples containing levels of target analyte near or over the high end of the calibration range. Reanalyze as needed to confirm.

11.6.3. Check peak integrations. Where possible, all integrations should be performed consistent with integration of the corresponding calibration standards and with ADM-INT.

11.6.4. Monitor the retention times of the ions in samples and QC. The retention times of the ClO_3^- m/z 83 peak and the IS $Cl^{18}O_3^-$ m/z 89 peak should not vary by more than 0.2 min from each other.

11.6.5. Monitor the mass ratio between ions 83/85. The ion ratio should fall within the established window of 2.3-3.8. If criteria not met, the sample(s) must be repeated. Reextract using cleanup procedures or alternative techniques to confirm the presence of perchlorate such as post spikes or dilutions to reduce the interference. Qualify the data and discuss in the case narrative as necessary.

12. QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

12.1. Daily tune verification – the daily tune verification is performed before the opening CCV. The quantitation ions must be within ±0.3 *m/z* of actual.

12.2. Initial Calibration Criteria: Calibration criteria is given in section 11.

12.3. Method Blank:

- Frequency - Process one MB with each preparation batch of 20 or fewer samples. The MB should be carried through all stages of sample preparation and analysis.
- Acceptance Criteria - The result of the MB must be less than ½ the reporting limit.
- Corrective Action - If it is not, determine the source of the contamination and reprep and reanalyze the associated samples.

12.4. Reagent blanks –

- Frequency – prior to calibration and after each batch is analyzed. When perchlorate concentrations in the samples are over the linear range, any samples which follow the overrange sample will be repeated if the sample concentrations were greater than ½ the RL.
- Acceptance Criteria – must be less than ½ RL.
- Corrective Action – reanalyze reagent blanks until no carryover is observed (<1/2 MRL). Reanalyze all samples processed since the contaminated blank. If the closing reagent blank fails, reanalyze all samples since the last clean reagent blank.

12.5. MS –

- Frequency - Prepare one MS (or MS/MSD pair) with each batch of 20 or fewer samples of the same matrix.
- Acceptance Criteria - The limit for the water and soil is 80-120% of the true value.
- Corrective Action - If recovery of MS fails on a sample batch the samples are acceptable only if the LCS meets acceptance criteria. If the LCS passes, but the MS fails, report the MS recoveries and note outliers in the case narrative.

12.6. LCS –

- Frequency - Prepare one LCS with each batch of 20 or fewer samples of the same matrix.
- Acceptance Criteria (recovery) - The limit for the water and soil LCS is 80-120%. The limits for biota and milk are under development.
- Corrective Action - If the LCS fails on a sample batch, reprep and reanalyze the sample batch. If a duplicate LCS was run with the batch and one LCS was slightly out, but the other LCS was in, the data is accepted.

12.7. DUP/MSD Precision –

- Frequency - Precision for each prep batch of 20 or fewer samples of the same matrix must be established by either analyzing a sample in duplicate (DUP) or analyzing a MS in duplicate (MSD).
- Acceptance Criteria – (for all samples above the reporting limit), the RPD value between samples or MS/MSD results must not exceed 15%.
- Corrective Action - examine the chromatograms and benchsheets for potential matrix interferences. Reanalyze the pair if deemed appropriate. The outlying RPD should be mentioned in the Case Narrative so that data may be flagged appropriately.

12.8. The ICV is discussed in Section 11.

12.9. CCV –

- Frequency – bracketing every 10 or fewer samples
- Acceptance Criteria - All samples must be bracketed by an acceptable CCV. The acceptance limit is 15% difference relative to the true value.
- Corrective Action - If the CCV does not meet acceptance criteria, correct the problem and achieve an acceptable CCV. Recalibration may be necessary. All samples bound by the unacceptable CCV must be reanalyzed with acceptable QC.

12.10. Internal standard area response verification:

- Frequency – The IS is added to every sample, spiked sample, standard, instrument blank, and method blank
- Acceptance Criteria - The internal standard area counts for each sample and QC standard must be monitored throughout the analysis and the IS area must be within ±50% of the average of the internal standard area counts of the ICAL standards.
- Corrective Action - If the internal standard area counts exceed ± 50% of the average of the internal standard area counts of the ICAL standards, rerun the sample at increasing dilutions until the acceptance criteria are met. If the criteria cannot be met with dilution, the interference are suspected and the sample must be reprepared using additional pretreatment steps. Thoroughly document corrective action in the case narrative.

12.11. Internal standard and Target retention times

- Frequency – IS is added to every sample, spiked sample, standard, instrument blank, and method blank.
- Acceptance Criteria – The RRT (relative retention time) must be 0.98-1.02. Calculate the RRT in a sample by dividing the retention time of the perchlorate ion by the retention time of the internal standard.
- Corrective Action – Thoroughly document in the case narrative.

12.12. MDL – see section 14 and ADM-MDL.

12.13. LODV

- Frequency – before and directly after every analytical batch of samples. It may be run more frequently to reduce reanalysis rate.
- Acceptance criteria – the recovery must be within 30% of the true value. Exception – any samples with concentrations above the MRL may be reported.
- Corrective Action – if there are samples below the MRL, correct the problem, obtain a compliant LODV and reanalyze affected samples.

12.14. ICS

- Frequency – one ICS is extracted with every batch of 20 or fewer samples. At least one ICS must be analyzed daily.
- Acceptance Criteria – the recovery must be within 30% of the true value.
- Corrective action – Correct the problem and reanalyze all samples associated with a failed ICS.

13. DATA REDUCTION AND REPORTING

13.1. Identify perchlorate in the sample chromatograms:

13.1.1. Compare the retention times of the ClO_4^-, m/z 83, peak and the internal standard $Cl^{18}O_4^-$, m/z 89, peak. The retention times should not vary by more than 0.2 minutes from each other. The relative retention time (Retention time of perchlorate ion divided by the retention time of the internal standard) must be 0.98 – 1.02.

13.1.2. Evaluate the relative abundances of the m/z 83 and 85 ions in the chromatogram. To confirm the presence of perchlorate, the 83/85 peak area counts ratio should be 2.3-3.8. Repeat the samples if ratio criteria not met or flag the data as estimated and discuss in the case narrative.

13.2. Calculate the perchlorate concentration for each sample using the internal standard calibration. Use m/z 83 and 89 from the internal standard for quantitation. Calculate the concentration of each of the sample matrices as follows:

13.2.1. Water Samples –

13.2.1.1. From Response Factor Calibration:

$$\text{Concentration } (\mu g/L) = \frac{(A_s)(C_{is})(D)}{(A_{is})(\overline{RF})}$$

Where:

A_s = Area (or height) of the peak for the analyte in the sample.

A_{is} = Area (or height) of the peak for the internal standard.

C_{is} = Concentration of the internal standard in the concentrated sample extract in µg/L.

D = Dilution factor, if the sample or extract was diluted prior to analysis. If no dilution was made, D=1. The dilution factor is always dimensionless.

$\overline{RF}$ = Mean response factor from the initial calibration. Unlike calibration factors for external standard calibration, the response factor is dimensionless.

13.2.2. Solid Samples

$$\text{Final Result } (\mu g/kg\ ClO_4^-) = \frac{(C)(V)(D)}{M}$$

Where:
C = Concentration in extract (µg/L ClO_4^-)
V = Volume of sample extract used for analysis (mL)
D = Dilution factor (if needed)
M = Mass of initial sample extracted (g)

13.3 LIMS adjusts the result on soil samples based on Dry Weight.

13.4 Adjustments to the Method Reporting Limit - MRLs are elevated for insufficient sample volume, matrix interference, and dilutions.

13.5 Data Review: Data is reviewed according to ADM-DREV.

14. METHOD PERFORMANCE

14.1. MDL study – refer to ADM-MDL for more information. If there are conflicts between ADM-MDL and this SOP, this SOP is to be followed.

14.1.1. Design - The MDL study must be performed in the matrix of interest using a standard at a concentration that is 1 to 10 times the estimated MDL value. The standard is taken through the entire preparation and analysis procedure.

14.1.2. Frequency - A full MDL study must be conducted at initial setup and subsequently once per 12 month period and when major changes occur in the method's operating procedures (addition of cleanup procedures, column changes, mobile phase changes). If no changes have been made to the method, quarterly MDL verification checks (see below) may be performed in lieu of the yearly MDL study.

14.1.3. Acceptance criteria – The study must produce an MDL value which is no more than 10 times lower than the spike level (10x rule). The calculated MDL must be 3 times less than the reporting limit. The MDL must be verified by an acceptable MDL verification check (see below) prior to the analysis of samples.

14.1.4. Corrective Action –

14.1.4.1. If the MDL study does not meet the 10x rule, adjust the spike concentration and repeat the study.

14.1.4.2. If the MDL is not 3 times less than the reporting limit, correct the problem and repeat the MDL study or raise the reporting limit accordingly.

14.1.4.3. If the MDL verification check fails, see below.

14.2. MDL verifications checks –

14.2.1. Concentration – the MDL verification check is a low-level spike at approximately 2 times the MDL taken through the entire preparation process.

14.2.2. Frequency – with each new MDL study prior to the analysis of samples and quarterly if an annual study will not be performed.

14.2.3. Acceptance criteria – must produce a signal at least 3 times the instrument's noise level and meet the isotope ratio criteria of 2.3 to 3.8. Recovery should be within 30% of its true value.

14.2.4. Corrective action – re-perform the MDL study. Perform maintenance, if needed. The MDL verification check must pass before samples are analyzed.

14.3. File the MDL study and the MDL check with the QA office.

14.4. Demonstration of Capability is performed upon instrument set-up , whenever a new analyst begins independent analysis, and annually thereafter according to ADM-TRANDOC and section 19 below. The documentation of this method performance is retained by the Quality Assurance office.

15. WASTE MANAGEMENT AND POLLUTION PREVENTION

Standards are prepared on an as-needed basis in small quantities and minimum sample volumes are used during analysis. All expired standards are disposed of as hazardous and hazardous samples are disposed of either as acidic aqueous waste or as hazardous aqueous waste depending on their analytes' concentrations. These tasks are turned over to staff qualified and equipped for disposal. See SMO-SPLDIS for more discussion.

16. CORRECTIVE ACTIONS FOR OUT OF CONTROL DATA

If data is produced that is out of control, the samples are to be re-analyzed with in-control QA whenever possible. See corrective actions in Section 12 of this SOP and in the applicable Figures in Section 12 of the Quality Assurance Manual.

17. CONTINGENCIES FOR HANDLING OUT OF CONTROL OR UNACCEPTABLE DATA

If data is produced that is out of control and is not to be re-analyzed due to sample volume restrictions, holding times, or QC controls can not be met, follow the procedures in Section 15 of the Quality Assurance Manual.

18. REFERENCES

EPA SW-846 *Perchlorate in Water, Soils and Solid Wastes Using High Performance Liquid Chromatography/Electrospray Ionization/ Mass Spectrometry*. Method 6850. January 2007.

DoD Perchlorate Handbook, Revision 1, Change 1, August 2007.

Rapid Determination of Perchlorate Anion in Foods by Ion Chromatography – Tandem Mass Spectrometry. U.S. Food and Drug Administration. Rev.2. April 12, 2005. (for tissue preparation)

19. TRAINING OUTLINE

19.1. Read the most current SOP. Demonstrate a general understanding of the methodology and chemistry. Follow policies in ADM-TRANDOC.

19.2. Observe Sample Preparation and Analysis. Follow HPLC Training Plan Form.

19.3. Participate in the methodology, documentation, and data reduction with guidance.

19.4. Demonstrate Competency by performing the analysis independently. Analyze four replicates of the LCS. If recovery is within acceptable limits, complete Training Plan Form, IDC certificate and summary spreadsheet and file with QA. An IDC study must be successfully performed before the new analyst may analyze samples independently. Continued demonstration of Capability is performed annually by analyzing a PE, blind, or new 4 replicate study.

20. METHOD MODIFICATIONS

- This lab uses dilute (1%) acetic acid in the extraction of soil samples and QC. This was part of the original draft methods for 6850. The lab has continued to use the acetic acid for the soils because it causes the particulates to settle more completely in the extract and produces better baselines in the chromatography.

21. INSTRUMENT- SPECIFIC ADDENDUM

Instrument manuals are located near the instrument.

22. ATTACHMENTS

- Table 1: Recommended Instrument Settings.
- Table 2: Method 6850 Requirements

23. CHANGES FROM PREVIOUS REVISION

- Changed SOP title and SOP code to reflect that this SOP can be used for any DoD and any 6850 work. Provided explanation in Section 1 about the use of this SOP for DoD and for 6850 without DoD. Added Table 2 for further clarification.
- Made changes below mostly due to 2007 revision to DoD Perchlorate Handbook
- 1- Noted that this SOP is not to be used for drinking water.
- 2-Added that waters are not extracted and that solids are extracted in an ultrasonic bath
- 3-Eliminated SSCV and that DoD names the first CCV of day = ICV
- 2, 4, 11 – Eliminated filtering of all samples. Samples are filtered when needed
- 9 and 11 – Eliminated 0.10 standard from ICAL. Noted that lowest ICAL standard is to be at (not below) the RL and that it must be more than 3 times the MDL. Eliminated 10 standard from ICAL.
- 9 – Eliminated purchased 8 mg/L IS stock – now purchasing 1000 ug/L.
- 9 and Table 1 - Modified mobile phase from 52.7% CHCN3/ 46.8%H20 / 0.5%acetic to 50/50/0.1
- 9- Changed the concentration of the IS in the injections from 2 ug/L to 1 ug/L – changed quantity of IS additions throughout.
- 9- Eliminated the addition of acetic acid to the ICAL standards, ICV, and CCV
- 9-Changed “Tuning Standard” to “Mass Calibration Standard” and added “Tune Verification Standard” as a separate item. Tune verification standard changed from 1000ug/L to 100 ug/L and added that data is aquired in scan mode
- 9-Increased ICS Matrix from 1000 mg/L each to 5000 mg/L each. Modified prep of ICS.
- 11 and Table 1-Changed volume of injections from 25 uL to 30 uL
- 11 – Changed from mandatory filtering of samples to optional with need to filter all of prep batch if any samples in batch are filtered.
- 11-Eliminated the addition of acetic acid in the water preparation
- 11- Changed from weighing solid samples in a centrifuge tube to a scintillation vial.
- 11- Changed the mass calibration from 99, 101, 107 ions to 83, 85, and 89 ions
- 11-Eliminated Retention Time studies – added explanation for use of RRTs instead.
- 11-Incorporated 4/27/07 changes regarding the use of the Response Factor
- 11-Deleted confusing information regarding Analytical Sequence – referenced section 12 for QC frequency - Added “Daily Sample Analysis” which notes use of warm up blanks, tune verification and opening CCV.
- 11- Added to the Evaluation of Sample Analysis the monitoring of the retention time difference between the sample (83) and internal standard (89).
- 12- Added daily tune verification
- 12 – Changed the MS limit from 75-125 to 80-120%
- 12 – Changed the LCS limit from 85-115 to 80-120%
- 12 – Changed the RPD limit from 20 to 15
- 12- Added “average of the internal standard area counts” for the comparison of the IS area response
- 13 – Changed the limit for the RT difference of from 0.1 to 0.2. Added the RRT limit here.
- 13 - Changed from reporting “as received” to corrected for dry weight

- 14 – Added that the MDL verification check must meet the isotope ratio limit. Changed the corrective action. Eliminated the option to adjust the reported MDL based on the MDL checks.
- 18-Added 6850 to References, Updated Perchlorate Handbook reference, Eliminated DoD SOP reference
- 20 – Added explanation of method modification of using acetic acid in soil extraction
- 22 – Added Table 2
- Table 1 – changed the Fragmentor from 200 V to 210 V

TABLE 1

EXAMPLE HPLC/MS INSTRUMENT SETTINGS

Autosampler

Injection Volume: 30 µL

Analytical Column

Column Temperature: 30 ºC

HPLC Pump

Flow Rate: 0.5 mL/min

Run Time: 13.0 min

Mobile Phase:

50% CH_3CN/ 50% H_2O / 0.1% CH_3CO_2H

Mass Spectrometer

Ionization Mode: Electrospray

Polarity: Negative

SIM Parameters:

SIM Ion	Fragmentor	Gain (EMV)	Actual Dwell
83	210 V	3.0	392 msec
85			392 msec
89			392 msec

Spray Chamber:

Gas Temperature	Drying Gas (N_2)	Nebulizer Pressure
320 ºC	12.0 L/min	50 psig

Capillary voltage:

Negative
1450 V

TABLE 2
Method 6850 Requirements

Samples which are NOT for DoD may be reported if the following are met instead of the requirements in the text of this SOP.

Blanks (Method, Reagent, any others)	**Result less than MRL**
LODV – may be run at MRL and called Low CCV or LLOQ – may satisfy CCV frequency requirement	**±50%**
Ion Ratio for identification confirmation	**Ratio within 30% of average peak area ratio of mid-range CCV**
Matrix Spike Soil Recovery	**70-130%**
RPD limit for MSD in samples in low range of curve	**50%**
Internal Standard Area Counts	**Compare to CCV in daily run instead of ICAL**
RRT of 0.98-1.02 not required	

APPENDIX F

CSM, DQOs, AND PAL CRITERIA

APPENDIX F-1

PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS FOR D-6, 50-FOOT INDOOR RIFLE AND PISTOL RANGE (FORMER BUILDING 451)

PROBLEM DEFINITION (STEP 1)

The Problem Definition for the D-6 Small Arms Range is presented at the conclusion of the Conceptual Site Model (CSM) for this MRP site.

IDENTIFY THE GOALS OF THE STUDY (STEP 2)

The primary goals of the investigation of the D-6 Small Arms Range are as follows:

1. Collect adequate data to delineate the horizontal and vertical extent of MC contamination in soil and drainage ditch sediment. Lead from spent small arms ammunition is the primary indicator constituent and if present is expected to be concentrated in surface and near-surface soils at the site. A field-based X-ray fluorescence (XRF) sampling program will be used to screen, focus, and delineate the extent of lead concentrations in local soil and sediment. If the XRF field data collected during the initial round of sampling is adequate to delineate the horizontal and vertical extent of MC contamination, then stop collecting XRF data; otherwise, conduct additional XRF sampling (i.e., “step-out” vertically and/or horizontally as necessary) to delineate the extent of the lead concentrations in site soil and sediment.

2. Determine whether MC metals (antimony, arsenic, copper, lead, nickel, tin, and zinc) are present in surface soil, subsurface soil, surface water, sediment and groundwater and also perchlorate in groundwater and surface water, at concentrations greater than screening values and facility background concentrations, as applicable. If so, then recommend an RI/FS for the site. If MC metals and perchlorate concentrations in site media are less than screening values and facility background concentrations, as applicable, then no further action is required for the site.

IDENTIFY INFORMATION INPUTS (STEP 3)

Data required for making the decisions which include the following:

1. A comprehensive listing of the relevant, medium-specific RSBLs and potential chemical-specific ARARs for MC metals (antimony, arsenic, lead, copper, tin, and zinc) and perchlorate.

- Screening levels based on the USEPA action level for lead in soil assuming a residential land use scenario (400 mg/kg).

- North Carolina Soil Screening Levels (SSLs) (NCDENR, 2005).

- Soil data will be compared to North Carolina Soil Screening Levels (SSLs) (NCDENR, 2005) and USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites - Residential Soil (ORNL, 2008).

- Groundwater data will be compared to North Carolina 2L Standards (NCAC, 2005) and USEPA Regional Screening Values for Chemical Contaminants at Superfund Sites - Tap Water (ORNL, 2005).

- Surface water data, if collected, will be compared to North Carolina Surface Water Standards (NCDENR, 2007) and USEPA Recommended National Water Quality Criteria (USEPA, 2006).

- Sediment data, if collected will be compared to Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment (2001) and USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites - Residential Soil (ORNL, 2008).

The soil and groundwater data will also be compared to the MCB Camp Lejeune background soil and groundwater data from the *Final Base Background Soil Study Report* (Baker, 2001). Soil concentrations will be compared to two times the average soil background concentration, and groundwater concentrations will be compared to the arithmatic mean plus 2 standard deviations of the upper surficial aquifer groundwater background concentrations.

Laboratory method detection limits and project quantitation limits for the proposed analytical methods should not exceed the aforementioned screening levels and ARARs.

2. Laboratory analytical data characterizing concentrations of the six MC metals in surface soil, subsurface soil, groundwater, surface water, and sediment samples and perchlorate in groundwater and surface water samples will be used to decide if a risk assessment and remedial investigation is required for the site. Soil and sediment samples will be analyzed for selected MC metals using SW-846 Method 3050B/6020A. Groundwater and surface water will be analyzed for MC metals using SW-846 Method 6020A and perchlorate using SW-846 Method 6850.

3. XRF lead data gathered from the field for delineation purposes. An XRF field action level of 300 mg/kg will be used as the discriminator between contaminated and uncontaminated locations. The 300 mg/kg corresponds to the USEPA action level of 400 mg/kg reduced by a 25 percent margin of error to minimize the potential that contaminated areas go undetected. The margin of error was selected based on recent experiences with field XRF analyses at other small arms ranges.

4. Performance criteria (correlation coefficients) for correlation of the lead XRF data to fixed-base laboratory data for lead. The correlation coefficient shall be greater than or equal to 0.65 and less than or equal to 1.00. These correlations will be used to translate field XRF values into equivalent laboratory lead concentrations. Correlation analyses are not anticipated to be generated for the five other metals being analyzed.

5. Background soil and groundwater data suitable for site soil-versus-background and groundwater-versus-background data comparisons for the six metals of interest for use in site versus background comparisons.

6. Field identification/classification of soil and sediment types (i.e., lithology and USCS soil classification for grain size, color, plasticity, etc.). SOPs are provided in Appendix D.

7. Physical characterization of the major surface water drainage pathways, if present, (e.g., number, width, depth, physical characteristics of sediment, etc.). SOPs are provided in Appendix D.

8. QA/QC specifications and the results of the QA/QC reviews (e.g., data validation) conducted throughout the investigation.

DEFINE THE BOUNDARIES OF THE STUDY (STEP 4)

The current PA/SI includes the evaluation of surface soil, subsurface soil, surface water, sediment and groundwater at the D-6 Small Arms Range. Surface water and sediment will only be investigated if present in the drainage ditches at the time the SI is conducted. A visual depiction of the range area is provided on Figure 3-1. Establishing the nature and extent of contamination will require that both contaminated and non-contaminated soil be investigated so that the perimeter of the impacted area can be established. As previously identified in Step 3, field XRF screening will be used to focus the soil (and sediment if present) investigation in those areas that contain elevated lead concentrations. The following items address the horizontal and vertical boundaries as well as the temporal boundaries for the study:

1. The populations of interest include the environmental media that may have been contaminated directly by site operations or by subsequent migration of contaminants.

2. The initial horizontal study boundary will encompass the former Building 451 footprint and the surrounding area (Figure 3-1). Lateral expansion of this horizontal study boundary may be necessary if MC concentrations in soil along this boundary exceed screening levels (see Step 5, Decision Rules). The following sub-zones are within the study boundary:

   - The soil immediately around the former range firing line, which was below the concrete building slab, may have been contaminated with MC constituents (primarily from dust) from the building exhaust and ventilation system, as well from the building demolition and removal activities. The area is not expected to be contaminated with bullet fragments, possibly only MC-containing dust particles from the firing operation, so MC contamination in this area is anticipated to be marginal compared to locations near the bullet trap areas.

   - The soil in the vicinity of the range deflection plate and bullet pit or trap (i.e., the northeastern end of the building, behind the indoor range targets). Ammunition fired below the range targets may have impacted the gravel material overlying the concrete slab or the low CMU wall that contained the bullet trap sand material.

3. The initial vertical study boundary will be limited to 6 inches bgs, because the CSM indicates that penetration of soil and sediment by MC is not generally expected to be deeper than this. In the areas where the XRF results indicate that elevated lead concentrations may be present, the vertical boundary will be expanded to include these areas. The subsurface interval of interest is 6 inches bgs to a maximum of approximately 6 to 8 feet bgs depending on the depth groundwater. The groundwater investigation boundary is limited to the water table which is expected to be present at approximately 6 to 8 feet bgs. Vertical expansion of the study boundary beyond the water table is not envisioned at this time.

4. The temporal boundary is not a significant consideration in this study because MC concentrations (metals) are anticipated to be relatively unchanged (stable) over the course of time needed to conduct the environmental investigations and into the foreseeable future.

DEVELOP THE ANALYTIC APPROACH (STEP 5)

The decision rules for this investigation are as follows:

1. Lead concentrations in soil (and sediment if present) will first be determined using XRF field techniques. Chemical MC concentrations (select metals and perchorate, as applicable) in surface soil, subsurface soil, surface water, sediment, groundwater will then be determined using laboratory analysis. If MC concentrations in site media are less than screening and background levels, recommend NFA for the site. If MC concentrations in site media exceed screening values and facility background concentrations, then return to the site for an RI. An RI would be presented in another work plan.

2. If the XRF-measured concentrations of lead in any sample on the perimeter (vertical or horizontal) of the sampled area exceeds 300 mg/kg, then "step-out" (vertically and/or horizontally) as necessary for XRF lead analysis of additional soil (or sediment if present) until the results of the XRF analysis are less than 300 mg/kg. Based on knowledge of lead concentrations in similar soil, native soil and sediment lead concentrations are expected to be less than 50 mg/kg. Because of this, contaminated areas (e.g., with concentrations exceeding 400 mg/kg) are expected to be well delineated, with steep lead concentration gradients between clean and contaminated areas.

Note:

A) MC metals are defined specifically for this site as antimony, arsenic, lead, copper, tin, and zinc. MC in general for this site includes MC metals and perchlorate (as it applies to groundwater and surface water).

SPECIFY PERFORMANCE OR ACCEPTANCE CRITERIA (STEP 6)

Data will be gathered from areas most likely to be contaminated. This biased selection of sample locations does not support the use of quantitative statistics to estimate decision performance as specified in the DQO guidance (EPA, 2006). Instead, the Project Team will use the results of this investigation to determine whether the amount and type of data collected is sufficient to support the attainment of project objectives. This will involve an evaluation of contaminant concentrations to ensure that contaminants are likely to have been detected if present, and that enough data have been collected to support the SI.

Measurement performance criteria for field XRF analysis are listed in Section 3.0 of the Work Plan.

Performance criteria for analytical data meeting the PALs are listed on Table 3-3 for MC.

DEVELOP THE PLAN FOR OBTAINING DATA (STEP 7)

The proposed PA/SI field data collection program for the D-6 Small Arms Range is presented, to a large extent, on Figure 3-1. Surface water and sediment sampling is proposed for the drainage ditch located to the northeast of the former Building 451 location that receives surface runoff from the general area. The program assumes that based on the CSM, the following potential depositional areas exist within the general area of the former indoor firing range:

- The general ground surface in the immediate vicinity of the northeastern end of the former indoor range may be contaminated with stray bullet fragments if the bullet trap sand and materials were not removed prior to building demolition in December 1998. It is presumed that because the demolition was completed within the past ten years and the demolition plan included detailed lead concentrations for painted surfaces within the building that the range bullet trap materials were most likely removed before the building was demolished. Potential MC contamination from bullet trap materials (if present) would tend to be concentrated in surface soil within the area of the former bullet trap. Because there is no indication of residual bullet trap materials at the site, it is anticipated that lead concentrations at the site will be consistent with normal soil concentrations in the area. The limited field soil sampling and analysis by XRF with subsequent laboratory analysis of samples will confirm field analyses and support development of a correlation factor between field lead concentrations and laboratory lead concentrations for the same samples. Furthermore, the laboratory results for soil samples will demonstrate the relationship between lead and the other metals of concern at this former small arms range site.

- As Building 451 was an indoor range, there was no range surface danger zone and no potential for expended rounds to exit at the building perimeter. The primary impact point on the range was the angled deflection plate. Bullets fired below the range targets would likely be dispersed in the low CMU wall in front of the sand trap, or within the pea gravel layer placed above the concrete slab floor of the building. Bullets fired above the targets would contact the smaller angled baffles on the range and guide the off-target bullets to the main deflection baffle plate and the bullet trap. Bullets fired to the range sides would contact the CMU walls that lined the exterior metal building walls. Bullets that successfully hit the targets most likely would continue through the targets and strike the primary range deflection baffle plate and the bullet trap.

- Potential residual bullet trap materials in the surface soil could be available for entrainment and migration by surface water runoff. Surface water follows the local topography and drains to the north and west. A drainage ditch crosses the general area between Building 430 and the former Building

451 location, this lower lying area could receive precipitation runoff with range-derived MC, if present in soil.

- It is assumed that most of the expended ammunition would most likely have impacted the final deflection plate and been collected in the range bullet trap at the northeastern end of the former footprint of Building 451. As noted in Step 4, the horizontal and vertical boundaries of the soil and drainage ditch areas to be sampled will encompass all areas significantly impacted by site activities.

- The sampling design consists of four (approximately quarter-acre in size) quadrants that contain the footprint of the D-6 Small Arms Range and other adjacent areas that may have been impacted by building demolition activities. The XRF field sampling program will focus on characterizing lead concentrations within the quadrant areas and subsequent samples will be collected for laboratory analysis to confirm the field results. The soil samples will be collected within the quadrants to ensure that the decision units are well represented spatially. The MC sampling and analytical program is as follows:

Surface Soil Sampling

- Collection of five discrete surface soil samples (0 to 6 inches bgs) utilizing a hand auger within each of the four ¼-acre grids on the approximately 1-acre site, as shown in Figure 3-1. All 20 discrete samples will undergo field XRF analysis for lead.

- Any discrete sample location exhibiting an XRF lead concentration greater than 300 mg/kg will then be selected for composite sampling within that location for fixed-base laboratory (FBL) analysis.

- Up to 16 composite surface soil sample locations may be selected for FBL analysis. Based on field XRF lead concentrations at the discrete surface soil sample locations, up to 16 composite surface soil samples are proposed for collection within the approximate 1-acre investigation area utilizing a stainless-steel hand auger. Each composite sample will be comprised of seven sample aliquots utilizing the seven-point wheel approach. The composite sample locations will be collected at discrete sample locations having XRF lead concentrations exceeding 300 mg/kg. Surface soil samples will be collected from 0 to 6 inches bgs.

- If numerous surface soil sample locations have XRF lead concentrations greater than the decision criterion of 300 mg/kg, up to 12 additional composite surface soil samples may be collected to help identify contamination boundaries at the site.

- If all discrete samples exhibit XRF lead concentrations less than 300 mg/kg, two locations within each of the four sample grids will be selected for composite sampling and undergo both XRF and FBL analysis. These locations will be biased towards locations with the highest discrete XRF lead concentrations.

Subsurface Soil and Groundwater Sampling

- Collection of discrete subsurface soil samples in 2-foot increments from current grade to the groundwater table from each of the four ¼-acre grids in the approximate 1-acre investigation area utilizing DPT is planned. The subsurface soil samples will be collected at surface soil locations with the maximum XRF lead concentration. All subsurface soil samples will undergo field XRF analysis for lead.

- Installation of a temporary groundwater monitoring well within the surficial aquifer at each of the subsurface soil sample locations utilizing DPT is planned, groundwater samples will be collected from each of the temporary groundwater monitoring wells.

Drainage Ditch Sampling

- Prior to sampling, a site “walk over” will be conducted by the FOL to identify any obvious surface water drainage pathways potentially leading to adjoining surface water bodies. The discretionary drainage ditch sediment samples (up to three) will be collected from each of these pathways. Locations will be targeted for sampling based on proximity to surface soil locations with elevated lead concentrations, on the accumulation of sediment along the pathway with emphasis placed on sampling sediment collection points, and on the potential for the pathway to lead to an adjoining surface water body with emphasis placed on those drainages leading to surface water bodies.

- If present, collection of surface water samples will be performed at up to three locations. If water is present, one surface water sample will be collected immediately upstream of the site, one within the site, and the other will be collected immediately downstream of the site. The three sediment samples will be co-located with the surface water samples.

Analytical Program

- All soil and drainage ditch sediment samples (if collected) will be analyzed for lead using XRF field screening analysis. An estimated 16 composited samples may be analyzed for the MC metals of concern at a FBL. Samples will be analyzed for select metals by SW-846 Method 3050B/6020A. The samples sent to the FBL will be selected to reflect the range of lead concentrations detected in site media using XRF field screening, with the majority having field XRF lead concentrations between 250 and 550 mg/kg. A correlation study (field screening versus FBL concentrations) may be conducted to support data interpretation for the investigation.

- Surface water samples and groundwater samples will be sent to the FBL and analyzed for total and dissolved metals of concern by SW-846 Method 6020A. The unfiltered surface water and groundwater samples will also be analyzed for perchlorate by SW-846 Method 6850.

APPENDIX F-2

PROBLEM DEFINITION/CONCEPTUAL SITE MODEL FOR THE D-6 50-FT INDOOR RIFLE AND PISTOL RANGE, [ASR 2.64], CAMP LEJEUNE CANTONMENT

A component of the Preliminary Assessment/Site Inspection (PA/SI) is the refinement of the site-specific Conceptual Site Model (CSM) as developed for the site based on the information complied during the Historical Records Review report. The CSM describes the range and its environmental setting. The CSM was developed following guidance documents issued by the United States Environmental Protection Agency (USEPA) for hazardous waste sites and by the U.S. Army Corps of Engineers (USACE) for ordnance and explosives (OE) sites. Additional guidance documents relevant to CSM development are included in USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA/540/G-89/004) and USACE CSM Guidance Development of Integrated Conceptual Site Models for Environmental OE Sites (February 2003).

The CSM presents site-specific information regarding: 1) MEC and/or MC known or suspected to be at the range; 2) current and future reasonably anticipated or proposed uses of the real property; and 3) complete, potentially complete, or incomplete pathways for humans and environmental receptors for exposure to MEC and/or MC at the site. The CSM for the site concisely summarizes the information as it is currently known, how that relates to the project's goals, and serves as the basis for risk evaluation, prioritization, and remediation cost estimating.

The PA/SI effort must include a systematic planning program to ensure that the collected environmental data meet specific project needs. Accepted scientific concepts such as objectivity of approach and acceptability of results are critical in establishing a method to ensure that the level of documentation and level of effort in planning/data collection are commensurate with the intended use of the information and the available resources. The Data Quality Objectives (DQOs) process is a seven-step process used to establish performance or acceptance criteria, which serves as a basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study. Guidance documents relevant to DQO development include USEPA's Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4) (EPA/240/B-06/001). The seven steps for the DQO process are as follows:

- State the problem (define the problem the study is looking to solve).

- Identify the study goal [the PA/SI goal is to determine whether further response actions or remedial investigations are appropriate for the D-6 Small Arms Range site at the Marine Corps Base (MCB) Camp Lejeune].

- Identify information inputs (identify the data/information needed to answer study questions).

- Define the study boundaries (specify the target population; define spatial/temporal limits, characteristics of interest).

- Develop the analytical approach (define parameters of interest and develop logic for drawing conclusions from findings).

- Specify the performance or acceptance criteria for new or existing data and specify probability limits for false rejection and false acceptance decision errors.

- Develop the plan for obtaining data using a resource-effective sampling and analysis plan that meets performance criteria.

For the focused PA/SI at the D-6 Small Arms Range site at MCB Camp Lejeune, the CSM has been developed and refined based on the data collected during the information collection effort. Site-specific DQOs have been prepared to focus PA/SI efforts on collecting the supplemental environmental information needed to update the site-specific data resources and further define the nature and extent of potential MC contamination at the site. The Preliminary CSM and DQOs have been prepared to support the planning phase of the PA/SI program and are presented in this document. The combined CSM/DQOs were used as the basis for developing the PA/SI Work Plan and are included as Appendix F in the PA/SI Work Plan.

History and Site Description

The D-6 Small Arms Range in Building 451 appeared on a 1954 base map and is identified in Base Order 11102.B, dated 5 May 1960. The description of the range remained the same in BO P11102.1G, dated 6 February 1970, and in BO P11102.1K, dated 1 December 1986. Range fan information was extracted from range maps and one or more of the following documents: Training Regulations 140-5, dated 20 November 1931; AR 750-10, dated 22 May 1939; AR

750-10, dated 14 February 1942; AR 750-10, dated 22 January 1944; TM 9-855, dated 17 August 1944; TM 9-855, dated November 1951; Training Circular 25-1, dated 4 August 1978; Training Circular 25-8, dated 25 February 1992; MCO P3570.1A, dated 15 November 1983; MCO P3570.2, dated 5 January 1977, w/change 1, dated 1 June 1983; and, the Archive Search Report, USACoE, 2001. The Environmental Management office on MCB Camp Lejeune initially identified the range. Also, the range was identified in the Archive Search Report (ASR 2.64) prepared for MCB Camp Lejeune by the Corps of Engineers and finalized in 2000.

Building 451 consisted of metal sheeting on a steel frame (Butler Building) constructed on 01 November 1952. The original design blueprints dated 25 April 1952 indicate outside dimensions of 120 feet 6-inches long by 40-feet wide. Based on this documentation, Building 451 was used for small arms training from approximately 1952 to about 1998. Photographs and drawing details shown on the building demolition plan dated 09 July 1997 indicate the building entrance was on the southwestern wall and the direction of small arms fire was to the northeast. This drawing shows the northeastern end of the building and approximately 86 feet along the southeastern and northwestern walls were lined with concrete masonry unit (CMU) walls inside the Butler Building sheet metal exterior wall. The CMU walls were typical cinder block construction. The CMU walls inside Building 451 surrounding the range area were 12 feet 10-inches high. The indoor range at Building 451 was apparently eight firing lanes wide and accommodated target practice firing from a 50-foot distance and a 75-foot firing distance from the targets. The 75-foot firing line is consistent with the outside dimensions of the building and the dimensions of the CMU wall lining the inside of the building wall along the firing range.

The range bullet deflection system consisted of a series of four angled steel baffle plates suspended from the building's structural steel roof supports. The final baffle was a 13-foot wide steel plate that extended across the width of the range and covered the area behind the targets. The steel plate was oriented at a 45 degree downward angle from about 11-feet above the range floor to near the base of the downrange CMU wall. The leading edge of the final baffle was suspended above a two-foot high CMU wall about ten feet in front of the CMU wall at the northeastern (target) end of the building. Behind the two-foot wall about 8 to 16 inches of sand were placed over a four-inch layer of gravel directly overlying the foundation slab. The sand layer thickened from the 2-foot CMU wall toward the rear (downrange) CMU wall where the final baffle plate was anchored.

Bullets were fired from the firing line, passed through the targets, and continued downrange until striking the inclined deflection plate. After striking the plate, the bullets were deflected into the

sand pit (plate and pit bullet stop). The sand would catch the expended bullets, absorbing the energy of the bullet, and typically preventing the projectile or bullet fragments from escaping the bullet trap. No records were discovered to document the handling or management of the expended bullets or bullet fragments in the bullet trap sand in Building 451.

Figure F-1: 1996 Aerial Photograph of MCB Camp Lejeune showing the D-6 Small Arms Range

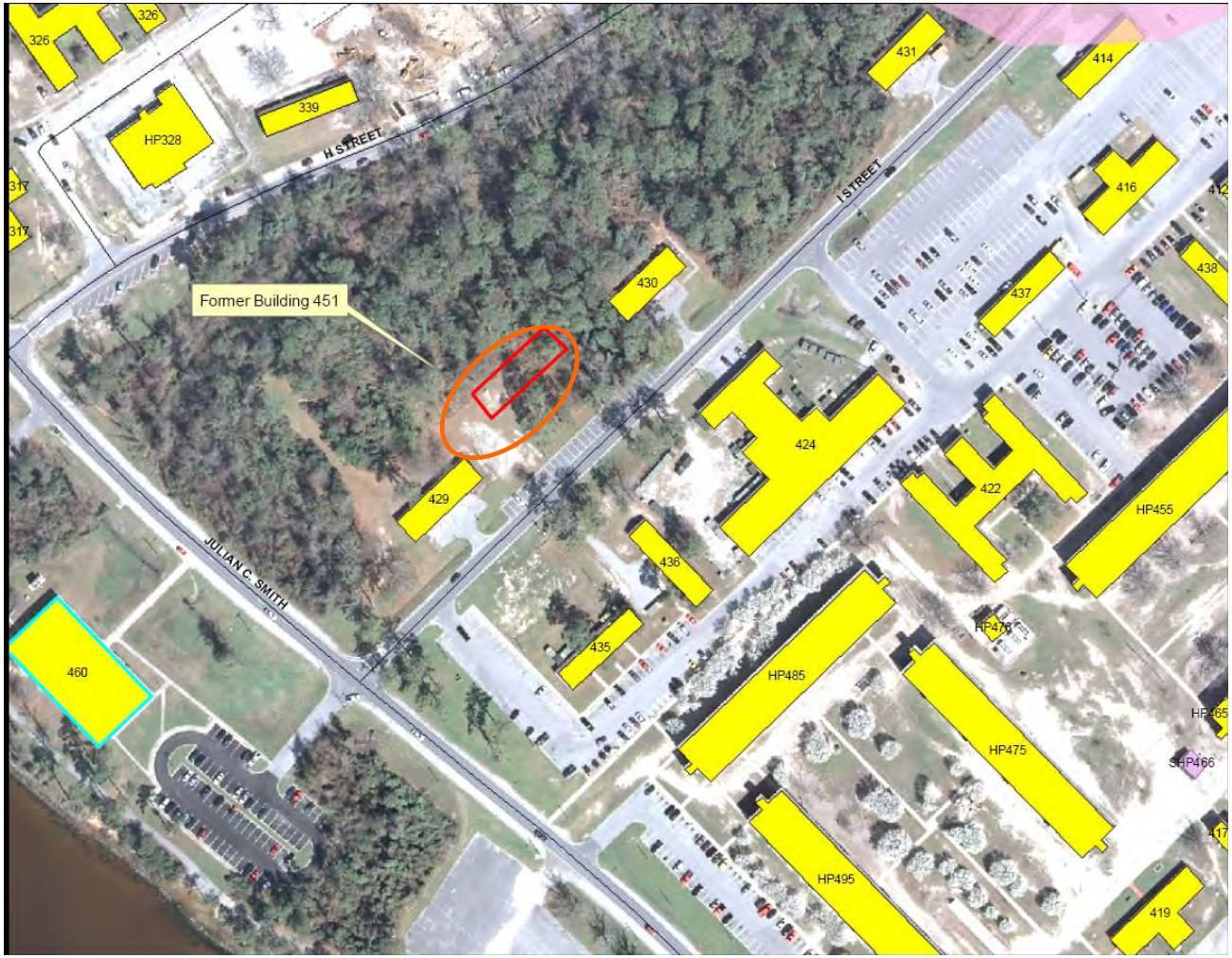

Figure F-2: Post-demolition aerial photograph of MCB Camp Lejeune showing the D-6 Small Arms Range.

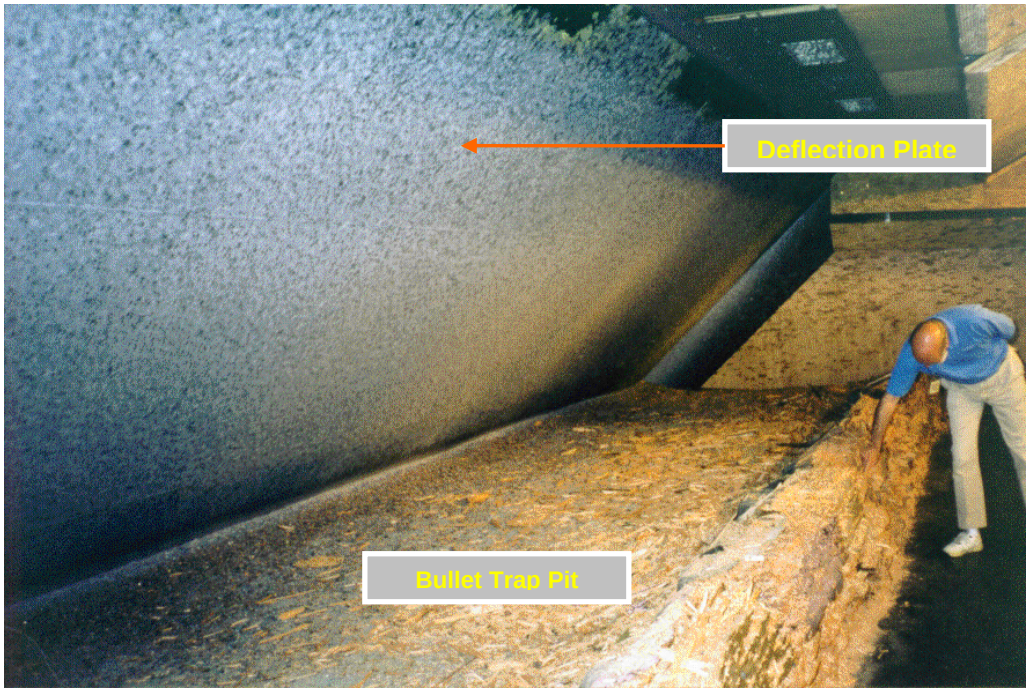

Figure F-3: Typical indoor range plate and pit bullet stop (Navy Environmental Health Center Technical Manual NEHC-TM6290.99-19 Rev.1, Indoor Firing Ranges Industrial Hygiene Technical Guide, May 2002), believed to be similar to that used at the D-6 Small Arms Range.

Navy indoor range technical guidance (NEHC-TM6290.99-19 Rev.1) indicates that plate and pit bullet traps are not recommended for use because they require a high level of maintenance. They required diligent maintenance to remove bullets from the sand trap because lack of bullet trap cleaning could cause ricochet hazards if bullets entering the sand pit struck other bullets. Sand pit cleaning has been characterized as a messy operation which may cause potential high lead exposure to those individuals tasked with bullet trap maintenance without proper personal protective equipment.

Property records indicated that Building 451 was improved in 1985 and that building upgrades may have been made to the ventilation system, electrical supply, and building acoustics as detailed in Building 451 improvement plans dated 20 June 1983.

Based on the photographs of the general area following the demolition of Building 451 in December 1998, the footprint covers an area approximately 200 feet long (parallel to I Street) and

extends back from I Street (to the northwest) approximately 150 feet. The PA/SI sampling effort proposed for the D-6 Small Arms Range will focus on this less than one acre area, but will also evaluate areas where surface soil could be transported by overland flow and accumulate in areas such as local drainage ditches.

The notes on the demolition plan indicate that the building demolition included removal of wood framed structures on the reinforced concrete foundation and slab including steel siding, CMU walls, partitions, and steel baffle plates. The demolition plan also identified known hazardous materials including friable asbestos in cloth-wrapped pipes, transite panels in the restroom ceiling, and lead-containing paint noted on building metal siding surfaces and the steel baffle plates. Note 4 on the demolition plan for Building 451 indicates the area was to be backfilled, raked, and seeded after building demolition and removal. This is relevant as there may have been non-native soil fill brought to the site and any potential surface soil contamination may now be at depth below clean fill. There was no mention in the demolition plan regarding expended lead bullets or the bullet trap sands that could contain particulate lead and bullet fragments. It is presumed that because this demolition activity was only completed ten years ago that the bullet trap sand and contents were removed by the Navy from Building 451 prior to demolition. It is also presumed that those materials were sent offsite to recycle the lead or for some other beneficial reuse.

The Class 2 Disposal Record dated 21 December 1998 indicated Building 451 was managed as property record number 204789. The disposal contract was recorded as FACLTR3DEC98, and the demolition/disposal for Building 451 was dated 18 December 1998.

Topography

The topography of MCB Camp Lejeune is relatively flat with ground surface elevations ranging from mean sea level (msl) to 72 feet above msl. Most of the MCB Camp Lejeune lies between 20 and 40 feet msl. The D-6 Small Arms Range area is approximately 700 feet northeast of the edge of the New River. The area proposed for the PA/SI is located along I Street, between Building 429 and Building 430. This property parcel slopes away from I Street to the northwest from 15 feet to seven feet above msl.

The l00-year flood plain elevation for this area of MCB Camp Lejeune is approximately 10 feet above msl. The elevation of the prepared soil surface when the Building 451 was constructed was approximately 13 feet above msl. The National Flood Insurance Program (NFIP) has

classified the location of the D-6 Small Arms Range as Zone X, which indicates that the area has been determined to be outside the 0.2 percent annual chance floodplain.

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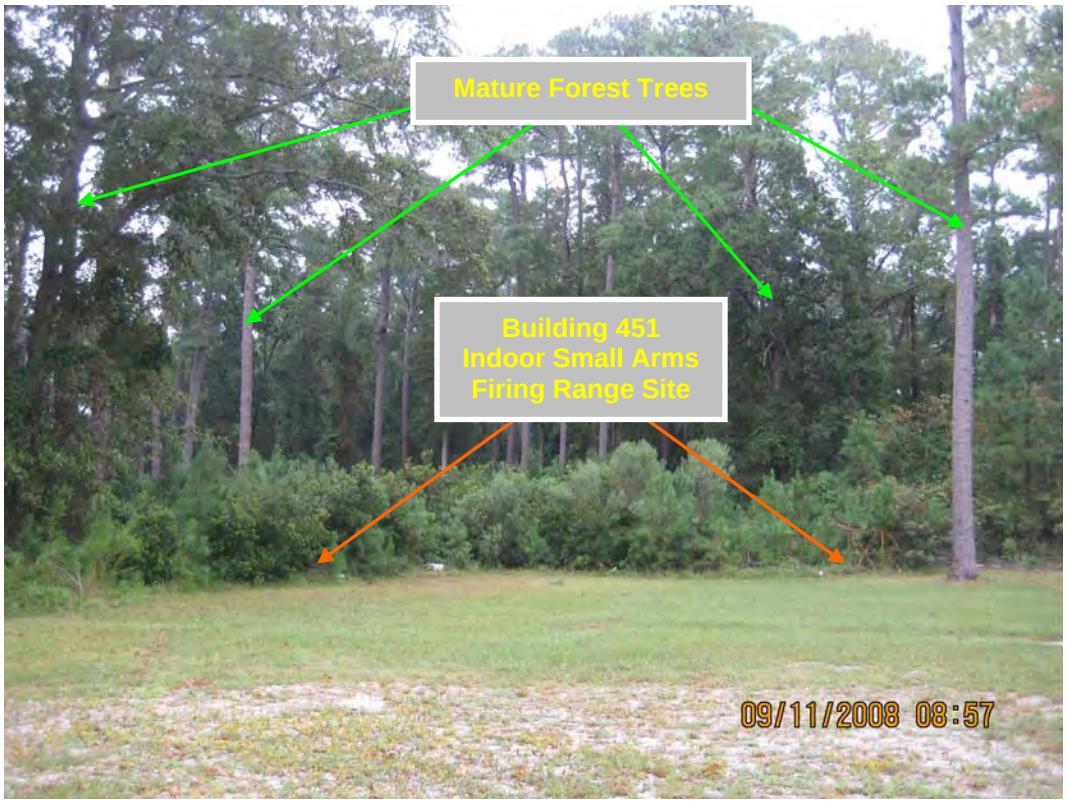


Figure F-4: D-6 Small Arms Range site (looking north) as recoded during September 2008 site walk/data collection visit. As this was a previously developed site, the former building location is fairly level. Remnants of access sidewalk are visible in the right foreground (see Figure F-6 for another view of the remaining sidewalk at the site).

The majority of the site is flat with a small downward slope toward the northwest. Due to the topography of the area and the predominant vegetative ground cover, the potential for erosion is limited. The local terrain at the location of the D-6 Small Arms Range is relatively level, varying between about 11 to about 13 feet above msl. To control surface runoff in this area, a drainage ditch was installed along the northwestern side of I Street. The drainage ditch conveys flow from the southwest through a culvert below the Building 430 driveway and then flows to the west between Building 430 and the former Building 451 location to eventually join a small stream that flows to the southwest near H Street and eventually discharges into the New River.

Geology

The uppermost undifferentiated formation of Holocene and Pleistocene age sediments consist of mostly fine, loose to medium dense sands, with a lesser amount of silt and clay and is present from land surface to depths of 20 to 30 feet below ground surface (bgs). Thin, discontinuous lenses of silt and clay may be regionally associated with the Belgrade formation. The Belgrade formation generally consists of mostly fine sands, silts and clays, with lesser amounts of shell fragments.

The upper portion of the River Bend Formation, which underlies the Quaternary age sediments, is composed of sands, silts, shell and fossil fragments, and trace amounts of clay. The River Bend Formation overlies the Eocene Castle Hayne Formation. The Castle Hayne formation consists of both poorly indurated and well indurated biomicrite and biomicrudite limestone (Harris, et al., 1991). Thickness of the Castle Hayne Formation ranges between 150 feet and over 450 feet locally at MCB Camp Lejeune (Cardinell, et al., 1993).

Site-specific geologic data are not available for this site, but will be collected during the PA/SI field investigation and presented in the PA/SI Report.

Soil and Vegetation Types

The mapped soil unit for the D-6 Small Arms Range area consists of the Baymeade-Urban land complex derived from loamy and sandy marine deposits with 0 to 6 percent slopes. The Baymeade-Urban soil unit consists of well drained fine sand material to a depth about 30 inches, underlain by about 10 inches of fine sandy loam (30-40 inches bgs), with a lower loamy fine sand at the soil base (40-80 inches bgs).

The vegetation in the local area consists of a mature stand of mixed conifer and deciduous trees (present prior to range building construction in 1952), with more recent understory vegetation pines, and partially growing within the former footprint of the building foundation slab, as shown in Figures F-2 and F-5.

Hydrology

To control surface runoff in this area, a drainage ditch was installed along the northwestern side of I Street. The drainage ditch conveys flow from the southwest through a culvert below the Building 430 driveway and then flows to the west between Building 430 and the former Building 451 location to eventually join a small stream that flows to the southwest near H Street and eventually discharges into the New River. The New River is approximately 675 feet southwest of the former Building 451 Indoor Small Arms Firing Range area.

Hydrogeology

The surficial aquifer, Upper Castle Hayne confining unit, and the Castle Hayne aquifer have all been described at MCB Camp Lejeune (Cardinell, et al., 1993). The surficial aquifer resides within the Undifferentiated Formation, and the Caste Hayne Aquifer resides locally within the River Bend Formation. The Belgrade Formation typically acts as a confining unit between the surficial and the Castle Hayne aquifer.

As related to the Baymeade-Urban land complex soil unit which has been mapped on the site of the D-6 Small Arms Range, the depth to the local water table is generally 48 to 60 inches bgs. Site-specific hydrogeologic data are not available for this site, but will be collected during the PA/SI and presented in the PA/SI Report.

Cultural and Natural Resources

The environmental sampling activities proposed to support this Work Plan involve a limited degree of intrusive activity. The area to be sampled has been previously developed and may have received limited fill or grading operations to support the original building construction, as well as possible limited fill activities following building demolition and removal of debris from the site.

The probability that any significant cultural or archeological resources will be impacted by the field investigation is low. Consultation with the Base archaeologist will confirm that no cultural or archaeological resources are known to lie within the area of investigation. If any unmapped cultural or archaeological materials or resources are discovered within the project investigation area, the Base archaeologist will be notified to provide guidance on performing further work in the area.

Endangered and Special Status Species

Protected species have been sited in the vicinity of and at MCB Camp Lejeune such as the American alligator, the green sea turtle, the loggerhead sea turtle, the piping plover, the red-cockaded woodpecker, bald eagle, seabeach amaranth, and the rough-leaf loosestrife (Marine Corps, 2006).

The installation's infrastructure development in the general cantonment area and related human activities in proximity to the D-6 Small Arms Range further limit the species that may inhabit that area. While MCB Camp Lejeune has active programs in place to protect the three federally protected avian species (American bald eagle, piping plover, and red cockaded woodpecker) that are known to occur on the Base, the D-6 Small Arms Range is not within the vicinity the red cockaded woodpecker management areas, and is outside the protective buffers established for an American bald eagle's nest (over nine miles away). Non-nesting eagles may use the D-6 Small Arms Range for foraging habitat. However, the proposed work is not expected to impact any special eagle habitat.

Suitable habitat for the American alligator, the piping plover, the eastern cougar, and the seabeach amaranth does not exist at the D-6 Small Arms Range. The D-6 Small Arms Range is approximately 14.5 miles from the Atlantic Coast and federally protected marine species (e.g., green sea turtle, leatherback sea turtle, loggerhead sea turtle, and West Indian manatee) are unlikely to inhabit this inland area.

Two of the four federally listed plant species have been identified on the Base: rough-leaved loosestrife and seabeach amaranth. Approximately 22 rough-leaved loosestrife sites are found on MCB Camp Lejeune with 76 acres buffered and marked to protect this species. Roughleaved loosestrife sites are visited annually to visually inspect for changes in extent and apparent health. None of these sites are located on or adjacent to the D-6 Small Arms Range. No adverse impacts to listed species are expected to result from the proposed work within the investigation area at the D-6 Small Arms Range.

Visual Survey Observations and Results

A visual survey of the D-6 Small Arms Range was conducted during an information collection/site visit on 11 September 2008 and photographs were collected at that time. This visual survey/site

walk was performed by Rick Barringer (Tetra Tech), Jim Goerdt (Tetra Tech), and Bob Lowder (Installation IR Program Manager-Environmental Department) as part of the data collection effort for the project.

In terms of former structures that remain at the site, only portions of the concrete sidewalk that joined I Street with the access door for the D-6 Small Arms Range were visible. There was no evidence of the former indoor small arms firing range activity. The site walk included taking photographs and documenting visual observations of field conditions (Figures F-4 through F-9).

Figure F-5: Current vegetation conditions observed during the 11 September 2008 site walk at the D-6 Small Arms Range site (view to northeast, looking downrange toward bullet trap location).

Figure F-6: Remains of sidewalk installed to access the entrance of the D-6 Small Arms Range (view to northwest, looking from the curb on I Street). No other elements of firing range structure are currently visible at the site.

Figure F-7: Remains of sidewalk installed to access the entrance of the D-6 Small Arms Range (view to southeast, looking back to I Street).

Figure F-8: Drainage ditch that passes though a culvert under the driveway to Building 430 and directs surface flow between the D-6 Small Arms Range and the adjacent Building 430 on I Street.

Figure F-9: Possible fill or concrete rubble material observed at the soil surface at the D-6 Small Arms Range as observed during 11 September 2008 site visit.

Munitions and Munitions-Related Materials Associated with the Site

This section describes the munitions or munitions-related materials known or suspected to be at the range. The D-6 Small Arms Range was used exclusively for small arms (pistol and rifle) training. The building blueprints indicate that both 50-foot and 75-foot firing lines were included at this range. Specific ammunition types used at the range are not known. Lead bullets/fragments are suspected to have been collected in the sand of the downrange bullet trap. No munitions-related debris items were identified during the site walk in September 2008.

Because this range was completely enclosed, a safety danger zone or range fan did not exist. The investigation area within the D-6 Small Arms Range will include a 1-acre area where the building was previously located and some residual demolition debris may still be present. The area of investigation is located northwest of I Street, between Building 429 and Building 430 (Figure F-1). Based on a review of publicly available aerial photographs and site reconnaissance, the investigation area has a gently sloping terrain and is approximately 25 percent heavily vegetated with young trees and thick understory shrub growth. The area that has experienced the most vegetation growth since the building demolition in 1998 appears to be the former general area of the bullet trap (the northeastern end of the former building).

MEC Presence

The D-6 Small Arms Range is located within the Cantonment area for Camp Lejeune. The buildings adjacent to the site, Building 429 to the southwest and Building 430 to northeast, were present in 1952 when Building 451 was designed and constructed. Small arms are not MEC; therefore, there are no areas at the D-6 Small Arms Range site are suspected to contain MEC.

Ordnance Penetration Estimates

Because Building 451 was an indoor small arms firing range, there is no projected ordnance penetration depth. The CMU wall lining inside the exterior metal sheeting of Building 451 was 12 feet 10-inches high and surrounded the range firing area. There were most likely eight firing lanes for target practice firing from a 50-foot and 75-foot distances. Bullets were fired from the firing line, passed through targets and continued downrange until striking an inclined 13-foot tall steel deflection plate that extended across the width of the range and covered the area behind the targets.

Because this was an enclosed indoor range it is unlikely that expended ammunition derived MC were released to the environment during operation. Although no records were discovered to document the handling or management of the expended bullets or bullet fragments in the bullet trap sand in Building 451, it is suspected that the MC residues and bullet trap sands were removed from the building before it was demolished in 1998.

Munitions Constituents

For small arms ammunition, the primary MC of concern is lead from the expended bullets. Other associated MC, less likely to be of concern, may include antimony, arsenic, copper, nickel, tin, and zinc.

Based on the exclusive nature of small arms usage at the D-6 Small Arms Range, the proposed metals analyses will be directed at those metals that have a connection to typical small arms ammunition:

- Antimony (bullet-hardening agent)
- Arsenic (antimony/lead heat treatment to improve bullet strength)
- Copper (used in jacketed bullets)
- Nickel (bullet jacket alloy and primer component)
- Lead (primary bullet component--typically over 90 percent lead, as well as primer constituents lead styphnate and lead azide)
- Tin (bullet-hardening agent)
- Zinc (bullet jacket alloy)

In addition to metals, perchlorate is also suspected to be a compound of concern at this former indoor firing range. Small arms bullets may have traces of perchlorate derived from certain double-base cartridge powder formulations. Although small arms tracer rounds may also contain potassium perchlorate as an added oxidizer to strengthen the pyrotechnic chemical reactions, it is unlikely that the indoor range in Building 451 was approved for tracer round ammunition. In either instance, perchlorate may not be fully consumed when small arms ammunition functions as designed, and there may be residual perchlorate associated with the expended bullets.

Metallic residue (the primary metals noted above) derived from expended small arms ammunition was collected in bullet trap sand pit. It is suspected that the bullet trap was regularly maintained to avoid potential ricochet hazards during use and that the sand pit contents were removed from

the site prior to building demolition. There were no records recovered concerning range procedures for sand pit management or to confirm the removal of sand pit residues before building demolition.

Contaminant Migration Routes

Contaminants at the former Building 451 location may potentially migrate within soil, groundwater, surface water and sediment. The former Building 451 location proximity to the New River, its unnamed tributary creek and the surface water drainage ditch system provides possible migration routes to surface water. Storm water discharges to surface water via overland flow and collects in the drainage ditch system. The sandy texture of the surface soil reduces the potential for local precipitation to flow along the ground surface to the drainage ditch. It most likely would infiltrate the local water table aquifer. Groundwater in the shallow water table aquifer also likely flows toward the New River; therefore, MC leaching from soil into shallow groundwater may migrate to surface water. Sediment can act as contaminant repositories, and sediment mixing and dredging can act as migration routes to surface water. MC in surface soil and sediment may migrate via plant/animal uptake. Direct human contact with surficial soil is possible if the soil is disturbed. It is unlikely that MC in shallow groundwater would migrate to deeper aquifers. However, shallow groundwater is considered a potential exposure medium, as it most likely recharges nearby surface water bodies.

Receptors

Potential human receptors include authorized Installation personnel (military and civilian), visitors, contractors, and maintenance workers. Examples of ecological receptors that could provide exposure routes to humans include mammals, birds, waterfowl, and fish.

Buildings Near/Within Site

There are no buildings currently located at the D-6 Small Arms Range. The building that contained the indoor firing range was demolished in December 1998. There are buildings on adjacent lots on the northwest side of I Street. Building 429 is approximately 60 feet southwest of the former Building 451 location and Building 430 is approximately 62 feet northeast of the former Building 451 location.

Building 429, southwest of the former Building 451 location is used as a storage warehouse and Building 430, northeast of the former Building 451 location houses the Individual Simulated

Marksman Facility. Similar, but slightly more distant buildings (Buildings 428, 435, 436, and 424) are located on the southeast side of I Street from the site of the D-6 Small Arms Range.

Utilities On/Near Site

An underground two-inch water supply line and an underground electrical cable were connected to Building 451 according to the 1952 site and utility plan. A six-inch sanitary sewer line was connected from the restrooms in Building 451 to an existing sanitary sewer line behind Building 429. An overhead telephone line originally connected Building 451 with the installation's communication system. Both the water line and electrical cable were routed from I Street and connected through the Building 451 slab near the location of the access sidewalk (Figure F-10).

As part of the demolition plan for Building 451, the overhead phone service line was to be removed, and the underground electrical service conductors were to be removed to Building 1611. The electrical conduit to the power panels was permitted to remain, but the conductors were to be terminated in the panel in accordance with NEC requirements. Following the Building 451 demolition in 1998, the former sanitary sewer line and the potable water supply line may still be underground at the location of the D-6 Small Arms Range. All of the underground utilities known to have been on the site are shown on Figure F-10. Confirmation of utility locations will be coordinated with North Carolina One-Call Center (1-800-632-4949).

Land Use

There is no readily available information on land use prior to 1952, but historical information indicates that this cantonment portion of MCB Camp Lejeune had been used to support a variety of activities with multiple building structures including offices, classrooms, barracks, and storage and warehouse facilities. The buildings closest to the D-6 Small Arms Range (Building 429 and Building 430) were present when the indoor range building was originally constructed in 1952. Additional buildings across I Street from the indoor range included Building 428, Building 436, and Building 424. Following the demolition of Building 451 in 1998, the site has not been redeveloped, and small pine trees and understory vegetation are beginning to reestablish themselves in the open area within the footprint of the former indoor firing range. According to installation personnel, there are no planned changes for the former Building 451 location.

Access Controls/Restrictions

No public access is authorized at MCB Camp Lejeune. Signs, security fencing, locked/secured gates, login books/gate office check-in requirements, and vehicle security patrols are used to control the entire facility. There are no specialized access control features specific to the D-6 Small Arms Range, beyond those established for the main installation. As such, it is unlikely that a trespasser would be able to access the site or be exposed to potential MC in the soil.

Conceptual Site Model

For the purpose of this Work Plan, only MC associated with the D-6 Small Arms Range is considered in the CSM exposure pathway analysis.

Historical and visual evidence indicate that MEC are not present at the D-6 Small Arms Range. Therefore, incomplete exposure pathways exist for MEC and no exposure pathway analysis was completed for MEC. Soil impacted by MC represents a primary potential source medium, as illustrated in the CSM. Potential receptors include human (Installation personnel (military and civilian), contractors, visitors, and maintenance workers) that and certain ecological receptors could contact MC in soil that could pose a threat to human receptors. A potentially complete exposure pathway exists for surface soil through ingestion, inhalation, and dermal contact for human receptors.

Precipitation infiltration may mobilize contaminants into subsurface soil and into the shallow or surficial groundwater aquifer, which is assumed to be connected to nearby surface water bodies. Subsurface soil represents an exposure medium when considering potential future construction or ground disturbances by Installation personnel (military and civilian), contractors, visitors, and maintenance workers. Runoff/erosion impacting surface water/sediment also presents a potential exposure medium to human receptors. Potentially complete exposure pathways do not exist for MC in shallow groundwater for ingestion in human receptors because shallow groundwater is not used for local water supplies. A deeper aquifer (Castle Hayne Formation) is used for the local water supply. The MC exposure pathway analysis for the D-6 Small Arms Range is presented on Figure F-11.

Problem Definition Summary

The following is a summary of the problem definition:

- Environmental contamination may exist at the D-6 Small Arms Range (approximately one acre) because the facility was an active small arms firing range from 1952 through 1998. This indoor range features a 75-foot firing line and a 50-foot firing line for small bore weapons target training.

- Specific small arms ammunition types and materials used at the D-6 Small Arms Range most likely included small arms and pistol ammunition (5.56mm, 7.62mm, .22-cal, and possibly other small arms ammunition).

- This indoor range was constructed with a standard deflection plate and sand pit bullet trap behind the targets at the northeastern end of the building. To reduce the potential for ricochet hazards in the bullet trap the sand pit was routinely maintained and the expended bullets were collected and removed.

- There was no information discovered in the installation archive describing how the bullet trap sands or the expended bullets recovered from the Building 451 sand pit. It is presumed that standard range management and maintenance practices would periodically recover expended lead bullets and fragments from the sand pit and that recovered lead material was released off-site for recycling.

- Known hazardous material noted on the Building 451 demolition plans included friable asbestos in cloth-wrapped pipes, transite panels in the restroom ceiling, and details on the locations and concentrations of lead-containing paint in on building metal siding surfaces and the steel baffle plates. There was no mention in the demolition plan regarding expended lead bullets or the bullet trap sands that could contain particulate lead and bullet fragments. It is presumed that because this demolition activity was only completed ten years ago that the bullet trap sand and contents were removed by the Navy from Building 451 prior to demolition. It is also presumed that those materials were sent offsite to recycle the lead or support some other beneficial reuse.

- In the absence of documentation to conclusively indicate that bullet trap sands (containing expended lead bullets and lead fragments) were removed from Building 451 prior to demolition, a limited environmental sampling program has been proposed for the D-6 Small Arms Range area. If bullet-derived contamination is present at the site, it should be concentrated in the vicinity of the former indoor range bullet trap area, at the northeastern end of the former indoor range (approximately 62 feet southwest of Building 430).

- MC consisting of metals (primarily lead and, to a lesser extent, antimony, arsenic, copper, tin, and zinc) as well as perchlorate may be present in site soil, particularly surface soil (the 0- to 6-inch interval). Additional environmental media such as surface water and sediment in nearby drainage ditches leading from the former range may also be affected and these drainageways discharge to adjoining unnamed tributaries and eventually to the New River. Lead is assumed to be the primary MC metals of concern because it is the primary constituent in spent small arms munitions (typically 85 to 96 percent lead by weight) and because of the documented toxicity of lead to both human and ecological receptors. It is anticipated that other metals contamination will be spatially correlated with lead concentrations. MC, if present in surface soil, may have migrated to subsurface soil and subsequently infiltrated to underlying groundwater. These constituents may have also migrated to the adjoining surface water bodies via surface soil runoff or discharge of contaminated shallow groundwater to surface water. However, the nature and extent of the potential environmental contamination at the D-6 Small Arms Range is not known at this time (no environmental sampling has been conducted to date).

- The CSM indicates that potentially complete exposure pathways for MC exist for human receptors under both current and hypothetical future land uses. However, potential human risks have not been characterized for receptors exposed to the potentially contaminated environmental media.

- Sampling of local surface soil, subsurface soil, drainage ditch sediments, and groundwater (and possibly drainage ditch surface water, if present) will support the laboratory analysis of these media for the MC constituents of concern. The comparison of these analytical data against relevant medium-specific regional screening levels will aid in characterizing whether there has been a release of MC to the environment from the D-6 Small Arms Range.

Soil Reference Limits and Evaluation Background Table

D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451), MCB Camp Lejeune, North Carolina

CAS Number	Chemical	ORNL Regional Residential Screening Levels[1] (mg/kg)		North Carolina Soil Screening Levels[2] (mg/kg)
Miscellaneous Parameters				
14797-73-0	Perchlorate	5.5	N	NA
Metals				
7440-36-0	Antimony	310	N	5.42
7440-38-2	Arsenic	0.39	C	26.2
7440-50-8	Copper	3100	N	704
7439-92-1	Lead	400	N	270
7440-02-0	Nickel	1600	N	56.4
7440-31-5	Tin	47000	N	NA
7440-66-6	Zinc	23000	N	550

Notes
mg/kg - milligrams per kilograms
C - Carcinogenic
N - Noncarcinogenic
ORNL - Oak Ridge National Lab
NA - Not Available

1 - Oak Ridge National Laboratory Regional Screening Levels for Chemical Contaminants at Superfund Sites, September 12, 2008. [Cancer benchmark value = 1E-06, Hazard index (HI) = 1.0].
2 - North Carolina Hazardous Waste Section Soil Screening Level Concentrations (NCDENR, 2005)

Sediment Reference Limits and Evaluation Background Table

D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451), MCB Camp Lejeune, North Carolina

CAS Number	Chemical	ORNL Regional Residential Screening Levels[1] (mg/kg)	
Miscellaneous Parameters			
14797-73-0	Perchlorate	5.5	N
Metals			
7440-36-0	Antimony	310	N
7440-38-2	Arsenic	0.39	C
7440-50-8	Copper	3100	N
7439-92-1	Lead	400	N
7440-02-0	Nickel	1600	N
7440-31-5	Tin	47000	N
7440-66-6	Zinc	23000	N

Notes
mg/kg - milligrams per kilograms
C - Carcinogenic
N - Noncarcinogenic
ORNL - Oak Ridge National Lab

1 - Oak Ridge National Laboratory Regional Screening Levels for Chemical Contaminants at Superfund Sites, September 12, 2008. [Cancer benchmark value = 1E-06, Hazard index (HI) = 1.0].

Groundwater Reference Limits and Evaluation Background Table

D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451), MCB Camp Lejeune, North Carolina

CAS Number	Chemical	ORNL Regional Screening Level[1] Tap Water (µg/L)		North Carolina Groundwater Standards[2] (µg/L)
Miscellaneous Parameters				
14797-73-0	Perchlorate	26	N	NA
Metals				
7440-36-0	Antimony	15	N	NA
7440-38-2	Arsenic	0.045	C	50
7440-50-8	Copper	1500	N	1000
7439-92-1	Lead	15	N[3]	15
7440-02-0	Nickel	730	N	100
7440-31-5	Tin	22000	N	NA
7440-66-6	Zinc	11000	N	1050

Notes

µg/L - micrograms per liter

C - Carcinogenic

N - Noncarcinogenic

NA - Not Available

1 - Oak Ridge National Laboratory Regional (ORNL) Screening Levels for Chemical Contaminants at Superfund Sites, September 12, 2008. [Cancer benchmark value = 1E-06, Hazard index (HI) = 1.0].

2 - Classification and water Quality Standards Appicable to the Groundwaters of North Carolina (NCAC, 2005).

3 - Maximum Contaminant Level (MCL).

Surface water Reference Limits and Evaluation Background Table

D-6, 50-Foot Indoor Rifle and Pistol Range (Former Building 451), MCB Camp Lejeune, North Carolina

CAS Number	Chemical	USEPA Water Quality Criteria[1] (µg/L)	North Carolina Surface Water Standards[2] (µg/L)	
Miscellaneous Parameters				
14797-73-0	Perchlorate	NA	NA	
Metals				
7440-36-0	Antimony	NA	NA	
7440-38-2	Arsenic	150	50	C
7440-50-8	Copper	9	7	N
7439-92-1	Lead	2.5	25	N
7440-02-0	Nickel	52	88	N
7440-31-5	Tin	NA	NA	
7440-66-6	Zinc	120	50	

Notes

µg/L - micrograms per liter

C - Carcinogenic

N - Noncarcinogenic

NA - Not Available

1 - National Recommended Water Quality Criteria. Chronic Freshwater Standards. (USEPA, 2006).

2 - "Redbook" Surface Waters and Wetlands Standards. Freshwater Aquatic Life Standards. (NCDENR, 2007).

Parameter	CAS	Units	Region 4 Screening Level[1]	Region 3 Screening Levels[2]		ORNL Secondary Chronic Value[3]	ECOTOX Thresholds[4]	Final Screening Level[5]	Source of Final Screening Level	Direct Contact Residential (mg/kg) Direct Contact	Minimum of Eco and ORNL tap water	Reference of Mimimum
				Freshwater	Saltwater							
ANTIMONY	7440-36-0	MG/KG	2	2				2	Reg 4	31 N	2	Reg 4
ARSENIC	7440-38-2	MG/KG	7.24	9.8	7.24		8.2	7.24	Reg 4	0.39 C	0.39	Residential SSL
COPPER	7440-50-8	MG/KG	18.7	31.6	18.7		34	18.7	Reg 4	3100 N	18.7	Reg 4
LEAD	7439-92-1	MG/KG	30.2	35.8	30.2		47	30.2	Reg 4	400	30.2	Reg 4
NICKEL	7440-02-0	MG/KG	15.9	22.7	15.9		21	15.9	Reg 4	1600 N	15.9	Reg 4
ZINC	7440-66-6	MG/KG	124	121	124		150	124	Reg 4	23000 N	124	Reg 4

1 - Region 4 Screening Levels (USEPA, 2001)
2 - Region 3 Screening Levels (USEPA, 2006)
3 - Oak Ridge National Laboratory Secondary Chronic Value (Jones et al., 1997)
4 - USEPA ECOTOX Thresholds (USEPA, 1996)
5 - Final Screening Levels were selected in the following order of preference:
  a. Region 4 screening levels (Effects Levels)
  b. Lower of freshwater or marine Region 3 screening levels
  c. Oak Ridge National Laboratory Secondary Chronic Value (Jones et al., 1997)
  d. Other sources as presented in source of screening level column

Source of Screening Level

Residential SSL - Oakridge National Laboratory Regional screening levels (September 2008)
Reg 4 FW - Region 4 Screening Level
Reg 3 FW - Region 3 Freshwater Screening Level
Reg 3 MA - Region 3 Marine Screening Level
NOAA AET - NOAA Marine Apparent Effects Threshold
NOAA FW - NOAA Freshwater Water Quality Criteria (Buchman, 2008)
NOAA MA - NOAA Marine Water Quality Criteria (Buchman, 2008)
NOAA IV - NOAA Dutch Intervention Value (Buchman, 2008)
NOAA TV - NOAA Dutch Target Value (Buchman, 2008)
Talmage - Talmage et al., (1999)
NV - No value available

APPENDIX G

EXPLOSION SAFETY SUBMISSION DETERMINATION REQUEST

UNITED STATES MARINE CORPS
MARINE CORPS SYSTEMS COMMAND
2200 LESTER STREET
QUANTICO, VA 22134

IN REPLY REFER TO:
8020
204
11Mar09

From: Commander
To: Commanding Officer, Marine Corps Base PSC Box 2004 Camp Lejeune NC 28542-0004
Via: (1) Commander U.S. Marine Corps Bases Atlantic 1775 Forrestal Drive Norfolk VA 23551-2596
(2) Commanding General Marine Corps Installations East PSC Box 20005 Camp Lejeune NC 28542-0005

Subj: EXPLOSIVES SAFETY SUBMISSION (ESS) DETERMINATION REQUEST FOR REMEDIAL INVESTIGATION ASSOCIATED WITH RANGE CLOSURE ON MARINE CORPS BASE (MCB) CAMP LEJEUNE, NC

Ref: (a) MCO 5100.29A Marine Corps Safety Program
(b) CO MCBCL ltr BEMD of 28 Jan 09
(c) NOSSAINST 8020.15B

1. Reference (a) assigns Marine Corps Environmental and Explosives Safety Program implementation responsibilities to the Commander, Marine Corps Systems Command.

2. As requested in reference (b) and in accordance with reference (c), it has been determined that the submittal of an ESS is not required for activities at D-6, 50-Foot Indoor Rifle and Pistol Range and UXO-01 (former building 451) Small Arms Training Range. This determination is based on the locations being used for small arms training only.

3. As anomaly avoidance is not required at these sites, all personnel working this project will have a UXO brief and be instructed in procedures to follow if MEC is located

4. The point of contact at this Command is Mr. James Taylor, Marine Corps Systems Command, Program Manager for Ammunition, Environmental and Explosives Safety Team, DSN 378-4824, Email james.t.taylor1@usmc.mil

MAZZA.JERRY.L.

Digitally

Signed on 3/11/2009 Cert# 1027937086
JERRY L. MAZZA
By direction

Copy to: MCIE (ESO); MCBL (ESO); MCBL (ENV); HQMC LFL (I&L)

UNITED STATES MARINE CORPS
U.S. MARINE CORPS BASES ATLANTIC
1775 Forrestal Drive
NORFOLK, VIRGINIA 23551-2596

8020
DSS/ESO
19 Feb 2009

SECOND ENDORSEMENT on CO MCB CLNC LTR 5090.21 BEMD of 28 Jan 09

From: Commander, U.S. Marine Corps Bases Atlantic
To: Department of Defense Explosive Safety Board 2461 Eisenhower Avenue, Alexandria, VA 22331-0600
Via: (1) Commander, Marine Corps Systems Command,(Code 204) 2200 Lester Street, Quantico, VA 22134-6010

Subj: EXPLOSIVE SAFETY SUBMISSION (ESS) DETERMINATION REQUEST FOR REMEDIAL INVESTIGATIONS ASSOCIATED WITH RANGE CLOSURE ON MARINE CORPS BASE MCB), CAMP LEJEUNE, N.C.

1. Forwarded with concurrence and for continuing review.

2. Point of contact for Marine Corps Bases Atlantic is Mr Marvin Rahman (ESO) 757-836-2188.

J. C. HUNT
By direction

Copy to:
CNO (N411)
NOSSA (NOOM5)
NOSSA ESSOLANT
COMMARFORCOM (G4/FAC)
MCI EAST (ESO)
By Dir File

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS EAST
PSC BOX 20005
CAMP LEJEUNE, NC 28542-0005

IN REPLY REFER TO:
8020
ESO/2
10 Feb 09

FIRST ENDORSEMENT on CO MCB CamLej ltr 5090.21 BEMD of 28 Jan 09

From: Commanding General, Marine Corps Installations East, Camp Lejeune
To: Department of Defense Explosives Safety Board 2461 Eisenhower Avenue, Alexandria, VA 22331-0600
Via: (1) Commander, U.S. Marine Corps Bases Atlantic, (DSS/ESO), 1775 Forrestal Drive, Norfolk, VA 23551
(2) Commander, Marine Corps Systems Command, (Code 204), 2200 Lester Street, Quantico, VA 22134-6010

Subj: EXPLOSIVE SAFETY SUBMISSION (ESS) DETERMINATION REQUEST FOR REMEDIAL INVESTIGATION ASSOCIATED WITH RANGE CLOSURE ON MARINE CORPS BASE (MCB), CAMP LEJEUNE

1. Forwarded with concurrence and for continuing review.

2. Point of contact for Marine Corps Installations East, Explosives Safety Office is CWO2 J.J. Luce at (910) 451-6281 or (910) 554-9175.

T. G. BARTON
By direction

UNITED STATES MARINE CORPS
MARINE CORPS BASE
PSC BOX 20004
CAMP LEJEUNE, NC 28542-0004

IN REPLY REFER TO:
5090.21
BEMD
JAN 2 8 2009

From: Commanding Officer, Marine Corps Base, Camp Lejeune
To: Department of Defense Explosives Safety Board (DDESB)
2461 Eisenhower Avenue, Alexandria, Virginia 22331-0600
Via: (1) Commanding General, Marine Corps Installations East (ESO), PSC Box 20005, Camp Lejeune, NC 28542-0005
(2) Commander, U.S. Marine Corps Bases Atlantic, (DSS/ESO) 1775 Forrestal Drive, Norfolk, Virginia 23551
(3) Commander, Marine Corps Systems Command (Mr. Taylor Code 204), 2200 Lester Street, Quantico, Virginia 22134-6010

Subj: EXPLOSIVE SAFETY SUBMISSION (ESS) DETERMINATION REQUEST FOR REMEDIAL INVESTIGATION ASSOCIATED WITH RANGE CLOSURE ON MARINE CORPS BASE (MCB), CAMP LEJEUNE

Ref: (a) OPNAVINST 8020.15/MCO 8020.13
(b) NOSSAINST 8020.15
(c) DoD Directive 6055.9
(d) DoD 6055.9-STD
(e) OP 5 Vol. 1
(f) NAVFACINST 11010.45

Encl: (1) ESS Determination form for Former Live Fire Range D-6, 50-Foot Indoor Rifle and Pistol Range (UXO-01), ASR #2.64

1. In accordance with references (a) through (f), and to ensure the protection of human health and the environment, the attached ESS determination form for the former range is submitted for your approval. It is understood that this range may require a full ESS based on the types of munitions known to be used at the range.

2. If you have questions or comments, please contact Mr. Robert Lowder, Environmental Quality Branch, Environmental Management Division, Installations and Environment Department, at 910-451-9607.

John R. Townson

JOHN R. TOWNSON
By direction

Subj: EXPLOSIVE SAFETY SUBMISSION (ESS) DETERMINATION REQUEST FOR REMEDIAL INVESTIGATIONS ASSOCIATED WITH RANGE CLOSURE ON MCB, CAMP LEJEUNE

Copy to:
HQMC LFL-6 (Mr. Sakai)
NAVFACENGCOM (Mr. Tysor)

REQUEST FOR A NOSSA EXPLOSIVES SAFETY SUBMISSION DETERMINATION

Instructions for use:

The responsible project manager may request a NOSSA N5 determination that an ESS is not required by completing and submitting this form. A blank copy (as a Word document) may be downloaded at https://intranet.nossa.navsea.navy.mil.

MRS identifier: Activity, City and State	Munitions Response Program (MRP) site: D-6, 50-Foot Indoor Rifle and Pistol Range – UXO-01 (Former Building 451) MCB Camp Lejeune North Carolina	Date submitted:	January 16, 2009
Responsible project manager: Name, activity, and contact information	Bryan Beck NAVFAC Mid-Atlantic Marine Corps NC IPT 6506 Hampton Boulevard Norfolk, Virginia 23508 (757) 322-4734 bryan.beck@navy.mil	EOD/UXO technical support: Contact information	Ralph Brooks UXO Program Manager Tetra Tech, Inc. 2171 West Park Ct, Ste E Stone Mountain, GA 30087 (770) 413-0965 Ext 231 ralph.brooks@tetratech.com

Site history: Briefly describe past site use; discuss why MEC are known or suspected to be present

MCB Camp Lejeune covers approximately 236 square miles and is located in Onslow County, North Carolina, approximately 47 miles north of Wilmington. Construction of MCB Camp Lejeune began in 1941 and the facility currently hosts several Marine Corps commands and one Navy Command. One "other than operable range" identified as D-6, 50-Foot Indoor Rifle and Pistol Range – UXO-01 (Former Building 451), has been selected for further evaluation under a Site Inspection (SI). A brief description of the site follows.

D-6, 50-Foot Indoor Rifle and Pistol Range, Site UXO-01 (Former Building 451): Building 451 consisted of metal sheeting on a steel frame (Butler Building) and measured 120 feet 6-inches long by 40-feet wide. The attached figure identifies the site location and approximate footprint of the Former Building 451.

The building was constructed in November 1952 as a small arms training range and was in use through approximately early 1998. The building was demolished in December 1998. The range consisted of eight firing lanes and accommodated target practice at 50-foot and 75-foot firing distances from the targets. Small arms ammunition was fired downrange into a bullet trap consisting of a series of angled steel plates and a sand pit. No records documenting the handling or management of the expended bullets or bullet fragments in the bullet trap sand have been located.

MEC encountered or believed to be present: Quantity, type/nomenclature, and condition

D-6, 50-Foot Indoor Rifle and Pistol Range, Site UXO-01 (Former Building 451): Facility records and interview findings indicate that this range was used exclusively for small arms training. Although the specific ammunition types used at the range are not known, only small bore weapons were authorized. There was no evidence of the presence of MEC/MPPEH or related debris during the site walk conducted in September 2008.

Munitions constituents (MC), if present, may be associated with the previous use of the location for small-bore rifle and pistol target training inside a building that was demolished and removed from the site in 1998.

Proposed operation: Describe on-call construction support, anomaly avoidance activities, or other proposed actions; identify if operation is encumbered by existing ESQD arc

D-6, 50-Foot Indoor Rifle and Pistol Range – UXO-01 (Former Building 451) was first identified in the "*Final Range Identification and Preliminary Range Assessment Report Marine Corps Base Camp Lejeune*," prepared by the USACE-St. Louis District (December 2001). A Site Inspection (SI) has been initiated for Site UXO-01 with SI field work currently scheduled to begin in April 2009. The objectives of the SI are as follows:

- To collect adequate data to delineate the horizontal and vertical extent of potential MC contamination in soil and drainage ditch sediment.
- To determine whether small arms ammunition MC (antimony, arsenic, lead, copper, tin, and zinc) are present in study area soil and drainage ditch sediment at concentrations that represent unacceptable human health or ecological risk.
- To determine whether MC (antimony, arsenic, lead, copper, tin, and zinc) are present in study area soil at concentrations that represent a threat to groundwater quality.
- To update the Conceptual Site Model (CSM) using field reconnaissance survey data, field and laboratory analytical data, and initial hazard and risk screening results.

Proposed SI field operations include field screening and sampling of surface soil and sediment, and limited subsurface soil and groundwater sample collection.

- X-ray fluorescence (XRF) sampling program will be used to screen, focus, and delineate the potential extent of lead concentrations in local soil and sediment.
- Sample locations will be surveyed and marked with wooden stakes or pin flags;
- Surface soil and sediment samples collected with hand tools for laboratory analysis for correlation with XRF field data and to support risk screening.
- Performance of subsurface soil and groundwater sample collection with direct push technology (DPT) from proposed soil borings up to approximately 6 to 8 feet below ground surface (bgs)

No anomaly avoidance activities or UXO Escort procedures are required for this site.

The site is not encumbered by an existing ESQD arc.

Risk Assessment Code from page 2:[1]

The potential risk at this site has been determined to be **negligible (5)** based on a risk assessment included as an attachment to this Explosive Safety Submission (ESS) waiver request.

Risk/hazard assessment. In accordance with OPNAVINST 3500.39, Operational Risk Management (ORM), Department of Navy activities must incorporate the principles of ORM into all phases of planning, operations, and training. This includes munitions response actions taken by the Department of Navy and its contractors. Since determining an ESS is not required carries with it inherent risks, the responsible project manager submitting this request must evaluate those risks using facts, prudence, experience, judgment, and situational awareness. Together with OPNAVINST 3500.39, the table below can serve as a tool in determining the overall risk. Transcribe the Risk Assessment Code to the page 1 of this enclosure.

[1] *Note: NOSSA will only consider determining that an ESS is not required when the Risk Assessment Codes are 4 (minor) or 5 (negligible).*

		Mishap Probability[2]			
		A	**B**	**C**	**D**
Hazard Severity[3]	**I**	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	3	4	5	5

Mishap Probability[2]:	Hazard Severity[3]:	Risk Assessment Codes:
A Likely to occur immediately **B** Probably will occur in time **C** May occur in time **D** Unlikely to occur	**I** May cause death **II** May cause severe injury **III** May cause minor injury **IV** Presents a minimal threat	**1** Critical } High **2** Serious } High **3** Moderate **4** Minor } Low **5** Negligible } Low

Enclose page 1 of this request in a letter or memo, or attach it to a digitally signed e-mail, and send to:

- Mail: COMMANDING OFFICER
  NAVAL ORDNANCE SAFETY AND SECURITY ACTIVITY
  ATTN: CODE N53
  23 STRAUSS AVE, BLDG D327
  INDIAN HEAD, MD 20640-5555
- Fax: 301-744-6749 (DSN 354

E-mail: (call 301-744-4450 to obtain an e-mail address)

[2] "Mishap Probability" is the probability that a hazard will result in a mishap or loss, based on an assessment of such factors as location exposure, affected populations, experience, or previously established statistical information.

[3] "Hazard Severity" is an assessment of the worst credible consequence that can occur as a result of a hazard. Severity is defined by potential degree of injury, illness, property damage, loss of assets, or effect on mission. The combination of two or more hazards may increase the overall level of risk. For the munitions encountered or believed to be present, consider the munitions and fuzing type and configuration, and its armed/unarmed status.

Risk/Hazard Assessment:

Prepared by: Jeff Fournier, Tetra Tech NUS, Inc., UXO Project Manager

Date: January 9, 2009

Task: **Background:** Tetra Tech NUS, Inc. will perform SI activities at Site UXO-01, MCB Camp Lejeune, North Carolina for NAVFAC Mid-Atlantic. The SI activities will include XRF surveying and field sampling of soil and groundwater to identify potential MC contamination. See the Site History section in the attached Waiver Request for additional details and references.

Based on the historic use of D-6, 50-Foot Indoor Rifle and Pistol Range – UXO-01 (Former Building 451) as a small arms training range, facility records, and interview findings, it is not likely that MEC will be present at the site. A Risk Assessment was conducted in accordance with OPNAVINST 3500.39B Operational Risk Management and Management Guidance for the Defense Environmental Restoration Program dated July 30, 2004. The recommended Risk Assessment Code (RAC) for this site is **RAC 5 – Negligible**. A review of the risk evaluation process is provided in the following paragraphs.

Hazard Severity assessment of the worst credible consequence that can occur as a result of the hazard posed by accidental explosion of reactive material was judged to be a **"Category IV" – hazard presents minimal threat.**

This determination was based on the assumption that no MEC is expected to be encountered during the April 2009 SI activities.

Mishap Probability that a hazard will result in a mishap or loss for this site is recommended to be **"Category D" – unlikely to occur.**

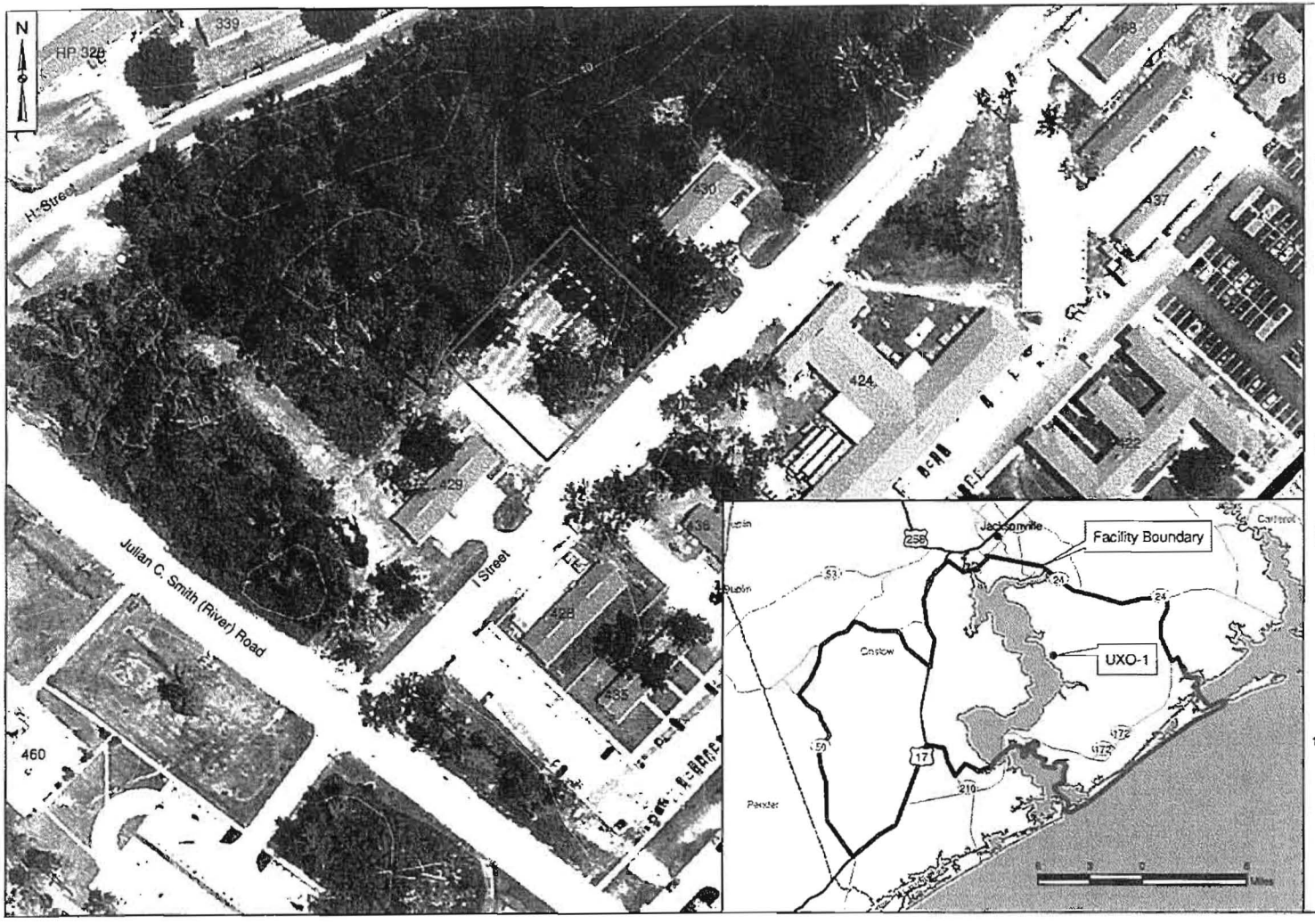
To date, there have been no reports of accidents occurring as a result of MEC/MPPEH at this site nor have any suspect MEC/MPPEH been reported to be found. The RAC Matrix results in a RAC of "5" – **Negligible** – for the combination of Hazard Severity and Mishap Probability categories recommended above.

		Mishap Probability[4]			
		A	B	C	D
Hazard Severity[5]	I	1	1	2	3
	II	1	2	3	4
	III	2	3	4	5
	IV	3	4	5	5

Mishap Probability[4]:	Hazard Severity[5]:	Risk Assessment Codes:
A Likely to occur immediately B Probably will occur in time C May occur in time D Unlikely to occur	I May cause death II May cause severe injury III May cause minor injury IV Presents a minimal threat	1 Critical 2 Serious 3 Moderate 4 Minor 5 Negligible

[4] "Mishap Probability" is the probability that a hazard will result in a mishap or loss, based on an assessment of such factors as location exposure, affected populations, experience, or previously established statistical information.

[5] "Hazard Severity" is an assessment of the worst credible consequence that can occur as a result of a hazard. Severity is defined by potential degree of injury, illness, property damage, loss of assets, or effect on mission. The combination of two or more hazards may increase the overall level of risk. For the munitions encountered or believed to be present, consider the munitions and fuzing type and configuration, and its armed/unarmed status.



TETRA TECH

Figure 1
Site UXO-1; D-6
50-Foot Indoor Rifle and Pistol Range
(Former Building 451)
Marine Corps Base Camp Lejeune
Onslow County, North Carolina

Legend

Topographic Contour (2 ft)

Proposed MRP Site Boundary

Former Location of UXO-1; D-6, 50-Foot Indoor Rifle and Pistol Range (Building 451)

Natural Color Digital Image
Dated May 1999 (0.15m/pixel resolution)

NOTE: Digital Image provided by Camp Lejeune Installation Geospatial and Information Service (IGI&S), East Coast Regional GEOFideis (Geospatial) Center

100 50 0 100 Feet

Drawn By: K. MOORE 10/22/08
Checked By: R. BARRINGER 1/15/09
Approved By:

Project Number: 112G01716
CTO 0153

P:\GIS\CAMP_LEJEUNE\MRP\MRP_SITE_UXO_1\UXO_1\1509.MXD