APPENDIX D

MASTER QUALITY ASSURANCE PROJECT PLAN

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Range Sustainability Environmental Program Assessment
Policy Implementation Manual
Attachment D

MASTER QUALITY ASSURANCE PROJECT PLAN

for

SAMPLING and TESTING
at
OPERATIONAL RANGES

FINAL Revision 0: December 2003

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TABLE of CONTENTS

List of Attachments

List of Figures

List of Tables

Title and Approval Page

Master Quality Assurance Program Plan for Sampling and Testing Operational Ranges
Document Title

CNO N45 **Wanda Holmes**
Lead Organization Contact Person

Jackie H. Sample, CNO N45/NAVSEA Laboratory Quality and Accreditation Office
Preparer's Name and Organizational Affiliation

1661 Redbank Rd. Suite 104 Charleston, SC 29445-6511 / 843-764-7337 x11
Preparer's Address /Telephone Number

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Approval Signatures: _____
Wanda Holmes – Program Manager Signature/Date

_____
Jackie H. Sample – RSEPA Program Quality Assurance Officer Signature/Date

Document Revision List

Revision	Date	Reason for Revision
Revision 0	December 2003	

EXECUTIVE SUMMARY

This document, the *Master Quality Assurance Project Plan for Sampling and Testing at Operational Ranges* (Master QAPP), provides a Navy-wide strategy for assessing off-range environmental impacts at land-based operational ranges. It describes environmental data collection and quality assurance objectives and procedures pertaining to Navy's Range Sustainability Environmental Program Assessment (RSEPA). The goals of RSEPA are to:

1. Ensure compliance with environmental regulations so that Navy will be able to sustain adequate training capacity for operational readiness, now and in the future, and
2. Identify, prioritize, and manage off-range environmental impacts per DoD Directive 4715.11, *Environmental and Explosives Safety Management on Department of Defense Active and Inactive Ranges within the United States,* 17 August 1999.

Before using this document, readers should become familiar with the RSEPA process, which is described in the front section of this manual.

This Master QAPP was developed according to the *Final Uniform Federal Policy for Implementing Environmental Quality Systems,* July 2002, and the *Draft Uniform Federal Policy for Quality Assurance Project Plans*, August 2003, prepared by the Intergovernmental Data Quality Task Force (IDQTF), a federal consensus organization.[1] It also meets the requirements of the national standard, ANSI/ASQC E4, *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*, which is referenced in the Federal Acquisition Regulations as an appropriate, high-level quality system requirement.

Purpose

This Master QAPP serves as a Navy-wide 'umbrella' document for which multiple, range-specific data collection efforts may be conducted under RSEPA. It provides the requirements that apply to environmental sampling and testing activities conducted at all operational ranges, ensuring that these activities will be performed in a *consistent and cost-effective* manner. Range-specific requirements must be developed and documented in range-specific QAPPs. This Master QAPP provides worksheets and instructions to guide the development of range-specific QAPPs.

Scope

The RSEPA process focuses on operational ranges that are the sites of either current or potential future training exercises. Operational ranges include both active and inactive ranges. The presence of munitions constituents within live impact areas (LIAs) on ranges is to be expected, and characterization of environmental effects **within the LIAs** is outside the scope

[1] The U.S. Environmental Protection Agency established the Intergovernmental Data Quality Task Force (IDQTF), chaired by the Director, Federal Facilities Restoration and Reuse Office (FFRRO) to address environmental data quality issues across governmental organizations. The IDQTF operates as a partnership, reaching decisions through consensus. While membership in IDQTF is open to any federal agency/department, current consensus members include representatives from the Department of Defense, the Department of Energy, and the U.S. Environmental Protection Agency.

of RSEPA. This Master QAPP supports RSEPA data collection efforts to determine if munitions constituents are migrating, or have the potential to migrate, to off-range environmental receptors.

RSEPA comprises three primary parts plus protective measures: the Range Condition Assessment (RCA), the Comprehensive Range Evaluation (CRE), and Sustainable Range Oversight (SRO). The RCA and CRE are conducted in multiple phases and include decision points. The RCA is based on existing data; environmental sampling and testing will be conducted during the CRE, if performed. This Master QAPP describes required data collection activities for the CRE Phase I, Preliminary Screening, and the CRE Phase II, Verification Analysis.

Key Requirements for Sampling, Testing, and Quality Assurance

This document promotes innovative quality systems tools and concepts to streamline project implementation, including:

1. Use of Operational Range Site Models (ORSMs), a specific type of Conceptual Site Model (CSM), to facilitate communication and decision-making.
2. Use of innovative technology (as promoted by the EPA/Technology Innovation Office Triad Approach) to streamline data acquisition. The Triad Approach incorporates the following steps:
   - o Systematic planning
   - o Field analytical technologies
   - o Dynamic work plans
3. Implementation of the *Uniform Federal Policy for Implementing Environmental Quality Systems* (UFP-QS) and the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP).
4. Implementation of laboratory quality systems based on the *DoD Quality Systems Manual for Environmental Laboratories* (DoD QSM).
5. Use of "marker compounds" to evaluate migration of munitions compounds to off-range receptors.
6. Use of standard electronic data formats that support Public Law 106-554 (Ensuring the Quality of Information Disseminated to the Public by Federal Agencies) by promoting efficient data transfer, storage, and retrieval.

Use of this document does not relieve any program participant from the responsibility of complying with contract requirements or with applicable federal, state, or local regulations. CNO N45 should be notified of substantive technical conflicts between this document and other applicable requirements. The CNO N45 point of contact is Ms. Wanda Holmes.

LIST OF ABREVIATIONS AND ACRONYMS

A2LA ..... American Association for Laboratory Accreditation
ANSI ..... American National Standards Institute
ASQC ..... American Society of Quality Control
CA..... corrective action
CAS No..... Chemical Abstracts Registry Number
CCC ..... criteria continuous concentration
CMC ..... criteria maximum concentration
CNO ..... Chief of Naval Operations
CRREL ..... U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory
CSM ..... Conceptual Site Model
DoD QSM..... *DoD Quality Systems Manual for Environmental Laboratories*
DoD ..... Department of Defense
DQI ..... data quality indicator
DQOs ..... data quality objectives
EDQW ..... Environmental Data Quality Workgroup
EOD ..... Explosive Ordnance Disposal
EPA ..... Environmental Protection Agency
EPA/TIO ..... Environmental Protection Agency/Technology Innovation Office
FUDS..... formerly used defense sites
GC-ECD ..... gas chromatography–electron capture detector
HMX 1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC ..... high performance liquid chromatography
HPLC/MS ..... high performance liquid chromatography–mass spectrometry
HPLC-DAD/UV high performance liquid chromatography–diode array detector/ultraviolet
IDQTF ..... Intergovernmental Data Quality Task Force
IEC..... International Electrotechnical Commission
IR ..... installation restoration
ISO ..... International Organization for Standardization
LFB ..... laboratory fortified blank
LIA..... live impact area
LOAEL ..... lowest observed adverse effect level
MDL ..... method detection limit
MPCs..... measurement performance criteria
MRL ..... method reporting limit
MQO ..... measurement quality objectives
MS ..... matrix spike
MSD ..... matrix spike duplicate
Navy IRCDQM.. *Navy Installation Restoration Chemical Data Quality Manual*
NELAP ..... National Environmental Laboratory Accreditation Program
OB/OD ..... open burning/open detonation
OMB..... Office of Management and Budget
ORSM..... Operational Range Site Model
PBMS ..... performance-based measurement system
PM ..... Project Manager
PT..... proficiency testing

QA ..... quality assurance
QAO ..... Quality Assurance Officer
QAPP..... Quality Assurance Project Plan
QC ..... quality control
QL..... quantitation limit
RCA..... range condition assessment
RDX hexahydro-1,3,5-trinitro-1,3,5-triazine
RE..... range evaluation
RPD..... relative percent difference
RPM ..... Regional Project Manager
RSEPA ..... Range Sustainability Environmental Program Assessments
RSO ..... Range Safety Officer
SOP..... standard operating procedure
SPP ..... systematic planning process
TAT..... turnaround time
TNT..... 2,4,6-trinitrotoluene
UFP-QAPP..... *Uniform Federal Policy for Quality Assurance Project Plans*
UFP-QS..... *Uniform Federal Policy for Implementing Environmental Quality Systems*
USACHPPM ..... U.S. Army Center for Health Promotion and Preventive Medicine
USAEC..... U.S. Army Environmental Center
UXO ..... unexploded ordnance
VSP-RSM ..... Visual Sample Plan – Range Sustainability Module

SECTION 1
INTRODUCTION/PROJECT DESCRIPTION

This Master Quality Assurance Project Plan (Master QAPP) describes sampling, testing, and quality assurance requirements and procedures pertaining to Navy's Range Sustainability Environmental Program Assessment (RSEPA). When deemed necessary by Navy, RSEPA includes plans to conduct Comprehensive Range Evaluations (CREs), involving environmental sampling and testing, at selected operational, land-based ranges.

This Master QAPP provides guidance for sampling and testing activities and has the following objectives:

- Ensure cost-effective and consistent approaches to environmental data collection activities, and
- Ensure that collected data are of the quality necessary to support decision-making during the CRE.

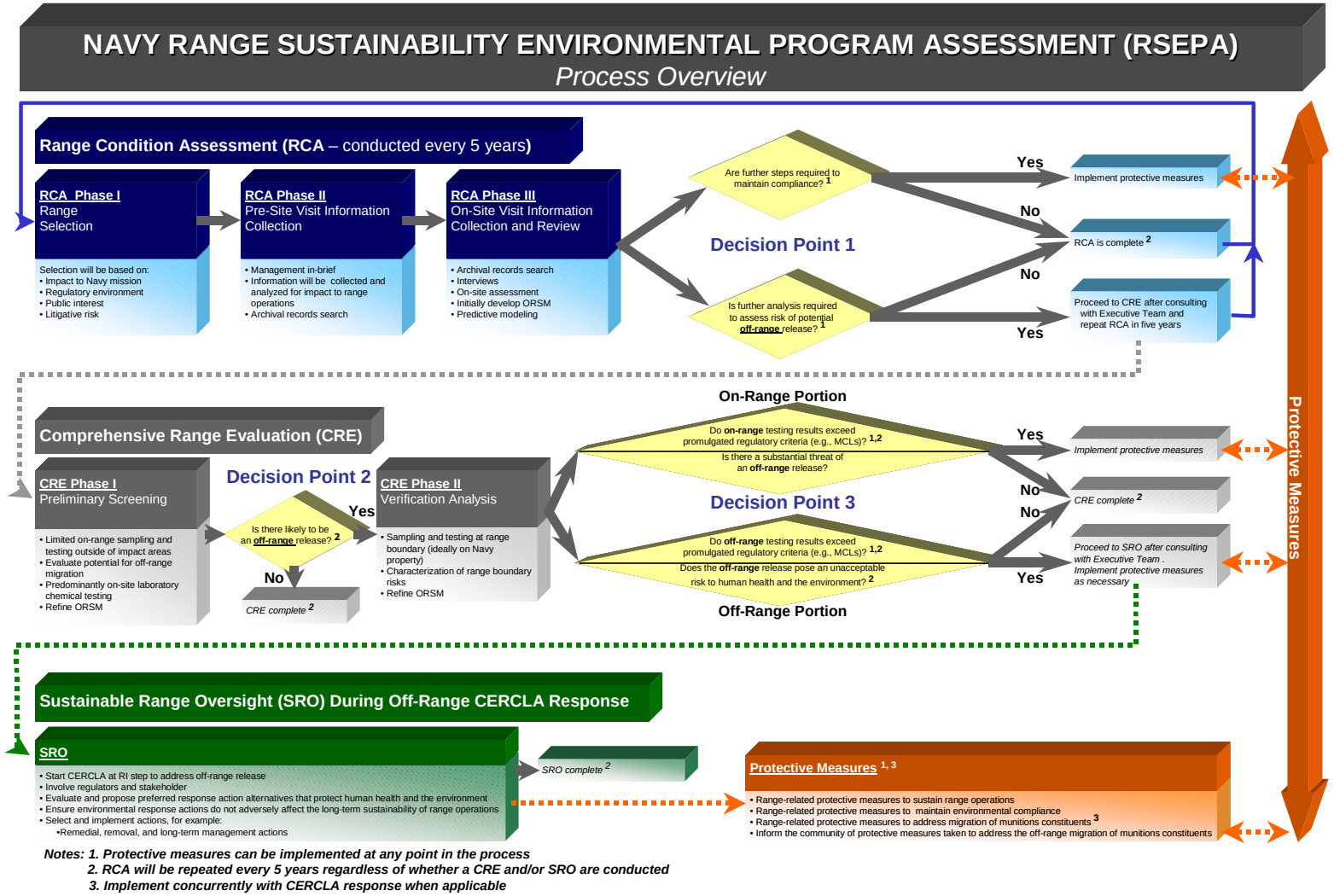
This document provides the overall data quality objectives (DQOs) that will apply to environmental sampling and testing conducted during the CRE. Additional range-specific information and data collection requirements must be documented in range-specific QAPPs. Section 7 of this Master QAPP provides worksheets to guide the development of range-specific QAPPs.

1.1 Navy RSEPA – Overview

Navy must comply with numerous state and federal environmental requirements at its facilities. Regulators and public interest groups are becoming increasingly concerned about the possibility of off-range human health and ecological impacts associated with the management and use of DoD ranges. The Navy operational community is concerned that increased environmental restrictions on DoD ranges may significantly alter the thoroughness and effectiveness by which Navy will be able to prepare for its defense-related mission.

Furthermore, DoD Directive 4715.11 requires that DoD Components, consistent with DoD's explosives safety authority, "respond to releases or substantial threats of release of munitions constituents from operational ranges to off-range areas when such a release poses an imminent and substantial threat to human health or the environment."

At present, DoD does not believe that any significant off-range environmental impacts result from long-term range operations; however, under RSEPA, Navy is taking steps to evaluate and document off-range environmental impacts. The RSEPA process is shown in Figure 1.1 and discussed below.



Notes: 1. Protective measures can be implemented at any point in the process
2. RCA will be repeated every 5 years regardless of whether a CRE and/or SRO are conducted
3. Implement concurrently with CERCLA response when applicable

Figure 1.1 - RSEPA Process

RANGE CONDITION ASSESSMENT

The Range Condition Assessment (RCA) is a recurring process that will be conducted every five years at each operational, land-based range. The goals of the RCA are to determine if further steps are necessary to maintain environmental compliance and/or determine if further analysis is required to assess the risk of an off-range release. During the RCA, Navy will identify and review applicable regulatory requirements and range environmental conditions. This includes identifying range operations and management practices, past or present, that have the potential to result in adverse environmental impacts. The RCA involves the following activities:

RCA Phase I:	Range Site Selection
RCA Phase II:	Pre-Site Visit Information Collection
RCA Phase III:	On-Site Visit information Collection and Review

COMPREHENSIVE RANGE EVALUATION

The Comprehensive Range Evaluation (CRE) involves studies to further characterize human health and/or environmental risks from potential off-range releases identified during the RCA. Studies may involve environmental sampling, testing, data evaluation, and modeling. The CRE includes the following activities:

CRE Phase I:	Preliminary Screening
CRE Phase II:	Verification Analysis

Sampling and testing activities, if necessary, will occur during the Preliminary Screening (CRE Phase I) and the Verification Analysis (CRE Phase II). The results or output of the data collected during the Preliminary Screening will determine the need for additional, focused sampling and testing during a Verification Analysis. Protective measures to address potential releases may be implemented at any time during the CRE.

1.2 Scope and Application

The Preliminary Screening (CRE Phase I) and Verification Analyses (CRE Phase II), will include the assessment of soil, sediment, surface water, and groundwater as necessary to evaluate the presence of munitions constituents (including perchlorate) and the potential for these constituents to migrate to off-range receptors. A key concern could be the evaluation of the groundwater pathway for the off-range migration. Studies conducted by the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (ERDC/CRREL TR-02-1, 2002) have shown 1) that munitions residues are found close to firing points and at sites where low-order detonations have occurred, and 2) that explosives residues (including explosives degradation products) are only transported through soil once they are dissolved in water. For this reason, only direct, non-biogenic, physical transport mechanisms will be evaluated during RSEPA, with an emphasis on surface water and groundwater flow. This Master QAPP does not address the air pathway as a direct (inhalation) exposure route; therefore, it does not address air sampling. The air pathway is considered only as a means of particulate (soil) deposition. Navy is not planning to conduct routine sampling and testing for metals; however, sampling and testing for metals may be conducted during the CRE if warranted based on range-specific data quality objectives (DQOs).

This document is not a training manual. The development of range-specific QAPPs requires prior training and experience in both using the systematic planning process (SPP) and preparing and implementing QAPPs. Furthermore, consistent with Navy policy (OPNAVINST 5090.1B CH-2, Chapter 25), environmental sampling and testing must be performed by persons who are appropriately qualified.

1.3 Key Requirements

Navy, as both lead service for the DoD Environmental Data Quality Workgroup (EDQW) and DoD voting member of the Intergovernmental Data Quality Task Force (IDQTF), is actively supporting intergovernmental "streamlining" initiatives, endorsed by the U.S. Environmental Protection Agency (EPA) to improve the quality and cost-effectiveness of environmental data collection. The EPA "supports the adoption of streamlined approaches to sampling, analysis, and data management activities conducted during site assessment, characterization, and cleanup" (EPA-542-F-01-030a, April 2001). This document explains the use of streamlining tools and concepts, which include the following:

1. Use of an Operational Range Site Model (ORSM) (a specific type of Conceptual Site Model) to facilitate information transfer, communication, and decision-making

The ORSM is an information management tool, based in a Geographic Information System (GIS) that organizes what is already known about a range and helps the RSEPA Technical Team and Management Team with project planning, data analysis, information transfer, and decision-making. It consists of maps, diagrams, text, and tabular data that collectively describe and display range operational information, expected sources of munitions constituents, actual or potential munitions constituent migration pathways, exposure routes, and potential human and ecological receptors. Development of the ORSM begins during the RCA, to help focus the remainder of the RSEPA process. It is continually refined as information is gathered; therefore, it depicts an up-to-date understanding of environmental conditions at a range and helps guide further investigations (if performed).

Outputs from the ORSM, in the form of digitized maps, can be used as input to determine the sampling designs for the CRE Phase I Preliminary Screening, using tools such as Visual Sample Plan – Range Sustainability Module (VSP-RSM) or other similar tools. [Guidance on developing ORSMs is contained in Appendix C of the RSEPA Policy Implementation Manual.]

2. Use of marker compounds to evaluate migration of munitions constituents

Section 3.2 describes the target analytes and other field parameters that may be measured during the Preliminary Screening. During the Preliminary Screening, all soil and sediment samples analyzed on site will be analyzed for the marker compounds hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), and 2,4,6-trinitrotoluene (TNT). [Section 3 and Attachment A explain the basis

for selection of the marker compounds.] If water samples are collected or if soil/sediment samples are analyzed at a fixed laboratory, then the target analytes will include all munitions constituents listed in Table 3-1. This is being done to verify information provided by the marker compounds and further validate this approach.

Samples collected during the Verification Analysis will be analyzed for range-specific munitions constituents, which should include munitions constituents listed on Table 3-1.

3. Use of Innovative Technology (as promoted by the Environmental Protection Agency/Technology Innovation Office (EPA/TIO) Triad Approach) to streamline data acquisition, including:
    a. Systematic planning process (SPP) to generate data quality objectives (DQOs)
    b. On-site analytical tools and on-site data interpretation and management
    c. Dynamic work plans

a. Systematic Planning Process - This Master QAPP explains the use of the systematic planning process to generate range-specific DQOs: statements that define the type, quality, and quantity of data required to answer specific environmental questions and support environmental decision-making for RSEPA. Section 3 of this Master QAPP provides program-wide DQOs for the CRE Phase I Preliminary Screening. The assessment of data from the Preliminary Screening will determine the need for sampling and testing in the CRE Phase II Verification Analyses. If a Verification Analysis is required, then the RSEPA Technical Team will conduct the systematic planning process to develop range-specific DQOs for the evaluation of applicable exposure pathways. Section 3 of this Master QAPP provides additional guidance on developing Verification Analysis DQOs.

b. On-site analytical tools and on-site data interpretation and analysis –Both the Preliminary Screening and the Verification Analysis can employ a combination of field and fixed-laboratory analytical technologies for the determination of munitions constituents in environmental media. On-site analysis and data interpretation permit decision-making in the field.

Methods to be used for range-specific studies will be based on project-specific DQOs and cost considerations. For example, on-site field analytical testing, supported by the selective use of fixed-laboratory testing may be cost effective for studies involving the collection of a large number of samples. Conversely, if a study involves the collection of only a few samples at a small range, the field analytical mobilization costs could be prohibitive, making it more cost effective to use only fixed-laboratory analyses. Section 3 discusses analytical method considerations.

c. Dynamic Work Plans – Dynamic work plans describe a flexible approach that is used in the field to determine how subsequent data collection activities should proceed. Dynamic work plans use a decision tree to guide project teams in making decisions about where to sample next, how many samples to collect, and when sampling can be stopped. The ability to execute a dynamic work plan requires both analytical capability and experienced staff with sampling decision authority in the field. As analytical results

are generated in the field, the information is used to continually update the ORSM. The ORSM facilitates data interpretation, allowing the project team to adapt the sampling and testing program as necessary while the field crew is still on site, thus avoiding multiple field mobilization efforts. Recently developed field-based technologies and computer-aided decision tools, such as the Visual Sample Plan – Range Sustainability Module (VSP-RSM) support the implementation of dynamic work plans by facilitating field decision-making. (Section 4 describes the use of VSP-RSM).

4. Implementation of the *Uniform Federal Policy for Implementing Environmental Quality Systems* (UFP-QS) and the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP).

Together, these documents explain essential quality system elements for environmental data collection efforts performed by federal agencies. The documents were developed under joint initiatives involving DoD, the Department of Energy (DOE), and EPA to ensure that:

- Environmental data are of known and documented quality, suitable for their intended uses,
- Environmental data collection and technology programs meet applicable requirements, and
- Federal agencies achieve consistency across all regions with respect to acceptable minimum quality assurance requirements.

The RSEPA Technical Team will comply with the terms of the UFP-QS. Range-specific QAPPs prepared according to this Master QAPP will comply with the UFP-QAPP.

5. Implementation of laboratory quality systems based on the *DoD Quality Systems Manual for Environmental Laboratories* (DoD QSM)[1]

Laboratories performing analyses in support of RSEPA must have an established and documented laboratory quality system that complies with the DoD QSM[1] (a copy may be downloaded from www.navylabs.navy.mil). Laboratories also must be accredited for *the applicable test method(s*), in accordance with ISO/IEC Guide 25 (being replaced by ISO 17025), by a state or nationally recognized, laboratory accreditation body (e.g., American Association for Laboratory Accreditation (A2LA) or National Environmental Laboratory Accreditation Program (NELAP). In addition, laboratory analyses must be conducted at a laboratory that has received an acceptable report or approval from an on-site laboratory assessment by one or more DoD Components. Navy will grant limited laboratory approval to laboratories, for the purpose of providing analytical services under RSEPA, once these requirements have been met. All laboratories must provide proof that they can meet the project-specific reporting limits and are capable of generating acceptable results from the analysis of proficiency-testing (PT) samples using the specified methods in the specified matrices.

[1] *Department Of Defense Quality Systems Manual For Environmental Laboratories*. Prepared By DoD Environmental Data Quality Workgroup, Department of Navy, Lead Service, Final Version 2. June 2002

6. Use of information management tools that support compliance with Public Law 106-554, as implemented by Deputy Secretary of Defense Memorandum *Ensuring Quality of Information Disseminated to the Public by the Department of Defense,* 10 February 2003

Public Law 106-554 directed the Office of Management and Budget (OMB) to issue guidelines to federal agencies for "ensuring and maximizing the quality, objectivity, utility, and integrity of information distributed by federal agencies. The subsequently issued OMB guidelines *(Federal Register*, January 3, 2002) require that agencies develop procedures to review and substantiate the quality of information before it is disseminated. The DoD 10 February 2003 Information Quality Memorandum directs that DoD Components "shall adopt standards of quality that are appropriate to the nature and timeliness of the information they disseminate." For this reason, careful consideration must be given to procedures used to archive both hard copy and electronic information used in RSEPA.

The ORSM is the decision-support tool for managing and displaying range-specific information. It also supports the development of sampling designs for both the Preliminary Screening and Verification Analyses. When building the ORSM, project teams must consider the formats of existing data as well as the data formats needed by data users, decision-makers, and other stakeholders. The source and quality of all data must be evaluated and documented in a manner that supports compliance with DoD's 10 February 2003 Information Quality Memorandum[2].

To provide well-supported sampling designs, the ORSM should contain the following information:

- A digitized map based on a current U.S. Geological Survey topographic quadrangle map (see www.usgs.gov for examples) showing the locations of range activities, live impact areas (LIAs), open burning/open detonation (OB/OD) pits, firing points, and any areas of munitions storage, disposal, or destruction
- Location and size of known/suspected sources of munitions constituents
- Actual or potential munitions constituent migration pathways

This information provides the basis for characterizing source-pathway-exposure route-receptor networks. The output of the preliminary ORSM, in the form of a digitized map compatible with ArcInfo, will show the preliminary boundaries of areas to be sampled. This map also serves as VSP-RSM input to determine the number and locations of samples.

[2] *Ensuring Quality of Information Disseminated to the Public by the Department of Defense*. Deputy Secretary of Defense. 10 February 2003.

SECTION 2
PROJECT MANAGEMENT, ROLES, RESPONSIBILITIES, AND QUALIFICATIONS

The program-level organization and lines of communication for RSEPA Studies are shown in Figure 2.1. Project-level information, including names, contact information, and each person's role in the project, must be provided in the range-specific QAPP after all project staff, including contractors and laboratories, have been identified.

2.1 Personnel Qualifications and Training

All Navy and contractor personnel involved in the collection of environmental sampling and testing data must meet the training requirements of Navy's *Environmental and Natural Resources Program Manual,* OPNAVINST 5090.1B, Ch-4, Chapter 25 – Sampling and Laboratory Testing. (A Chapter 25 web-based training program can be accessed free of charge at www.navylabs.navy.mil). Chapter 25 requires that sampling and laboratory personnel have the education, training, and experience necessary to complete their assigned responsibilities. Personnel qualifications, responsibilities, and training requirements for range-specific studies must be summarized in the range-specific QAPP. Resumes, or equivalent documentation, demonstrating the qualifications of key Navy and contractor personnel should be included in an appendix.

2.2 Roles and Responsibilities

The successful performance of RSEPA studies conducted under the Comprehensive Range Evaluation (CRE) depends on support at the Navy organizational level, RSEPA team level, and individual level. These roles and responsibilities are described below.

2.2.1 NAVSEA Laboratory Quality and Accreditation Office

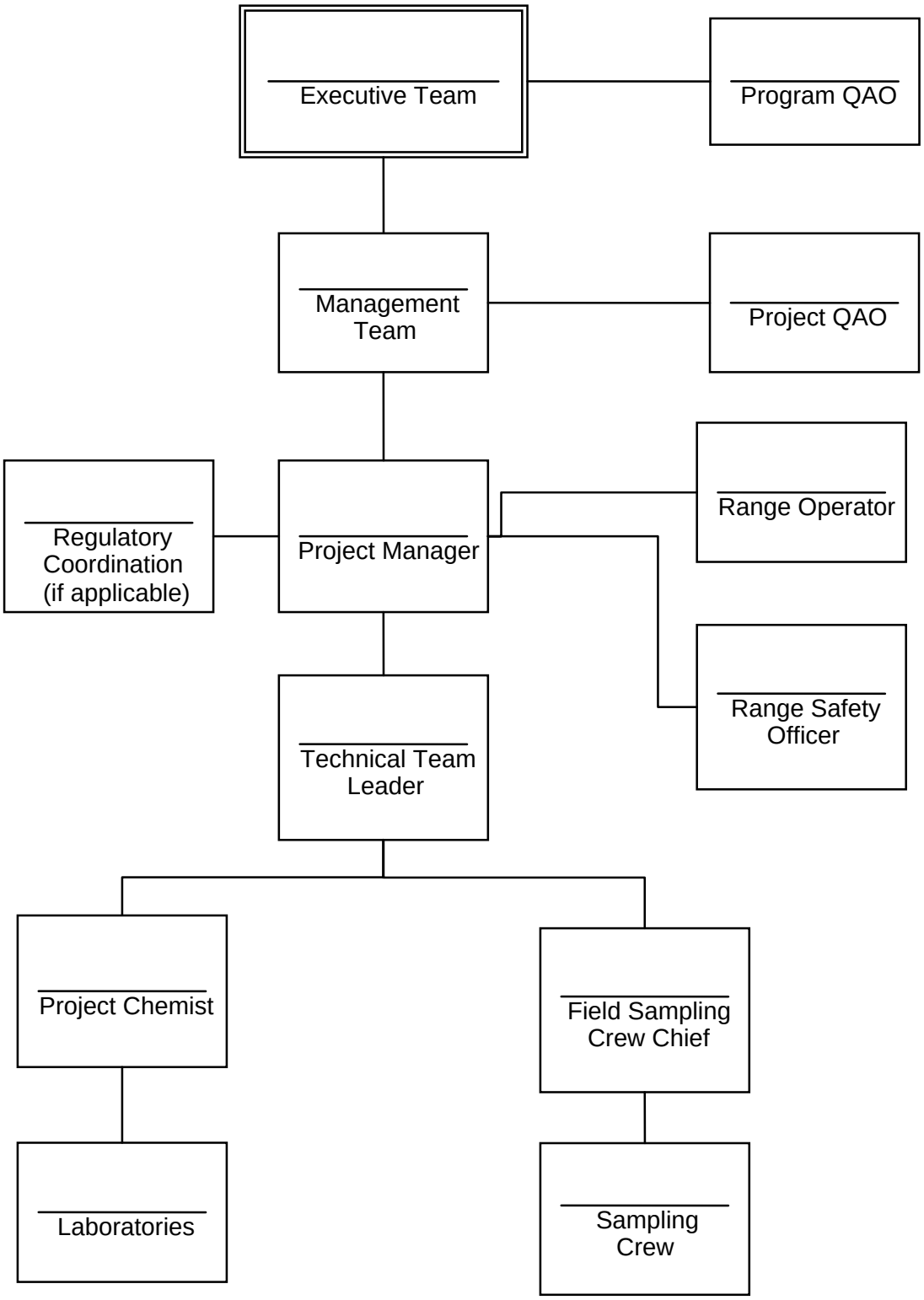
The NAVSEA Laboratory Quality and Accreditation Office, NAVSEA 04XQ (Labs), provides RSEPA sampling, testing, and data quality technical support and oversight to the Installations, Naval Facilities (NAVFAC); Regions; Commander, Fleet Forces Command (CFFC); Commander, Navy Installations (CNI); Systems Command/Claimants; and, the Chief of Naval Operations (CNO), as requested. This office prepared the original Master QAPP; reviews and prepares updates to the Master QAPP; provides assistance in the preparation of range-specific QAPPs, as requested; grants RSEPA-specific laboratory approvals; and provides assistance in the performance of field assessments.

2.2.2 RSEPA Team Roles and Responsibilities

RSEPA Executive Team

The RSEPA Executive Team includes the Office of the Chief of Naval Operations (CNO); CNI; Commander, Fleet Forces Command (CFFC); Systems Command/Claimants; and, the RSEPA Program Quality Assurance Officer (QAO), as necessary. The Executive Team provides operational, legal, and environmental expertise and oversight to RSEPA, serving as decision-maker for Navy precedent-setting issues. They also determine when to seek regulatory and public involvement.

Figure 2.1– Project Organizational Chart



RSEPA Management Team

The RSEPA Management Team is specific to each range. It includes the Point of Contact (POC) for CFFC and the Systems Command/Claimant, a RSEPA Project Manager (appointed by the Navy Region), the Project QAO, and the Installation Environmental Director and/or Range Manager. The Management Team is responsible for range-specific RSEPA oversight and decision-making. The Management Team designates the Technical Team Leader and determines the composition of the Technical Team.

RSEPA Technical Team

The RSEPA Technical Team includes the technical specialists responsible for all data collection activities during RSEPA. The composition of the technical team will vary, depending on expertise needed for the specific phase of study underway. The Technical Team will include the Technical Team Leader, Range Operator, Range Safety Officer, Explosive Ordnance Disposal (EOD) Technician, Project Chemist, Field Sampling Crew Chief, and personnel responsible for sampling, testing, and data collection.

2.2.3 Individual Roles and Responsibilities

Program Quality Assurance Officer (QAO) The Program QAO (must be a Navy employee) is a member of the Executive Team. The Program QAO is responsible for overall data integrity for the RSEPA Program, ensuring consistency of RSEPA process implementation within and across Systems Command/Claimants. The Program QAO monitors consistent application of this Master QAPP; determines the scope and frequency of assessments; reviews/responds to QA Management reports; raises any precedent-setting issues to the Executive Team; and monitors corrective action.

Project Manager The Project Manager (must be a Navy employee) is a member of the RSEPA Management Team and is responsible for overall execution of RSEPA studies at a particular range. The Project Manager identifies the Technical Team Leader for CRE studies and provides management and oversight of the RSEPA Technical Team. This includes convening the systematic planning process and coordinating development of the range-specific QAPP and range-specific safety and health plans.

Project QAO The Project QAO is a member of the RSEPA Management Team, and provides QA Management Reports to the Project Manager and the Program QAO. The Project QAO oversees development of and approves the range-specific QAPPs, approves the selection of laboratories, conducts field and laboratory assessments, monitors the implementation of the range-specific QAPP, documents nonconformance, and initiates corrective action. The Project QAO determines data usability criteria (in consultation with the Program QAO) and performs the data validation and data quality assessments. If any Project QAO responsibilities are performed by a contractor employee, Navy retains responsibility for the oversight of these tasks.

Technical Team Leader The Technical Team Leader (must be a Navy employee) is responsible for the execution of range-specific studies according to specifications contained in the Master and range-specific QAPPs. The Technical Team Leader identifies and manages work performed by the Technical Team members.

Range Safety Officer (RSO) (operational range, on-site personnel) The RSO must participate in project planning activities to ensure that appropriate considerations have been made for the safe collection and handling of samples. The RSO must approve the range-specific safety and health plan. The RSO, with assistance from the EOD technician, is responsible for surveying the range for each separate sampling event before any Navy or contractor personnel are allowed on the range. The RSO must be informed immediately of any unanticipated conditions that could affect the health or safety of field personnel.

Range Operator (operational range, on-site personnel) The Range Operator is the primary contact for operations, including sampling and testing activities, performed at operational ranges. The Range Operator is responsible for notifying sampling and testing personnel of any access restrictions (with the approval of the RSO) before any personnel are allowed on the range.

Field Sampling Crew Chief The Field Sampling Crew Chief, a member of the Technical Team, is responsible for collecting samples, making field measurements, implementing all field-related requirements contained in the Master and range-specific QAPPs, and adhering to all personnel protective measures described in the range safety and health plan. The Field Sampling Crew Chief must notify the Range Operator immediately upon discovering any suspected safety concerns. In addition to the 5090.1B, Chapter 25 training discussed above, the Field Crew Chief and sampling team members must be trained in the specific sampling techniques, range safety procedures, and other procedures, as documented in the range-specific QAPP.

Project Chemist The Project Chemist, a member of the Technical Team, is responsible for selecting appropriate analytical methods for range-specific studies, recommending qualified laboratories for approval, and coordinating with the laboratory throughout the specific RSEPA study. The Project Chemist performs data verification for all laboratory reports and supporting data to ensure compliance with analytical methods, standard operating procedures (SOPs), and QAPP requirements. As assigned by the Navy Project QAO, the Project Chemist also may coordinate the data validation and data quality (usability) assessments.

2.3 Contractors

All contractors and subcontractors providing sampling and testing support are responsible for complying with requirements outlined in the Master QAPP and range-specific QAPP. All contractors and subcontractors must provide evidence of a documented quality system meeting the requirements of ANSI/ASQC E4 and must be able to demonstrate and document proficiency in their assigned tasks. Personnel engaged in sampling and field-testing must meet the training requirements of OPNAVINST 5090.1B, Chapter 25. Contractor and subcontractor roles and responsibilities must be described, and lines of communication between Navy personnel, regulators (if actively involved), and contractors must be defined and displayed in the range-specific organization chart. Key contractor personnel should participate in the SPP and the development of the range-specific QAPPs.

2.4 Laboratories

Laboratories performing analyses in support of RSEPA must have an established and documented laboratory quality system that complies with the *DoD Quality Systems Manual for Environmental Laboratories* (a copy may be downloaded from www.navylabs.navy.mil). Laboratories also must be accredited for *the applicable test method(s*), in accordance with ISO/IEC Guide 25 (being replaced by ISO 17025), by a state or nationally recognized, laboratory accreditation body (e.g., American Association for Laboratory Accreditation (A2LA) or National Environmental Laboratory Accreditation Program (NELAP). In addition, laboratory analyses must be conducted at a laboratory that has received an acceptable report or approval from an on-site laboratory assessment by one or more DoD Components. Navy will grant limited laboratory approval to laboratories, for the purpose of providing analytical services under RSEPA, once these requirements have been met. All laboratories must provide proof that they can meet the project-specific reporting limits and are capable of generating acceptable results from the analysis of proficiency-testing (PT) samples using the specified methods in the specified matrices.

The laboratory (or the prime contractor for the laboratory) must provide the Project QAO and the NAVSEA Laboratory Quality and Accreditation Office with copies of the laboratory Quality Management Plan (however named), written SOPs for all sample preparation and analytical procedures, and relevant method detection limit (MDL) studies. These requirements apply to both fixed and field (mobile) laboratories.

After the analytical laboratory has been selected and approved, the laboratory's Quality Management Plan and relevant SOPs must be referenced in the range-specific QAPP. The laboratory must follow all requirements described in the Master and range-specific QAPPs. Unless approved in advance by the Project QAO, only analytical methods specified in this Master QAPP may be used. Any planned modifications to methods must be described in the laboratory SOPs and approved by the Project Chemist and Project QAO. The laboratory must document that the required measurement quality objectives (MQOs), including method reporting limits (MRLs), can be achieved in the appropriate matrices; equipment must be properly calibrated and maintained; specified quality assurance/quality control (QA/QC) procedures must be followed; and specified chain of custody procedures must be adhered to.

During analysis, the laboratory must notify the Project Chemist of any quality control exceptions including, but not limited to, the presence of matrix interferences, failure to meet hold times, failure to meet specified MRLs or other quality control acceptance criteria, the need to dilute any samples or sample extracts, and any corrective actions that may be necessary. Specific notification procedures must be spelled out in the range-specific QAPP. The laboratory must analyze the samples within the specified holding times and provide a complete laboratory report to the Project Chemist within the specified analytical turnaround time (TAT) (a standard TAT is typically 30 days).

2.5 Preparation of Range-Specific QAPP

The following approach is recommended for preparing the range-specific QAPP:

Step 1: Convene a meeting with the Technical Team to review the range-specific ORSM and other range-specific records and data.

Step 2: Identify data necessary to complete the ORSM for the range-specific study.

Step 3: Conduct the systematic planning process as appropriate to the specific study. (Resolve any range-specific issues with input from the Management and Executive Teams, if necessary, before preparing the range-specific plans.)

Step 4: Develop the range-specific QAPP by completing the worksheets contained in Section 7 of this Master QAPP.

2.6 QAPP Review and Approval

The NAVSEA Laboratory Quality and Accreditation Office will review this Master QAPP at least annually, and update it as required. In addition, before each range-specific study is conducted, this Master QAPP, the range-specific QAPP, and the range-specific safety and health plans must be reviewed and signed by key personnel on the RSEPA Management Team, Technical Team, and regulators (as appropriate) to verify that 1) data users and end uses of the data have been correctly and completely defined; 2) data will meet the data quality objectives for the range-specific study; 3) all range-specific constraints to data collection have been identified, including access restrictions, conflicts with range operations, and health and safety issues; and 4) specified information management and document control procedures meet applicable data integrity requirements.

After the range-specific QAPP has been reviewed, it is returned to the primary author for any comment resolution, if needed. Once approved, each person identified on the signature page must sign the appropriate QAPP approval form.

SECTION 3
DATA ACQUISITION

This Section describes the development of the data quality objectives (DQOs) and sample designs for the Comprehensive Range Evaluation (CRE), which includes the Preliminary Screening (CRE Phase I) and Verification Analysis (CRE Phase II). Range-specific information and data-collection requirements must be documented in range-specific QAPPs

3.1 Purpose

The CRE is designed to evaluate the potential for release of munitions constituents via migration pathways identified in the Operational Range Site Model (ORSM). The presence of munitions constituents and the likelihood of their migrating off range will be evaluated by collecting and analyzing samples of surface soil, sediment, surface water, and/or groundwater, as necessary. A key concern could be the evaluation of the groundwater pathway for the off-range migration of MCs.

As discussed in Section 1, studies conducted by the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) have shown that munitions residues are found very close to firing points and at sites where low-order detonations have occurred. Explosives-related residues are found as various-sized particulates that are dispersed in a heterogeneous manner in the source region. Explosives are solid at ambient temperature, dissolve slowly and sparingly in aqueous solutions, and possess low vapor pressure; therefore, they are transported through soil only when they are dissolved in water. Perchlorate, as a salt, is very soluble water, and it sorbs poorly to mineral surfaces and organic material. However, it is the most mobile constituent in the water pathway followed by RDX, HMX and TNT. For these reasons, only direct, non-biogenic, physical transport mechanisms will be evaluated during the CRE.

3.2 Technical Approach

The accurate characterization of the potential for off-range releases requires the development and implementation of range-specific sampling strategies. As stated in the CRREL report, “the unusual nature of explosives-related residues as contaminants must be taken into consideration for all aspects of sampling, preparation, and analysis.”

First, the area(s) of interest at a specific range must be delineated. This could be the entire range or several defined areas (i.e., separate sources of munitions constituents) within a range. The distribution of munitions constituents within each area of interest, and their likelihood to migrate as dissolved constituents, will depend on several factors, including (but not limited to) the manner in which the constituents were released, soil types, surface topography, hydrogeology, and weather factors. This information will be contained in the Operational Range Site Model (ORSM).

The approach being used for RSEPA is the identification of potential migration pathways during Phase I (the Preliminary Screening) based on a limited characterization of the surface deposition of munitions constituents and groundwater quality. Phase I is

followed by Phase II (the Verification Analysis) if necessary, to provide a more comprehensive characterization of potential pathways identified during Phase I.

Groundwater sampling during the Preliminary Screening could indicate whether munitions constituents have leached into groundwater. Surface sampling within the range boundary will be necessary to establish outer boundaries for suspected sources of munitions constituents and evaluate the future potential for transport of munitions constituents to groundwater or off-range areas.

During Phase I (Preliminary Screening), the concentrations of munitions constituents in environmental samples will be compared to their respective screening values given in Table 3.1. Wherever it is cost effective to do so, surface soil and sediment samples will be analyzed in the field for the 'marker compounds' TNT, RDX, and HMX. [The technical justification for this approach is explained in Section 3.3 and Attachment A.] Selected surface soil/sediment samples, as well as all surface water and groundwater samples, will be sent to an off-site laboratory to be analyzed for all constituents listed in Table 3.1. Analytical results will be used to refine the ORSM, which will be evaluated to determine if 1) actions are necessary to ensure on-going regulatory compliance, 2) protective measures are necessary to address potential releases, or 3) further assessment (i.e., a Verification Analysis) is necessary.

Phase II (Verification Analysis) will be conducted at ranges where results from the Preliminary Screening (incorporated into the ORSM) indicate a potential for off-range release, and the release poses a potential risk to human health or the environment. Verification Analyses, if performed, will focus on range-specific constituents of concern and any potentially complete exposure pathways identified in the ORSM.

Verification Analysis data will be used to 1) support ecological and human health risk assessments, as appropriate, 2) support the development of range-specific action levels, and 3) support the evaluation of protective measures.

Table 3.1 – Target Analytes – Munitions Constituents

Analyte[10]	Abbr.	CAS Num.	Human Health Screening Values[1]				Federal Ambient Water Quality (µg/L)		Sediment Quality Benchmark (mg/Kg)[3]	Quantitation Limit			
			Residential Soil[1] (mg/Kg)	Cancer/ Non-Cancer	Industrial Soil[1] (mg/Kg)	Ground Water (µg/L)	CMC[2]	CCC[2]		Ground Water (µg/L)	Surface Water (µg/L)	Sediment (mg/Kg)	Soil (mg/Kg)
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	4	C	16	0.61[1,4]	4000 [5*]	190 [6*]	0.190	0.1	0.3	0.01	0.01
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	3100	NC	31000	400[7]		330 [6*]	0.330	3	3	0.05	0.05
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	16	C	60	2.2[1,4]	560 [5*]	<40 [5*]	0.13	0.03	0.03	0.01	0.01
Perchlorate [11]		7601-90-3								See Section 3.3.3.3			
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	1800	NC	18000	1100[1,4]	30 [6*]	14 [6*]	0.02	0.03	0.03	0.02	0.02
1,3-Dinitrobenzene	1,3-DNB	99-65-0	6	NC	60	1.0[9]	110 [6*]	30 [6*]	0.04	0.09	0.09	0.02	0.02
2,4-Dinitrotoluene	2,4-DNT	121-14-2	120	NC	1200	5.0[7]	0.11 [10]		0.230	0.02	0.02	0.02	0.02
2,6-Dinitrotoluene	2,6-DNT	606-20-2	60	NC	600	5.0[7]	18,500 [5*]		18.5	0.01	0.01	0.02	0.01
2-Amino-4, 6-dinitrotoluene [12]	2-Am-DNT	355-72-78-2								0.1	0.1	0.02	0.02
2-Nitrotoluene	2-NT	88-72-2	370	NC	1000	61[1,4]				0.09	0.09	0.02	0.02
3-Nitrotoluene	3-NT	99-08-1	370	NC	1000	61[1,4]				0.09	0.09	0.02	0.02
4-Amino-2,6-dinitrotoluene [12]	4-Am-DNT	1946-51-0								0.1	0.1	0.05	0.05
4-Nitrotoluene	4-NT	99-99-0	370	NC	1000	61[1,4]				0.09	0.09	0.05	0.02
Nitrobenzene	NB	98-95-3	20	NC	100	3.4[1,4]	27,000 [6*]		27.0	0.03	0.03	0.02	0.02
Nitroglycerin	NG	55-63-0	30	C	120	4.8[7]	1,700 [5*]	200 [5*]		0.09	0.09	0.05	0.05
Methyl-2,4,6-trinitrophenylnitramine [12]	Tetryl	479-45-8								0.5	0.5	0.02	0.02

Shaded cells indicate marker compounds.

1. EPA Region 9 Preliminary Remediation Goal Tables (10/01/02) (www.epa.gov/region09/waste/sfund/prg/index.htm)
2. CMC, the criteria maximum concentration, will protect against acute effects in aquatic life and is the highest in-stream concentration of a priority toxic pollutant consisting of a 1-hour average not to be exceeded more than once every 3 years on average.
CCC, the criteria continuous concentration, will protect against chronic effects in aquatic life and is the highest in-stream concentration of a priority toxic pollutant consisting of a 4-day average not to be exceeded more than once every 3 years on average.
3. Calculated from water toxicity data based on 1% organic matter according to Talmage S.S. and D.M. Opresko, 1995, Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge TN
4. EPA Region 6 Corrective Action Strategy, EPA Region 6, Dallas TX, November 2000.
5. Burrows, E.P., D.H. Rosenblatt, W.R. Mitchell, and D.L. Parmer, 1989, Organic Explosives and Related Compounds: Environmental and Health Considerations, U.S. Army Biomedical Research and Development Laboratory.
6. Talmage, S.S., and D.M. Opresko, 1995, Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge TN.
7. U.S. Environmental Protection Agency, Summer 2000, Drinking Water Standards and Health Advisories, EPA 822-B-00-001, Office of Water, Washington, D.C.
8. Roberts, W. C., and W. R. Hartley, editors, 1992, Drinking Water Health Advisories: Munitions, U.S. EPA Drinking Water Health Advisories, Lewis Publishers, Boca Raton, FL, 535 pp.
9. Human Health for Consumption of Water and Organism, U.S. Environmental Protection Agency, National Recommended Water Quality Criteria: 2002 Office of Water, Washington, D.C., EPA-822-R-02-047
10. Some methods may provide results for constituents that are not MCs as defined in RSEPA, but may still be related to testing and/or training operations with munitions.
11. Screening levels have not been developed for perchlorate. Detections of perchlorate should be verified using confirmatory methods such as liquid chromatography/mass spectrum/mass spectrum (LC/MS/MS). DoD will continue to develop guidance and more accurate and reliable methods for sampling and testing perchlorate. Decisions regarding perchlorate should be made by the Management or Executive Teams.
12. No health- or risk-based screening values are available for these MCs and degradants, but because some of these compounds are highly soluble in water, they should be included in this analysis.
* Lowest observed adverse effect level (LOAEL). Not enough data to develop criteria.

3.3 Preliminary Screening (CRE Phase I)

The Preliminary Screening will evaluate the potential for munitions constituents to migrate from live impact areas (LIAs) or other suspected source areas (e.g. buried ordnance) into off-range areas where they may potentially affect human health or the environment. If the ORSM does not contain adequate information to evaluate the potential for the off-range migration of munitions constituents, then the Preliminary Screening will focus first on filling in gaps in the ORSM, such as installing piezometers to determine groundwater depth and flow direction.

Numerous studies (summarized in the USACE *Guide for Characterization of Sites Contaminated with Energetic Materials* ERDC/CRREL TR-02-1) on the frequency of occurrence of specific munitions constituents in soil and groundwater have shown that 2,4,6-trinitrotoluene (TNT) and/or hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) are detected in a high percentage of samples containing munitions constituents. Studies also have shown that RDX and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) are the most mobile munitions constituents (with the exception of perchlorate) and therefore the most likely to present a groundwater contamination risk. For these reasons, the presence of munitions constituents in surface soil and sediment samples, and the likelihood of their migrating off range, will be evaluated by performing field analyses for the 'marker compounds' TNT, RDX, and HMX, wherever it is cost effective to do so. Because the field analytical methods approved for use in RSEPA provide accurate results and rapid feedback, they can be used to support dynamic work plans that focus sampling efforts while the project team is still on site. For the purpose of providing documentation validating the selection of the marker compounds, all samples sent to fixed laboratories, including all groundwater samples, will be analyzed for the complete list of munitions constituents in Table 3.1.

Table 3.1 contains the list of target analytes, quantitation limits, and tentative human health screening values applicable to the Preliminary Screening (CRE Phase I). The development of Table 3.1 is discussed in Attachment B. Range-specific screening values must be documented in the Range-specific QAPP.

Concentrations of the target analytes, including marker compounds, in surface soil, sediment, surface water, and groundwater samples collected during the Preliminary Screening will be compared to their corresponding range-specific screening values. The analytical methods selected for use during the Verification Analysis must be capable of generating Quantitation Limits at or below the range-specific screening values.

3.3.1 Preliminary Screening - Sample Design Considerations

To facilitate development of surface soil sampling designs for the Preliminary Screening, Navy has developed a statistical tool: the Visual Sample Plan – Range Sustainability Module (VSP-RSM). Section 4 describes VSP-RSM in more detail.

If groundwater sampling is to be conducted, groundwater monitoring wells will be placed and constructed to intercept known or suspected groundwater pathways (i.e. within the range boundary, down-gradient from any potential source area.)

Groundwater sampling during the Preliminary Screening will not be designed to determine the precise extent of any groundwater plumes, as monitoring wells will not be installed off range. The delineation of any plumes would be performed during the Verification Analysis, if required. Piezometers may be installed during the Preliminary Screening, if necessary to gather information on groundwater depth and flow direction.

In all cases where subsurface sampling (drilling) is to be performed, a registered, professional geologist/hydrogeologist must be consulted to determine the proper locations, drilling techniques, depths, and monitoring well construction specifications. Drilling must only be conducted in areas determined to be free from unexploded ordnance (UXO), unless appropriate precautions are made and approved in advance by the Range Safety Officer. Wells should only be installed in areas where the chance of damage from range use is low; therefore, wells generally will not be located near LIAs. In addition, sources of munitions constituents, such as formerly used defense sites (FUDS), need to be identified. *[Note – state and local regulations may require permits for installation of wells.]*

3.3.2 Sampling Considerations and Sampling Theory

Sampling procedures for soils and groundwater are detailed in standard operating procedures (SOPs) provided in Appendix C. Sediment and surface water sampling procedures can be found in the *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*, (1997) NAVSEA T0300-AZ-PRO-010 and the American Society for Testing and Materials (ASTM) Standards on Environmental Sampling, Second edition. The range-specific QAPP must contain copies of the actual sampling SOPs used, which must include any range-specific modifications that are made.

The soil sampling SOP (S-1) contained in Appendix C employs *multiple increment sampling* as a means to address the heterogeneous distribution of munitions constituents that is typical in surface soils on training ranges. *Increment sampling* involves the extraction of a representative portion of material from within a single *sampling unit.* (*Particulate Sampling Theory: Pierre Gy, 1998, Francis Petard, 1993, and Charles Ramsey, 2002).* In particulate sampling theory, all sampling is increment sampling, because only a portion of the sampling unit is collected for analysis. Either single or multiple *increments* can be collected from a single *sampling unit.* In *multiple increment sampling,* several increments from the same sampling unit are combined to form one sample that is submitted for analysis. SOP S-1 describes the collection of 5 increments per sampling unit.

Multiple increment sampling is different from *composite sampling*. As it is described in *Guidance on Choosing a Sampling Design for Environmental Data Collection*, EPA QA/G-5S, *composite sampling* involves the collection and compositing of *subsamples* from different *sampling units.* Composite sampling is generally performed to help control the high cost of sample analysis, when it is acceptable to determine an average concentration across the study area. *Multiple increment sampling*, on the other hand, involves the collection of *increments* from within the same *sampling unit*; therefore it does not result in a reduction in the number of samples submitted for laboratory analysis. By combining several increments from within the same sampling unit, *multiple*

increment sampling results in the collection of a sample that is more representative of the area.

Because munitions constituents contained in surface water, sediments, and groundwater have been subjected to fluid mechanics, their distribution in these media is much more homogeneous than in surface soils. For this reason, surface water, sediments and groundwater samples will be collected as single increment samples per sampling unit.

3.3.3 Analytical Method Considerations

Both the Preliminary Screening and the Verification Analysis can employ a combination of field and fixed-laboratory analytical technologies for the determination of munitions constituents in environmental media. The use of field analytical methods permits decision-making in the field.

3.3.3.1 Explosives – Field Analytical Method

GC-TID will be used in the field to analyze soil and sediment samples for RDX, HMX, and TNT. The following field analytical method may be used:

- Gas Chromatography – Thermal Ionization Detector (GC-TID) method for soils and sediments, developed by the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL); Technical Report ERDC/CRREL TR-01-9

A number of field-test kits are available for the analysis of explosives. Method development in this area is ongoing, and the reliability of field-test methods continues to improve. If the Technical Team wishes to use field-test kits during the Preliminary Screening Study at a particular range, the procedures must be capable of satisfying the range-specific data quality objectives (DQOs) and measurement quality objectives (MQOs). Their use should be explained and justified in the range-specific QAPP, and the results for selected samples should be confirmed using fixed-laboratory analysis to demonstrate initial method performance. In general, field-test kits should not be used during the Verification Analysis. Further information on the use of field-test kits for Preliminary Screening Studies, which will be updated periodically, can be found on the Navylabs website (www.navylabs.navy.mil)

3.3.3.2 Explosives – Fixed Laboratory Methods

Selected field analytical results for surface soil samples will be independently confirmed using fixed-laboratory analysis. All surface and groundwater samples collected will be analyzed using fixed-laboratory analysis. Samples submitted for fixed-laboratory analysis will be analyzed for explosives constituents listed in Table 3.1.

Applicable fixed-laboratory methods include the following methods from *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*, SW-846, Third Edition:

- Gas Chromatography–Electron Capture Detector (GC-ECD) SW-846 Method 8095 (soils, sediments, and aqueous samples)

- High Performance Liquid Chromatography–Diode Array Detector/Ultraviolet (HPLC-DAD/UV) SW-846 Method 8330

[*Note- When using either Method 8330 or Method 8095, only the Solid-Phase Extraction (SPE) sample preparation method for waters (as described in SW-846 Method 3535A) may be used. The DoD LCS Study has demonstrated that the salting-out sample preparation procedure results in inferior method performance.]*

Because Methods 8330 and 8095 are *non-specific* methods (identification is based on the retention time of chromatographic peaks), the following fixed-laboratory technology should be used to confirm the identification and concentration of explosives that are detected at concentrations at or above their range-specific screening values:

- High Performance Liquid Chromatography–Mass Spectrometry (HPLC/MS/MS) Thermo spray/Mass Spectrometry (a performance-based measurement system (PBMS) application of SW-846 Method 8321).

3.3.3.3 Perchlorate

At this time, the only EPA-approved method for the analysis of perchlorate is Method 314.0, which was developed and validated for use only in drinking water samples. Method 314.0 is a "non-specific" method, subject to false positive results due to interferences from numerous sources. Furthermore, the Method Reporting Level (MRL) for Method 314.0 in pure drinking water may not meet the range-specific measurement quality objective for sensitivity.

Currently, there is no EPA-approved method for quantifying perchlorate in surface water, non-potable groundwater, or soil samples; however, efforts are underway in both EPA and the private sector to develop alternative methods with improved sensitivity and specificity for perchlorate in environmental samples. Alternative analytical methods with improved sensitivity and specificity are commercially available on a limited basis; however, none has yet been published or approved for use by EPA.

When conducting sampling and testing for perchlorate in surface soil, groundwater, surface water, sediments, or other environmental matrices under RSEPA, the Technical Team must identify an analytical method that can document the specified Method Reporting Limit (MRL), *in the specific matrix of concern*. Either a modified Method 314 or alternate method should be used. If non-specific analytical methods (e.g. method 314.0 modifications) are used, then any results detected above the range-specific MRL should be confirmed using definitive analytical methods, such as those employing mass spectrometry (MS) (i.e. SW-846 Method 8321A modified).

Regardless of the method used, each laboratory must document Quantitation Limits *in the specific matrix of concern* that meets or exceeds the specified MRL in Table 3.1. The MRL cannot be lower than the lowest calibration standard. Calibration procedures and procedures for documenting the MRL must be equivalent to those specified in Method 314.0. Additional information on the analysis of perchlorate in environmental

samples, which is updated periodically, can be found on the Navylabs website (www.navylabs.navy.mil).

3.3.4 Preliminary Screening - Data Quality Objectives (DQOs)

The following discussion outlines the program-wide DQOs for the Preliminary Screening.

DQO Statement #1: State the problem:

To support the RSEPA process, Navy will conduct sampling and testing at land-based, operational ranges to determine whether munitions constituents are migrating, or have the potential to migrate, from areas where munitions constituents might potentially have been generated (e.g., live impact areas (LIAs), firing points, and open burning/open detonation (OB/OD) pits) into off-range areas.

DQO Statement #2: Identify the decisions to be made:

Sampling and testing will be conducted to determine whether

a. Actions/responses are needed to maintain or restore environmental compliance,
b. Protective measures are necessary to address the release of munitions constituents to off-range areas, and
c. A Verification Analysis is required to complete the evaluation of source-pathway-exposure route-receptor networks.

DQO Statement #3: Identify the information required to support the decision:

The Preliminary Screening requires information to ascertain if munitions constituents have the potential to migrate from known or suspected source areas into other areas of concern. If there are gaps in the ORSM, such that potential source-pathway-receptor-exposure route networks cannot be evaluated, additional information must be collected. Examples of the types of information needed include the following:

- Locations and approximate sizes of potential source areas
- Potential migration pathways
- Locations of human and ecological receptors
- Depth to groundwater
- Groundwater use classification

DQO Statement #4: Define the study boundaries:

For each range, the project team will use the ORSM to define the approximate spatial boundary (called a *transect line*) around known or suspected source areas of munitions constituents within the range complex (e.g. LIAs, OB/ODs, etc.). VSP-RSM may be used to confirm this transect line at the surface. In general, sampling during the Preliminary Screening will not be conducted outside Navy property. The project team must identify and document any practical constraints on data collection (for example, the presence of UXO that would make sampling unsafe or areas that are inaccessible).

The scope of the Preliminary Screening includes the characterization of soil, sediment, groundwater, and surface water. Only potentially complete pathways, i.e. those pathways that may affect human health or the environment, need to be sampled and analyzed for munitions constituents.

DQO Statement #5: Develop a decision rule:

The Preliminary Screening decision rules are as follows:

H_o : If the concentration of a munitions constituent associated with a specific pathway or study area at or near the range boundary is equal to or greater than its range-specific screening value, then the range will be considered a candidate for performance of a Verification Analysis.

H_A : If munitions constituent concentrations for all pathways and study areas within the range boundary are below their respective range-specific screening values, then the range will be considered to have no significant impact to human health or the environment and no further studies will be recommended.

DQO Statement #6: Define tolerable limits on uncertainty:

Since decision-making errors (i.e., choosing the wrong alternative) exist because the knowledge of "true" environmental conditions at a site is never perfect, the acceptable uncertainty (or decision error) must be defined. Uncertainty can be controlled, but not eliminated. This uncertainty is a function of the inherent site variability, the analytical measurement uncertainty, and the number of samples collected and analyzed.

The VSP-RSM sampling design has been tailored to demonstrate with 95% certainty that marker compound concentrations are less than their corresponding screening levels at the outermost transect line. Alternative sampling designs are acceptable, provided they produce results with equivalent limits on uncertainty.

DQO #7: Optimize the study design:

VSP-RSM relies on the establishment of a transect line between areas where munitions concentrations are expected to exceed the screening values (e.g., LIAs and OB/OD areas) and areas where concentrations are expected to be below the range-specific screening values. The project team will determine the placement of the Transect Line from information in the ORSM. The Transect Line will be placed such that it contains or crosses any surface water bodies expected to collect or channel munitions constituents. VSP-RSM will use the Transect Line to establish the locations and numbers of soil samples to be collected for each bounded area within each range.

If the Transect Line crosses one or more surface features expected to collect or channel munitions constituents (e.g. rivers, streams, canals, lakes, wetlands, drainage swales, etc.) then surface water samples (if present) and sediment samples shall be collected along the Transect Line where it intersects each relevant feature. [If environmentally sensitive habitats (e.g., wetlands, ponds) exist on the range complex, but these features

do not intersect the Transect Line, then decisions on whether to sample these features will be made on a case-by-case basis.]

Areas along the Transect Line where munitions constituent concentrations exceed the screening values will be sampled using the linear adaptive approach discussed in Section 4. This feature of the VSP-RSM allows the project team to "triangulate" the boundary of presumed source areas and modify the boundary as necessary based on the analytical results. If field analytical technology is employed, data can be acquired in real time, and boundaries can be rapidly evaluated and redrawn while the field crew is still on site. Regardless of the sampling method, incremental sampling (as discussed in Section 3.2.2) will be used at each sample point to manage the heterogeneous distribution of munitions constituents in surface soils typically found on ranges.

Results from the Preliminary Screening will be incorporated into the ORSM. In general, if the concentrations of munitions constituents in surface environmental samples (e.g. surface soil, sediment, and surface water) at the outermost transect line are below their respective screening values, and the concentrations in all groundwater samples are below their screening values, then a finding of "no significant operational impact" will be reported to the RSEPA Management Team, with a recommendation that the Preliminary Screening be considered complete.

If, however, the concentration of any munitions constituent in any surface sample collected at the outermost sampling boundary exceeds its screening value, or if the concentration of any munitions constituent in any groundwater sample exceeds its screening value, the RSEPA Technical Team will assess the data along with other information in the ORSM to determine the appropriate actions and whether the range should proceed to a Verification Analysis (CRE Phase II). Based on findings from DoD range studies (summarized in Attachment A), it is expected that if marker compound concentrations do not exceed their screening values, then the concentrations of the remaining organic munitions constituents will not exceed their screening values.

3.4 Verification Analysis (CRE Phase II)

Verification Analyses will be conducted on ranges where information compiled in the ORSM indicates a probable off-range release, and the release poses a potential risk to human health or the environment. Studies will focus on specific constituents of concern and any potentially complete exposure pathways identified in the ORSM. Verification Analyses can include collecting samples of surface soils, sediments, subsurface soils, surface water, and/or groundwater, both on and off range as needed to evaluate potential exposure pathways. **The RSEPA Management Team must approve any recommendations to collect samples of environmental media off Navy property as well as recommendations to collect biological samples either on or off Navy property.**

Target analytes for Verification Analyses will include range-specific munitions constituents and other chemicals of concern associated with a potentially complete exposure pathway. For example, if the ORSM indicates a potentially complete groundwater pathway for RDX and HMX, then the Verification Analysis will collect and

analyze samples of the appropriate media (e.g. subsurface soils and groundwater) to further evaluate this pathway. Table 3.1 can be used as a guide for developing range-specific DQOs and target analytes for Verification Analyses.

The objective of the Verification Analysis is not to characterize the distribution (i.e. nature and extent) of munitions constituents on the range per se. For example, the distribution of munitions constituents within Live Impact Areas (LIAs) will be characterized only to the extent necessary to confirm or rule out a potentially complete exposure pathway. Information collected during the Verification Analysis will be compiled in the ORSM, to be used as the basis for further decision-making. As discussed earlier, protective measures to address potential releases, such as Best Management Practices, can be implemented at any time.

The RSEPA Technical Team will use the systematic planning process (SPP) to develop range-specific DQOs for Verification Analyses:

1. State the problem
2. Identify the decisions to be made
3. Identify the information required to support the decisions
4. Define the study boundaries
5. Develop decision rule(s)
6. Define tolerable limits of uncertainty
7. Optimize the study design

The UFP-QAPP provides further guidance on the SPP. The technical team also can follow the formal DQO process described in the U.S. EPA document, *Guidance for the Data Quality Objective Process* (EPA QA/G-4), EPA/800/R-96/055, August 2000.

A Verification Analysis QAPP must be prepared to document the study design, range-specific DQOs, action levels, and detailed sampling and testing specifications and procedures. This document should be used to guide the development of the Verification Analysis QAPP.

SECTION 4
VISUAL SAMPLE PLAN – RANGE SUSTAINABILITY MODULE

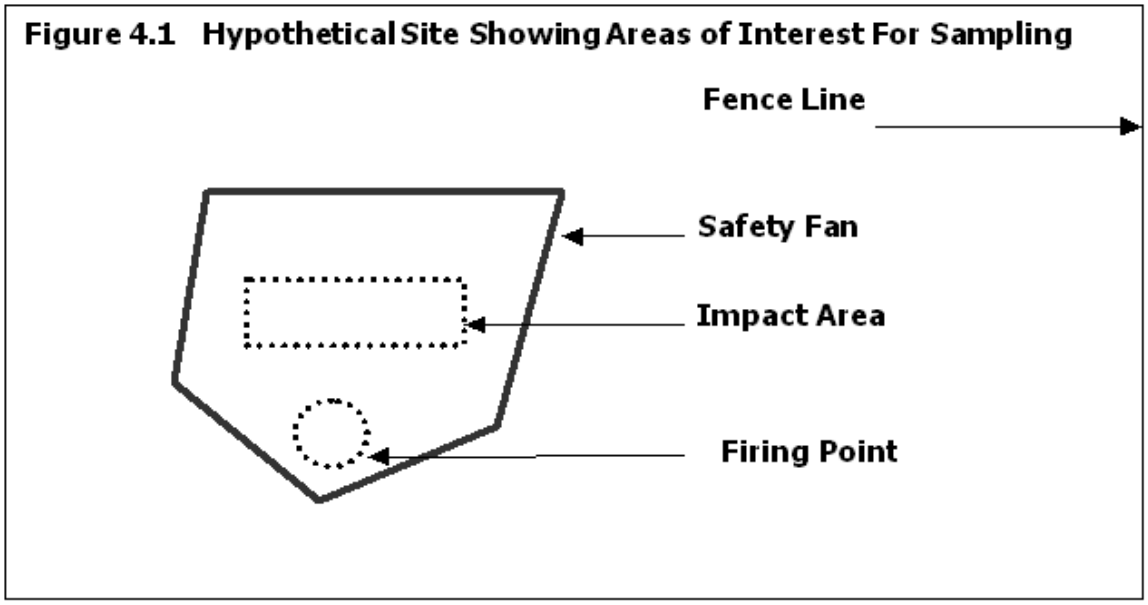
Sampling is the process of gaining information about a population by examining a portion of that population. A key goal of any environmental sampling design is to specify the number of samples and sampling locations necessary to provide information concerning the presence and distribution of target analytes. The Visual Sample Plan – Range Sustainability Module (VSP-RSM) is a software tool for selecting the optimal number and locations of samples so that data collected according to the sampling plan provide the end user with the required confidence level for decision-making.
Alternative sampling designs are acceptable provided they produce results with equivalent limits on uncertainty.
[Note: A free copy of VSP with the Range Sustainability Module can be obtained through: www.navylabs.navy.mil]

4.1 VSP-RSM Overview

The VSP-RSM supports a sampling approach designed to bound a suspected "source area," i.e., the two-dimensional surface area suspected of containing concentrations of munitions constituents above the relevant screening levels. Based on information incorporated into the Operational Range Site Model (ORSM), VSP-RSM may be used to develop an initial boundary (called Transect Lines) that is expected to contain the source area. *Perimeter Transect Sampling* is conducted along the Transect Lines to verify or refine this assumption.

If munitions constituent concentrations found in samples collected along the initial Transect Lines are *below* their corresponding screening levels, then the suspected source area will be deemed "bounded." If the concentration of one or more munitions constituents detected along the initial Transect Lines exceeds its corresponding screening level, then additional sampling outside the initial boundary set by the Transect Lines will be performed to establish a revised source area boundary. VSP-RSM uses *Linear Adaptive Sampling* to extend the boundary, with the least amount of sampling required. The use of Perimeter Transect Sampling and Linear Adaptive Sampling are illustrated in the following examples:

Figure 4.1 illustrates a hypothetical range, showing the firing point, impact area, and surrounding "safety fan."



4.2 Perimeter Transect Sampling

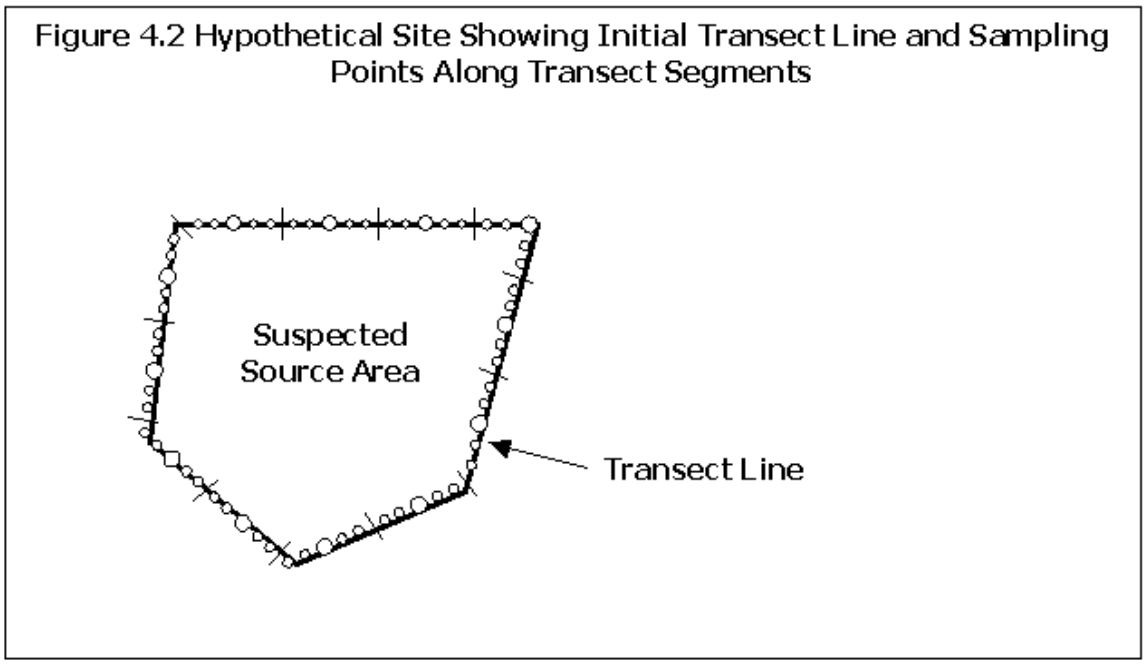
In Perimeter Transect Sampling, VSP-RSM determines the required spacing and placement of sampling points along the assumed source area boundary (Transect Lines). The Transect Lines are based on information contained in the ORSM.

Figure 4.2 depicts Transect Lines divided into transect segments. Each segment is partitioned into 5 points (a VSP-RSM default). At each of the 5 points, 5 increments are collected. The 25 increments for each segment are combined into one field sample. The required spacing between sampling points is a function of:

- The size and shape of the potential source area and
- The proximity of the source area to potential off-range environmental receptors.

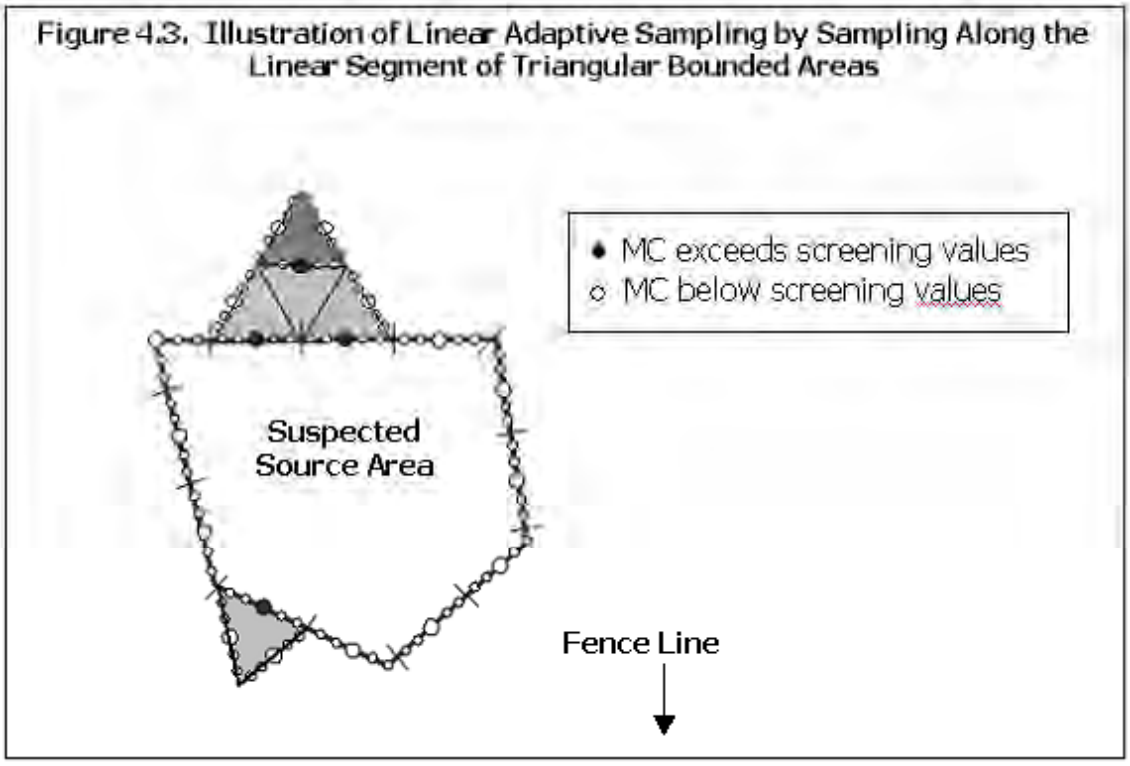
Multiple increment sampling is employed to improve the representativeness of samples and to manage sampling uncertainty due to inherent site variability.

If Transect Lines cross surface features that are expected to collect or channel munitions constituents (e.g. ravines, dry creek beds, valleys, storm water runoff areas, etc.), these areas will be targeted first.

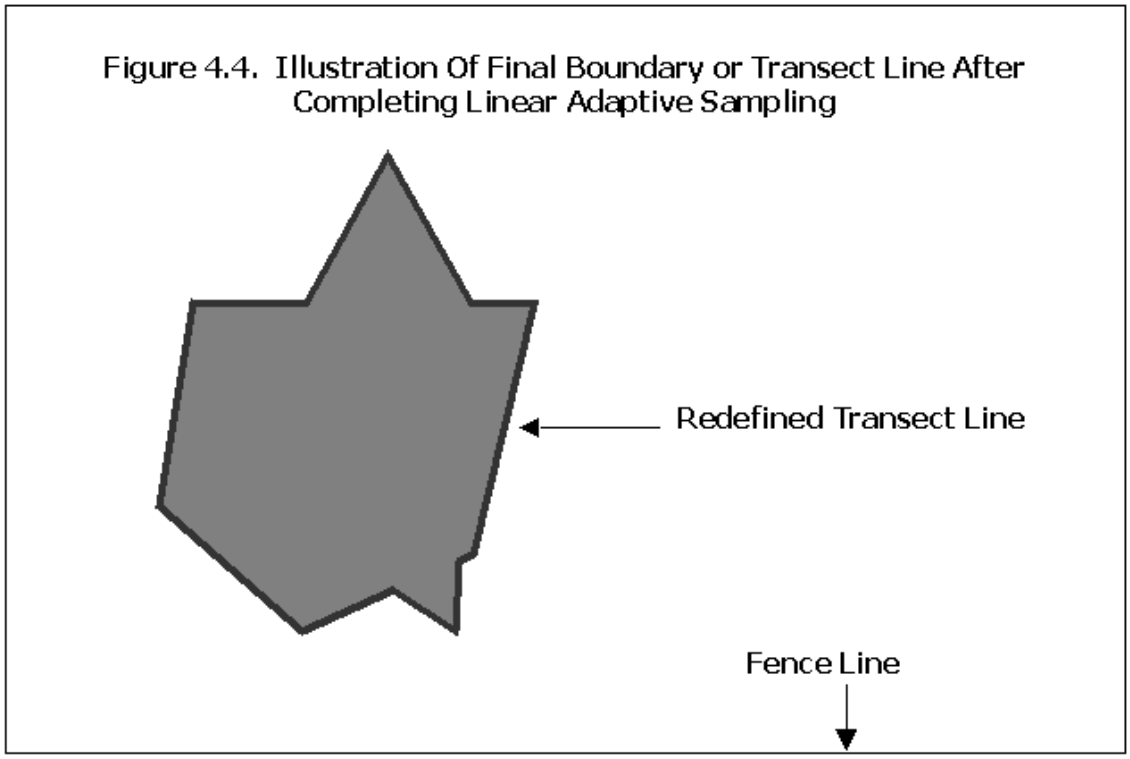


4.3 *Linear Adaptive Sampling*

If samples collected along the initial Transect Lines identify munitions constituent concentrations exceeding the relevant screening levels, then Linear Adaptive Sampling will be conducted outside the initial Transect Lines to establish a revised boundary. This approach is depicted in Figure 4.3.



For each segment on the boundary where the initial Perimeter Transect Sampling shows munitions constituent concentrations exceeding the relevant screening values, VSP-RSM selects subsequent sample points by triangulating out from that segment. Figure 4.3 shows how the boundary changes as sampling proceeds through the Linear Adaptive Sampling process. The black dots represent segments where results were found to exceed the screening levels. The points along the light gray area boundary represent the first stage of follow-up sampling, and the dark gray area represents the second stage of follow-up sampling. Figure 4.4 shows the redefined Transect Lines. Linear Adaptive Sampling will not continue beyond the fence line (property line).



4.4 Site Map and VSP Interface

The VSP-RSM requires that an ESRI® ArcGIS-compatible site map be imported before it can generate statistically valid sampling designs. The VSP interface with the ArcGIS geographical information system gives VSP-RSM the capability of displaying the suspected source area boundaries, transect segments, approximate sampling points, and Transect Lines segment results.

4.5 Enclosed Boundary Scenario

Generally, the sampling Transect Lines will enclose an area. In scenarios where the information provided by the ORSM is limited, enclosing the source area provides the highest degree of confidence. For example, if information such as prevailing wind direction or topography is incomplete then surface contaminant migration pathways may

not be adequately defined. Thus, enclosing the source area becomes the only practical way to assess potential off-range migration. VSP-RSM has the capability to surround an area with sampling Transect Lines. In Figure 4.5a, the sampling Transect Lines enclose a source area. The firing point is located southeast of the impact area and the range is surrounded by the safety fan. The ORSM indicates that the range is located on a slope facing east. The circles represent sampling segments and the black dots represent sampling segments where results were found to exceed the screening level.

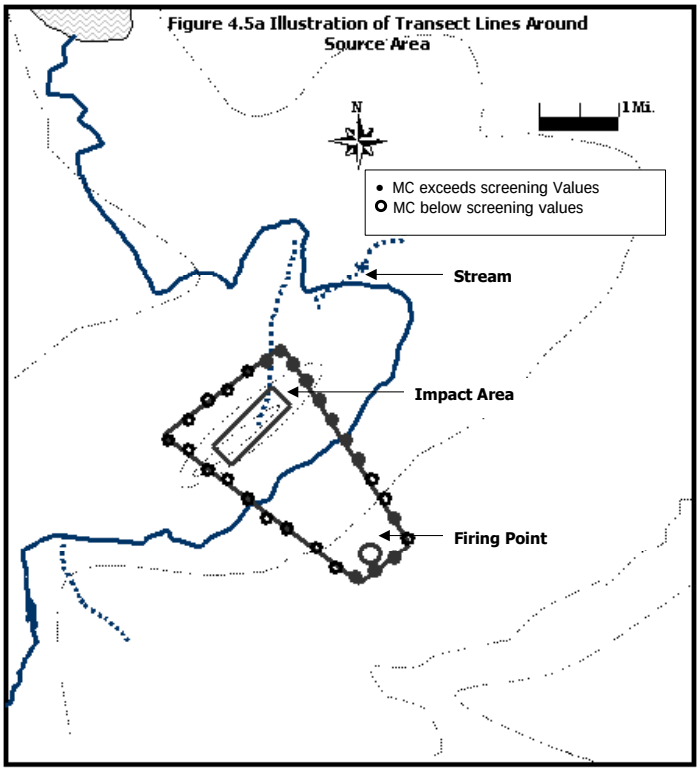
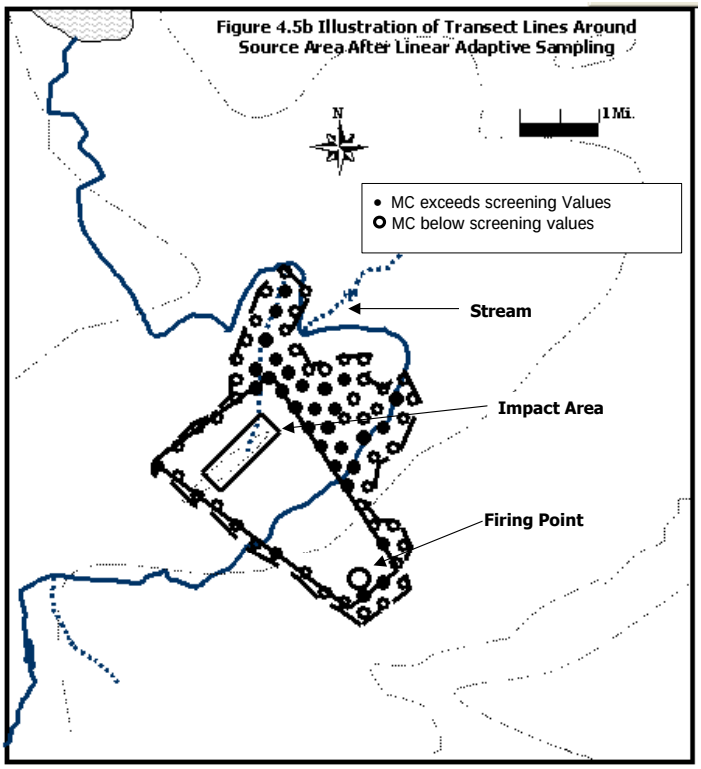


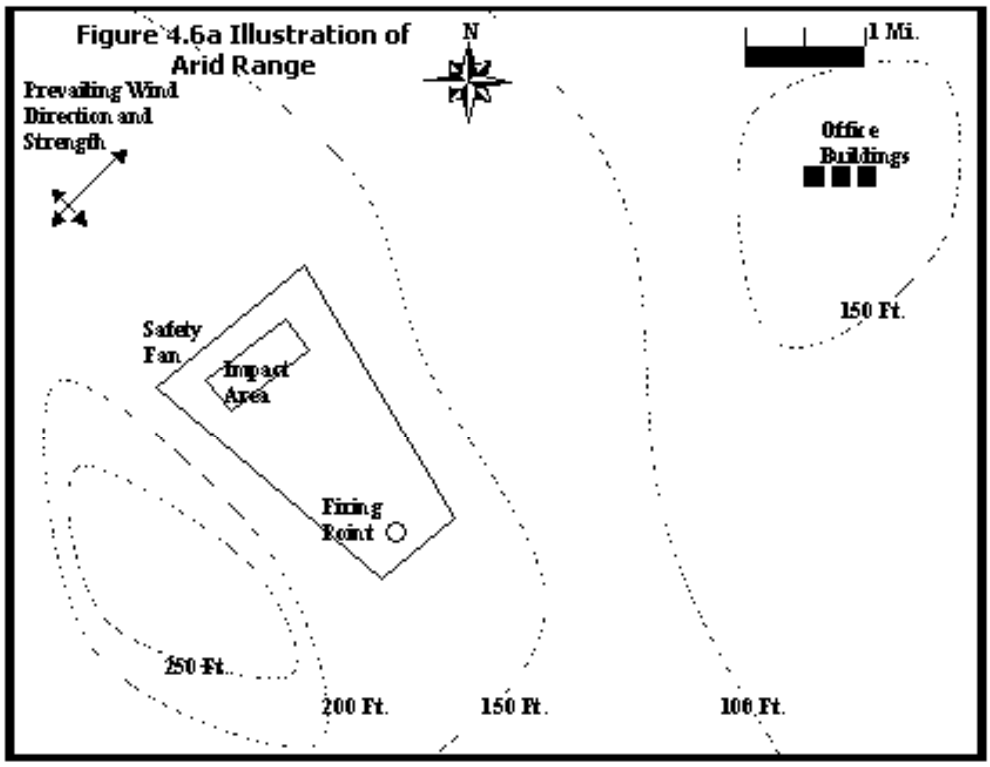
Figure 4.5b represents the source area bounded with closed sampling Transect Lines. The circles represent sampling segments and the black dots represent sampling segments where results were found to exceed the screening level. The dashed line represents the boundary of the source area after linear adaptive sampling.



4.6 Non-enclosed Boundary Scenario

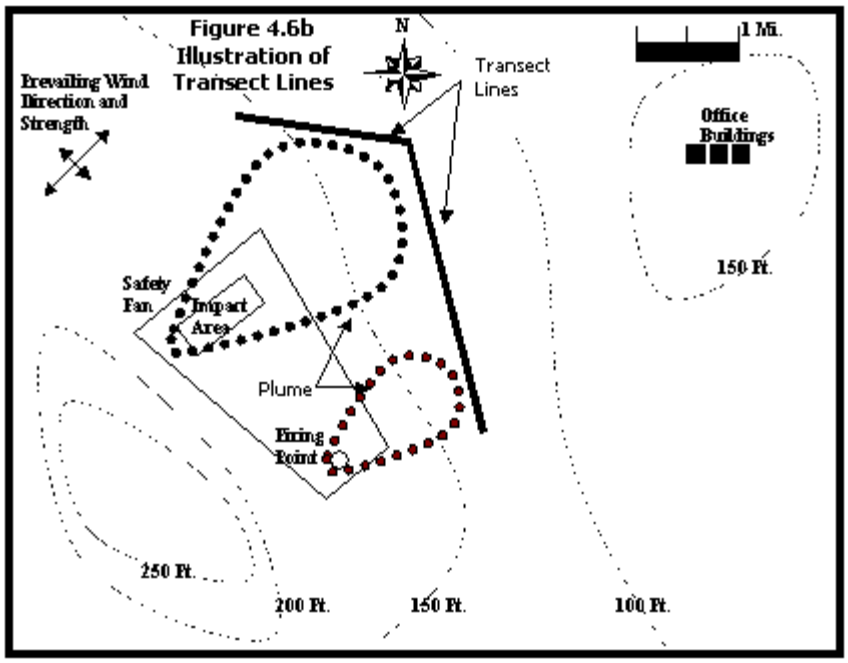
Sampling designs that incorporate enclosing the entire source area provide the highest level of scientific, statistical, and public confidence. In special cases, however, the sampling Transect Lines may not enclose an area. In scenarios where ORSM information is complete and indicates a predominant surface migration pathway, then transect lines that do not enclose a source area may be cost effective. For example, if a predominant wind direction is known and there are complete exposure pathways identified, then limited sampling along a Transect Line may be appropriate. VSP-RSM has the capability for mapping the sampling of Transect Lines that do not surround an area. Two examples are provided showing how to locate source area boundaries (Transect Lines) using VSP-RSM for surface soil sampling that do not enclose an area. In addition, location of samples for sediment sampling for non-enclosed boundaries or Transect Lines is also illustrated. The examples demonstrate determination of sampling based on information contained in the ORSM.

The first scenario is a hypothetical range located in an arid region (Figure 4.6a). From the ORSM, surface soil is unconsolidated gravel with little vegetation overlying desert hardpan clay. Hydrology is negligible with insignificant surface water or groundwater in the area.

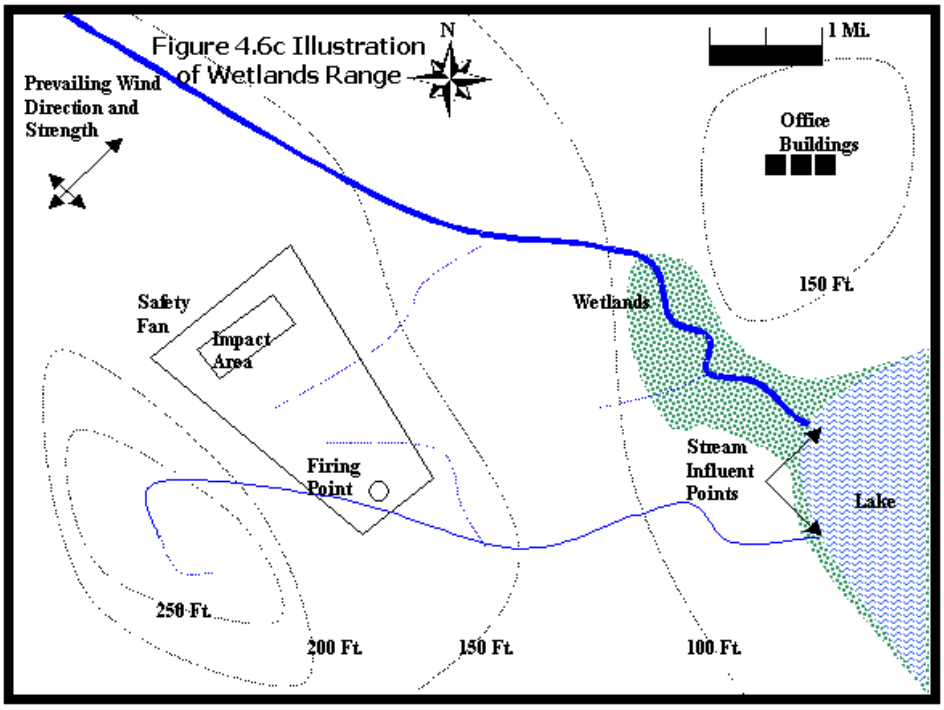


On map Figure 4.6a the firing point is located southeast of the impact area and the range is surrounded by the safety fan. The ORSM indicates that the range is located on a slope facing east and that the prevailing winds are from the southwest. The nearest human receptors are located in office building several miles from the impact area. There are no identified ecological receptors. Based on information from the ORSM, the expected source area from windblown transport deposition of explosive residues is outlined by a dotted line in Figure 4.6b.

The source area is the area of the range that explosive residues could exceed the screening level. The sampling Transect Lines are represented by lines that bound the expected deposition of explosive residues. The sampling Transect Lines are selected because of wind direction, slope of the topography and direction of the office buildings from the source area. Notice that the entire range is not surrounded. Only the expected source areas in the transport direction are bounded.

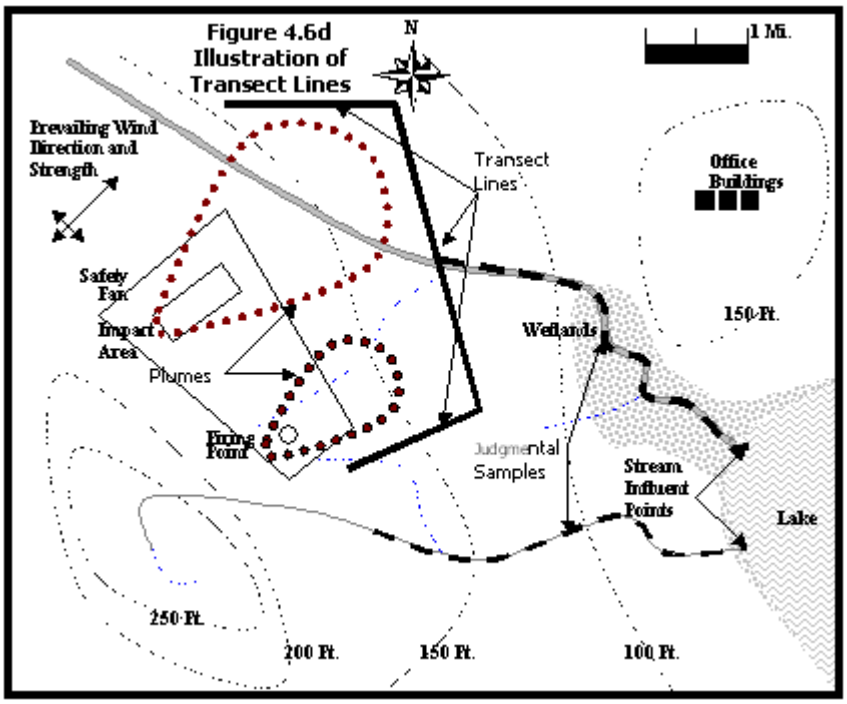


In the next scenario, a hypothetical range is located in an area with a complex hydrology and ecology (Figure 4.6c). The ORSM shows that the area is grass-covered loam overlying a relatively impermeable clay stratum with aquitard properties. The area is not a recharge zone for an aquifer. However, the range is near a wetlands area, and streams (solid lines) and seasonal stormwater runoff creeks (broken lines) traverse the range and flow into wetlands and a lake used for recreational fishing.



On map Figure 4.6c, as in the arid range scenario (Figure 4.6a), the firing point is located southeast of the impact area and the range is surrounded by the safety fan. The ORSM indicates that the range is located on a slope facing east and that the prevailing winds are from the southwest. The nearest human receptors are located in office buildings several miles from the range. However, other human receptors include recreational users of the lake. Also, ecological receptors exist in the ecologically sensitive wetlands and lake.

Based on information from the ORSM, the expected source area from windblown deposition of explosive residues is outlined by a dotted line in Figure 4.6d.



Stormwater runoff may also transport explosives through streams into wetlands and the lake. The sampling Transect Lines are represented by the heavy lines that surround the expected deposition of explosive residues and streams that transverse the source area. A dash line following the streams represents judgmental sampling along banks and streambeds. Again, notice that the entire range is not surrounded. Only the expected source areas and transport routes are bounded.

SECTION 5
ASSESSMENTS AND OVERSIGHT

The performance of assessments and oversight is a key component in ensuring that environmental decisions for RSEPA are based on data of known and documented quality appropriate for their intended use. The Program Quality Assurance Officer (QAO), in consultation with the RSEPA Executive Team, shall determine the scope and frequency of assessments for conformance to the RSEPA Policy Implementation Manual, the Master QAPP, and range-specific QAPP. Assessments will be designed to ensure and document overall data integrity and consistency of RSEPA process implementation within and across Major Claimants.

Three types of assessments shall be performed:

- Laboratory assessments,
- Field assessments (sampling and field-testing activities), and
- Project documentation assessments.

5.1 Assessor Qualifications

Personnel performing assessments/oversight in accordance with this Master QAPP (e.g., laboratory assessors, field assessors, project document assessors, data validators, and data quality assessors) shall provide resumes or equivalent documentation demonstrating their qualifications and experience needed to perform their duties. In addition, each assessor shall:

- Be independent of the process under evaluation,
- Understand and subscribe to the standards of ethical conduct detailed in the U.S. Navy, Installation Restoration Chemical Data Quality Manual (IRCDQM), September 1999, or equivalent
- Sign a statement certifying the absence of conflicts of interest as detailed in the IRCDQM or equivalent
- Comply with all applicable requirements of the RSEPA Policy Implementation Manual, Master QAPP, and range-specific QAPP.

5.2 Laboratory Assessments

Laboratory assessments will be performed at the request of the RSEPA Management Team and may be executed by either contractor or Navy personnel. For assistance in obtaining laboratory approval, the Project QAO can access the Navy help desk www.navylabs.navy.mil or contact the NAVSEA Laboratory Quality and Accreditation Office (LQAO):

NAVSEA 04XQ (Labs)
Phone: 843-764-7337

The LQAO will work with the Navy Installation Restoration Laboratory Approval Program to maximize resources and the use of pre-approved laboratories.

5.2.1 Baseline Laboratory Requirements

Laboratories must be accredited and/or approved to perform all specified test methods for RSEPA studies. Laboratory accreditation assessments are usually performed by federal, state, or third-party nationally or internationally recognized accrediting bodies, which evaluate the laboratory's compliance with the quality systems requirements issued by the International Organisation for Standardisation (ISO) in ISO Guide 25 (being replaced by ISO 17025). Based upon successful completion of the accreditation process, laboratories are granted accreditation or certification and issued a scope of accreditation that lists the test methods for which they are accredited. This process provides initial assurance of a laboratory's competency to perform work. Laboratories accredited under the National Environmental Laboratory Accreditation Program (NELAP) for the relevant fields of testing (i.e. analysis of munitions constituents in environmental media using one or more methods approved for use by this Master QAPP) meet the baseline accreditation requirements for RSEPA.

5.2.2 DoD Requirements

In addition to the baseline accreditation requirements, laboratories must comply with the requirements of the DoD Quality Systems Manual (DoD QSM), which provides DoD-specific clarification of ISO Guide 25 (and ISO 17025) criteria and method-specific performance information, as described in Section 2.4. Compliance with the DoD QSM is usually demonstrated by DoD Component-specific laboratory approval programs. (For example, the Navy's Installation Restoration (IR) Laboratory Approval Program meets this requirement for restoration programs.)

To obtain approval to use laboratories that do not participate in a Component-specific laboratory approval program, the laboratory or prime contractor must complete a process comparable to that used for the Navy IR Laboratory Approval Program, which is described in the *Navy Installation Restoration Chemical Data Quality Manual* (Navy IRCDQM) available at http://navylabs.navy.mil

For additional information or assistance, personnel may contact the NAVSEA Laboratory Quality and Accreditation Office listed above.

5.2.3 RSEPA Program Requirements

The Program QAO will review the laboratory's accreditation status and Component-specific assessment report(s) to verify the laboratory's qualifications to perform analytical services for RSEPA studies. The Program QAO will verify that the baseline accreditation requirements and DoD quality system requirements are met for the specific analytical procedures being performed under RSEPA. The QAO will also determine whether a project-specific on-site assessment is necessary. After verifying the laboratory's qualifications and completing the on-site, if required, the Program QAO will grant a limited, two-year laboratory approval, specific to the relevant fields of testing being performed under RSEPA. [*Note- This approval does not constitute Navy or DoD approval for any other Navy or DoD projects or programs.*]

5.2.4 Proficiency Testing Program

Every six months the laboratory shall demonstrate proficient method performance through the submittal of copies of PT results, directly from the PT provider, (including corrective actions as appropriate) to the Project Chemist and the NAVSEA LQAO. The PT samples shall be obtained from a provider who successfully participates in a nationally recognized PT program. Navy will review the results and determine if additional PT samples are needed to demonstrate acceptable performance. The parameters subject to review are limited to those for which the laboratory has been accepted.

5.2.5 Follow-up Assessment

A follow-up assessment may be conducted at any time during the performance of the project, as determined by the Program QAO in consultation with the Management Team, to satisfy a limited set of objectives; it may be conducted on either an announced or unannounced basis. The objective of a follow-up assessment is to verify that laboratories are meeting project-specific requirements and implementing any corrective actions necessary to address findings presented in the original assessment. The laboratory may be required to analyze PT samples as part of a follow-up assessment.

5.2.6 Reassessment

Six months prior to the end of the laboratory's two-year acceptance period, the Program QAO, with input from the Management Team, will determine the appropriate course of action to take concerning reassessment of the laboratory. The Navy will notify the laboratory in writing of the Program QAO's decision. The Program QAO may elect to:

- Allow the laboratory's acceptance status to lapse if there are no pending projects that require the laboratory's services,
- Perform a complete reassessment, or
- Perform an abbreviated review (e.g., paper review, brief Navy on-site, PT, etc.).

5.3 Field Assessments

Field assessments of sampling and field-testing activities will be performed by the Project QAO as directed by the Management Team for selected Comprehensive Range Evaluation (CRE) studies to examine conformance to QAPP requirements and to provide objective evidence of the effectiveness of field operations. Factors that influence the scope and frequency of field assessments include:

- Magnitude and complexity of the sampling effort and
- Nature and visibility (i.e., level of regulatory or public concern) of environmental concerns at a given range.

The Navy IRCDQM provides checklists for various field-sampling activities that may be adapted for use in RSEPA studies and included in the range-specific QAPP. The Project QAO, in consultation with the Program QAO, will coordinate any necessary corrective action identified during a field assessment.

5.4 Project Document Assessments

As directed by the Program QAO, in consultation with the Executive Team, project documents will be reviewed to verify that:

- The basis for all planned sampling and analysis activities is well documented and technically valid,
- The documents are technically defensible and compliant with applicable quality standards and regulations,
- The proposed sampling design will satisfy the project DQOs,
- Field and laboratory records are complete and in compliance with the Master QAPP and range-specific QAPP, and
- Field and laboratory data are valid and reproducible.

Project document assessments will be performed at the Technical, Management, and Executive levels, as directed by the Program QAO.

Project documents include:

- Range-specific QAPP
- Range-specific safety and health plan
- Laboratory quality manual
- Field and laboratory SOPs
- Training records and personnel qualifications
- Field logs and field notes
- Sample preservation documentation
- Chain of custody forms
- Laboratory reports
- Equipment and instrument operational and maintenance logs

SECTION 6
DATA ASSESSMENT

This Section provides an overview of the RSEPA data assessment process, which is consistent with guidance contained in the UFP-QAPP, as well as EPA publications QA-G-8, and QA-G-9. The Project Quality Assurance Officer (QAO), in consultation with the Program QAO, shall establish the level of effort and designate personnel responsible for conducting data assessment, based on range-specific decision-making requirements. Data assessment requirements should be established during the systematic planning process, and documented in the range-specific QAPP.

Data assessment usually involves in three steps:

1. Data verification is the process of evaluating records produced in the field and laboratory to make sure they are complete and correct, and that they document compliance with predetermined specifications given primarily in the contracts, methods, and SOPs. The goal of data verification is to ensure that the records accurately reflect what was done.
2. Data validation is the process of evaluating the overall quality of the data set to determine whether the measurement performance criteria (MPCs) established in the range-specific QAPP have been achieved.
3. Data usability assessment focuses on environmental decision-making. This step examines the verified and validated data to determine how well the data support the data quality objectives (DQOs) contained in the Master and range-specific QAPPs, i.e. whether the data effectively support the decisions that need to be made for the specific range in question and can be used as intended with the desired level of confidence.

6.1 Data Verification

Data verification is generally performed at the Technical Team level, but may also be checked at the Management Team level. At the field level, verification is usually performed by the Field Crew Chief and/or Project Chemist. Data verification of the laboratory data package is usually performed by the Project Chemist. The first step in data verification is collection of the project documents that are the sources of the relevant specifications. These documents include the Master QAPP, range-specific QAPP, laboratory contract, analytical methods, and SOPs. The next step in verification is collection of the records to be reviewed. Examples of such records include:

- Sample collection records (field logs, drilling logs, chain-of-custody forms, air bills),
- Sample receipt records (receiver's copy or acknowledgment of chain-of-custody and air bills, laboratory sample receipt logs),
- Sample preparation records (analytical service request forms, sample preparation and/or extraction logs, manufacturer's certificates for standards),
- Analytical reports (sample results, calibration records, QC sample results), and
- Field instrument operation and maintenance records.

Data verification compares the records to the specifications to verify the following:

- The chain-of-custody documentation is complete.
- Sample holding times and preservation requirements were met and documented.
- Appropriate methods and SOPs were used and cited.

- Results are reported in the appropriate units.
- Field and laboratory records are complete, accurate, and free from transcription errors.
- Calibration and quality control meet specified limits.
- Laboratory data package is complete, properly formatted, and ready for validation.

The outputs from this process are 1) the verified data and 2) the data verification statement. The data verification statement is a brief narrative describing the scope of the verification, records reviewed, and checklists used, and identifying any technical non-compliance issues or gaps in the records. [Note: Data verification does not make judgments about the acceptability of data for supporting project-specific decisions.]

6.2 Data Validation

Data validation is the systematic process for reviewing verified data for conformance to project-specific MPCs contained in project documents (e.g., Master QAPP and range-specific QAPP). It applies to both field and laboratory activities. To ensure a thorough and objective review, validation should be performed at the Management Team level by persons (e.g. the Project QAO) who are independent of the Technical Team. Inputs to the data validation process include the verified data set, data verification statement, and copies of all project planning documents and procedures.

Data validation is conducted to ensure that:

- Field and laboratory work followed all specified procedures in the QAPP and SOPs,
- Laboratory QC information and QC sample results either met the specified acceptance criteria or were appropriately qualified or "flagged,"
- The laboratory report narrative explains any anomalies in sample preparation or analysis, and
- All required corrective actions were properly executed and documented.

Where possible, data validation determines the reasons for any exceptions to meeting specifications and evaluates the impact of the exceptions to the overall data set. The outputs of data validation are the qualified data and the data validation report.

The overall scope of the data validation effort may be relatively comprehensive for data that are critical to making decisions with either high risk or low tolerance for risk (such as Confirmation Studies). Conversely, a less rigorous validation may be warranted for studies that are exploratory in nature (such as Verification Analyses). Methods to reduce the costs of data validation, such as using batch-specific PT samples, should be addressed during the early stages of the SPP.

6.3 Data Usability Assessment

The data usability assessment evaluates whether the type, quantity, and quality of data support the study's DQOs and whether the data can be used as intended. Depending on the nature and visibility of environmental concerns at a particular range, this assessment can be performed by either the Program QAO or the Project QAO. It involves a comprehensive review of project planning, sampling, and analytical records. It evaluates how well the methods performed in the actual sample matrices and estimates measurement uncertainty. Adherence to the QAPP and SOPs will control, but not

eliminate, measurement uncertainty. Factors that influence measurement uncertainty include components of both sampling uncertainty and analytical uncertainty, such as:

- Natural variability in the distribution of target analytes in the environmental media,
- Analytical interferences caused by the environmental matrix,
- Method sensitivity, selectivity, reproducibility (precision), and bias (accuracy),
- Field and laboratory subsampling,
- Sample preservation,
- Field and laboratory contamination, and
- Proficiency of the samplers and analysts.

The data usability assessment evaluates how overall uncertainty affects both range-specific project decisions and RSEPA policy decisions that need to be made. EPA QA-G-9 provides guidance for assessing data usability.

7. RANGE-SPECIFIC QAPP WORKSHEETS

List of Worksheets

1. Title and Approval Page
2. Controlled Distribution List
3. Project Personnel Sign-Off Sheet
4. Project Description
5. Project Organizational Chart
6. Personnel Responsibilities, Qualifications, and Contact Information
7. Specialized Training or Certification/Licensing/Registration Requirements
8. Project Meeting Attendance Sheet
9. Target Analytes and Field Parameters
10. Analytical Services
11. Sampling Design and Rationale
12. Sampling SOP Reference Table
13. Sampling and Analysis Summary Table
14. Sampling Equipment Checklist
15. Field Equipment Calibration Table
16. Field Quality Control Sample Summary
17. Chain of Custody Form
18. Analytical Methods and SOPs
19. Laboratory-Specific Method Detection Limits and Quantitation Limits
20. Analytical Quality Control Summary Table
21. Quality Assurance and Assessment Reports
22. Data Quality Assessment
23. Project Documents and Records

Worksheet 1

Title and Approval Page

Range: _____

Location: _____

_____
Document Title

_____
Lead Organization Contact Person

_____
Preparer's Name and Organizational Affiliation

_____
Preparer's Address and Telephone Number

_____
Preparation Date (Day/Month/Year)

Approval Signatures: _____
Signature/Date

_____
Name, Installation Commanding Officer

_____
Signature/Date

_____
Name, Range Manager

_____
Signature/Date

_____
Name, Laboratory Manager

_____
Signature/Date

_____
Name, Sampling Crew Chief

[Include spaces for regulatory agency approvals, as appropriate]

_____
Signature/Date

_____
Name, U.S. EPA Region ___

_____
Signature/Date

_____
Name, Office, State/Territory

Worksheet 2

Controlled Distribution List

List people who will receive the approved QAPP, QAPP revisions, addenda, and/ or amendments.

QAPP Recipient	Title	Organization	Document Control Number

Worksheet 3

Project Personnel Sign-Off Sheet

Copies of this form must be signed by lead personnel from each organization (including sampling contractors and laboratories) to indicate that they have read the QAPP and will implement the QAPP as prescribed. Each organization should forward signed sheets to the central project file.

Organization:_____

Name	Title	Signature	Date

Worksheet 4

Project Description

This should include:

1. **A synopsis of historical data.**
   a. Period of time the range has been in use
   b. Information about the amount and type of munitions used.
   c. Any information about former use for the site.

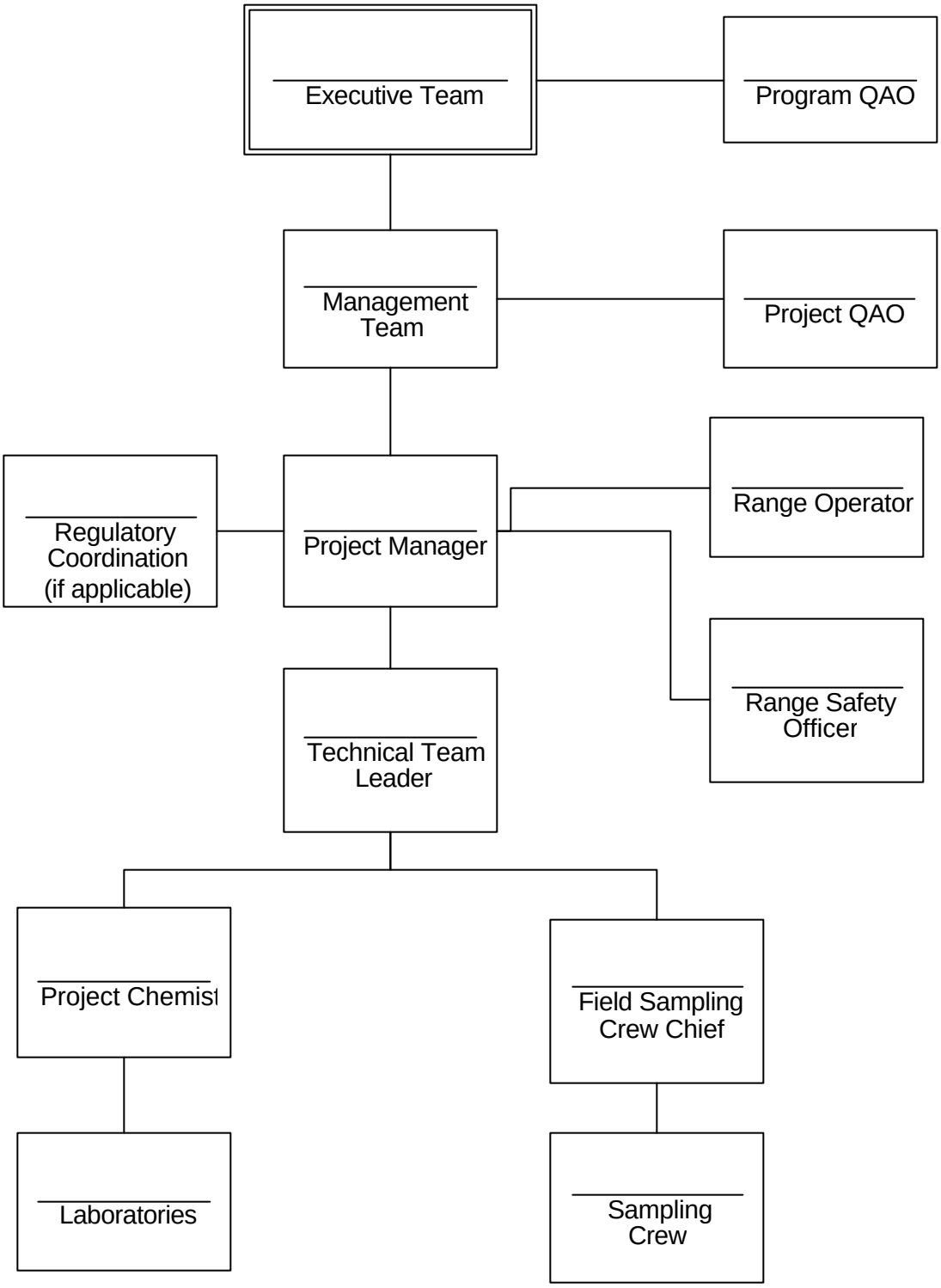
2. **Summary of migration pathways**
   a. Depth to groundwater
   b. Locations and flow directions of any streams or lakes
   c. Prevalent wind direction

3. **Assessment of potential off-range receptors.**
   a. Location of nearest population areas
   b. Description of population area (i.e. size, name)
   c. Use of underlying groundwater (i.e. drinking water, agricultural)

4. **Site Maps including:**
   - A detailed site map that shows the Range in its present state indicating firing points and target areas
   - A map that places the site in geographical context
   - Any historical maps of the location
   - Maps identifying past and planned sampling locations
   - Historical and current aerial photographs

Worksheet 5

Project Organizational Chart



Worksheet 6

Key Personnel Responsibilities, Qualifications, and Contact Information

Identify key project personnel for each organization, participating in responsible project functions. Include resumes (or equivalent documentation) in an appendix to the QAPP. Use a separate form for each organization.

Organization: _____

Name	Title	Contact Information (email and phone no.)	Project Responsibilities	Education, Certifications, Years experience

Worksheet 7

Specialized Training or Certification/Licensing/Registration Requirements

Provide the following information to document any specialized training requirements or certifications. Reference the location of training records and certificates.

Project Function	Specialized Training – Title of Course or Description	Training Provided By	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates*
[Example: Field Sampling]	OPNAVINST 5090.1B, CH-2, Chapter 25 Training – Navy Field Sampling Requirements			Field Sampling Team		
[Example: EOD Technician]						

*If training records or certificates are on file elsewhere, document their location in this column. If training records or certificates do not exist or are not available, then this should be noted.

Worksheet 8

Project Meeting Attendance Sheet

Complete this worksheet for key project planning and review meetings (e.g. project kick-off meeting, health and safety briefings, etc.). Attach meeting agenda and minutes (or reference their locations).

Date of Meeting: _____

Meeting Location: _____

Name	Title	Organization	Contact Information	Project Role

Meeting Purpose: _____

_____

_____

_____

Comments: _____

_____

_____

_____

_____

_____

_____

Target Analytes and Field Parameters

Analyte	Abbr.	CAS Num.	Human Health Screening Values[1]				Federal Ambient Water Quality (µg/L)		Sediment Quality Benchmark (mg/Kg)[3]	Quantitation Limit			
			Residential Soil[1] (mg/Kg)	Cancer/ Non-Cancer	Industrial Soil[1] (mg/Kg)	Ground Water (µg/L)	CMC[2]	CCC[2]		Ground Water (µg/L)	Surface Water (µg/L)	Sediment (mg/Kg)	Soil (mg/Kg)
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	4	C	16	0.61[1,4]	4000 [5*]	190 [6*]	0.190	0.1	0.3	0.01	0.01
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	3100	NC	31000	400[7]		330 [6*]	0.330	3	3	0.05	0.05
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	16	C	60	2.2[1,4]	560 [5*]	<40 [5*]	0.13	0.03	0.03	0.01	0.01
Perchlorate [11]		7601-90-3								See Section 3.3.3.3			
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	1800	NC	18000	1100[1,4]	30 [6*]	14 [6*]	0.02	0.03	0.03	0.02	0.02
1,3-Dinitrobenzene	1,3-DNB	99-65-0	6	NC	60	1.0[9]	110 [6*]	30 [6*]	0.04	0.09	0.09	0.02	0.02
2,4-Dinitrotoluene	2,4-DNT	121-14-2	120	NC	1200	5.0[7]	0.11 [10]		0.230	0.02	0.02	0.02	0.02
2,6-Dinitrotoluene	2,6-DNT	606-20-2	60	NC	600	5.0[7]	18,500 [5*]		18.5	0.01	0.01	0.02	0.01
2-Amino-4, 6-dinitrotoluene [12]	2-Am-DNT	355-72-78-2								0.1	0.1	0.02	0.02
2-Nitrotoluene	2-NT	88-72-2	370	NC	1000	61[1,4]				0.09	0.09	0.02	0.02
3-Nitrotoluene	3-NT	99-08-1	370	NC	1000	61[1,4]				0.09	0.09	0.02	0.02
4-Amino-2,6-dinitrotoluene [12]	4-Am-DNT	1946-51-0								0.1	0.1	0.05	0.05
4-Nitrotoluene	4-NT	99-99-0	370	NC	1000	61[1,4]				0.09	0.09	0.05	0.02
Nitrobenzene	NB	98-95-3	20	NC	100	3.4[1,4]	27,000 [6*]		27.0	0.03	0.03	0.02	0.02
Nitroglycerin	NG	55-63-0	30	C	120	4.8[7]	1,700 [5*]	200 [5*]		0.09	0.09	0.05	0.05
Methyl-2,4,6-trinitrophenylnitramine [12]	Tetryl	479-45-8								0.5	0.5	0.02	0.02

Shaded cells indicate marker compounds.

1. EPA Region 9 Preliminary Remediation Goal Tables (10/01/02) (www.epa.gov/region09/waste/sfund/prg/index.htm)
2. CMC, the criteria maximum concentration, will protect against acute effects in aquatic life and is the highest in-stream concentration of a priority toxic pollutant consisting of a 1-hour average not to be exceeded more than once every 3 years on average. CCC, the criteria continuous concentration, will protect against chronic effects in aquatic life and is the highest in-stream concentration of a priority toxic pollutant consisting of a 4-day average not to be exceeded more than once every 3 years on average.
3. Calculated from water toxicity data based on 1% organic matter according to Talmage S.S. and D.M. Opresko, 1995, Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge TN
4. EPA Region 6 Corrective Action Strategy, EPA Region 6, Dallas TX, November 2000.
5. Burrows, E.P., D.H. Rosenblatt, W.R. Mitchell, and D.L. Parmer, 1989, Organic Explosives and Related Compounds: Environmental and Health Considerations, U.S. Army Biomedical Research and Development Laboratory.
6. Talmage, S.S., and D.M. Opresko, 1995, Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge TN.
7. U.S. Environmental Protection Agency, Summer 2000, Drinking Water Standards and Health Advisories, EPA 822-B-00-001, Office of Water, Washington, D.C.
8. Human Health for Consumption of Water and Organism, U.S. Environmental Protection Agency, National Recommended Water Quality Criteria: 2002 Office of Water, Washington, D.C., EPA-822-R-02-047
9. Some methods may provide results for constituents that are not MCs as defined in RSEPA, but may still be related to testing and/or training operations with munitions.
10. Screening levels have not been developed for perchlorate. Detections of perchlorate should be verified using confirmatory methods such as liquid chromatography/mass spectrum/mass spectrum (LC/MS/MS). DoD will continue to develop guidance and more accurate and reliable methods for sampling and testing perchlorate. Decisions regarding perchlorate should be made by the Management or Executive Teams.
11. No health- or risk-based screening values are available for these MCs and degradants, but because some of these compounds are highly soluble in water, they should be included in this analysis.
* Lowest observed adverse effect level (LOAEL). Not enough data to develop criteria.

Worksheet 9 (cont.)

Target Analytes and Field Parameters

Analyte	Abbr.	CAS Num.	Human Health Screening Values[1]				Federal Ambient Water Quality (µg/L)		Sediment Quality Benchmark (mg/Kg)[3]	Quantitation Limit			
			Residential Soil[1] (mg/Kg)	Cancer/ Non-Cancer	Industrial Soil[1] (mg/Kg)	Ground Water (µg/L)	CMC[2]	CCC[2]		Ground Water (µg/L)	Surface Water (µg/L)	Sediment (mg/Kg)	Soil (mg/Kg)
Antimony	Sb	7440-36-0								40	40	20	20
Arsenic	As	7440-38-2								30	30	15	15
Barium	Ba	7440-38-2								10	10	5	5
Boron	B	7440-42-8											
Cadmium	Cd	7440-43-9								5	5	2.5	2.5
Chromium	Cr	7440-47-3								10	10	5	5
Copper	Cu	7440-50-8								10	10	5	5
Lead	Pb	7439-92-1								40	40	20	20
Mercury	Hg	7439-97-6								0.2	0.2	0.05	0.05
Nickel	Ni	7440-02-0								20	20	10	10
Selenium	Se	7782-49-2								40	40	20	20
Silver	Ag	7440-22-4								10	10	5	5
Strontium	St	7440-24-6								10	10	5	5
Zinc	Zn	7440-66-6								10	10	10	10
Field Measurements													
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	4	C	16	0.61 [1,2]	4000 [6*]	190 [7*]	0.190	0.1	0.3	0.01	0.01
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	3100	NC	31000	4004		330 [7*]	0.330	3	3	0.05	0.05
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	16	C	60	2.2 [1,2]	550 [6*]	<40 [6*]	0.13	0.03	0.03	0.01	0.01

Shaded cells indicate marker compounds.

1. EPA Region 9 Preliminary Remediation Goal Tables (10/01/02) (www.epa.gov/region09/waste/sfund/prg/index.htm)
2. CMC, the criteria maximum concentration, will protect against acute effects in aquatic life and is the highest in-stream concentration of a priority toxic pollutant consisting of a 1-hour average not to be exceeded more than once every 3 years on average. CCC, the criteria continuous concentration, will protect against chronic effects in aquatic life and is the highest in-stream concentration of a priority toxic pollutant consisting of a 4-day average not to be exceeded more than once every 3 years on average.
3. Calculated from water toxicity data based on 1% organic matter according to Talmage S.S. and D.M. Opresko, 1995, Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge TN
4. EPA Region 6 Corrective Action Strategy, EPA Region 6, Dallas TX, November 2000.
5. Burrows, E.P., D.H. Rosenblatt, W.R. Mitchell, and D.L. Parmer, 1989, Organic Explosives and Related Compounds: Environmental and Health Considerations, U.S. Army Biomedical Research and Development Laboratory.
6. Talmage, S.S., and D.M. Opresko, 1995, Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge TN.
7. U.S. Environmental Protection Agency, Summer 2000, Drinking Water Standards and Health Advisories, EPA 822-B-00-001, Office of Water, Washington, D.C.
8. Human Health for Consumption of Water and Organism, U.S. Environmental Protection Agency, National Recommended Water Quality Criteria: 2002 Office of Water, Washington, D.C., EPA-822-R-02-047
9. Some methods may provide results for constituents that are not MCs as defined in RSEPA, but may still be related to testing and/or training operations with munitions.
10. Screening levels have not been developed for perchlorate. Detections of perchlorate should be verified using confirmatory methods such as liquid chromatography/mass spectrum/mass spectrum (LC/MS/MS). DoD will continue to develop guidance and more accurate and reliable methods for sampling and testing perchlorate. Decisions regarding perchlorate should be made by the Management or Executive Teams.
11. No health- or risk-based screening values are available for these MCs and degradants, but because some of these compounds are highly soluble in water, they should be included in this analysis.

* Lowest observed adverse effect level (LOAEL). Not enough data to develop criteria.

Worksheet 10

Analytical Services (Planning Document)

Complete this worksheet for each medium/matrix, analytical parameter, and expected concentration level (e.g. low, medium, high). Identify all laboratories/organizations that will provide analytical services for the project, including field screening, field analytical, and fixed laboratory analytical work. If applicable, identify the backup laboratory/organization that will be used if the primary laboratory/organization cannot be used.

Medium/ Matrix	Analytical Parameter	Concentration Level	Analytical Method/SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person and Phone Number)	Backup Laboratory/Organization (Name and Address: Contact Person and Phone Number)

Medium/ Matrix	Analytical Parameter	Concentration Level	Analytical Method/SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person and Phone Number)	Backup Laboratory/Organization (Name and Address: Contact Person and Phone Number)

Worksheet 11

Sampling Design and Rationale

Describe the project sampling design, and provide a diagram.

Worksheet 12

Sampling SOP Reference Table

Reference Number	Title, Revision Date, and/ or Number	Originating Organization	Comments
1	Standard Operating Procedure for Soil Sampling with a Trowel (S-1, Attachment C)	U.S. Navy (Environmental Compliance and Field Testing Procedures Manual	
2	Standard Operating Procedure for Groundwater Sampling (S-2, Attachment C)	U.S. Navy (Environmental Compliance and Field Testing Procedures Manual)	
3			
4			
5			

Worksheet 13

Sampling and Analysis Summary Table

Complete all required information, using additional worksheets if necessary.

Sampling Location[1,2]	Location ID Number	Medium / Matrix	Depth (units)	Analytical Parameter	Sampling SOP	Analytical Method / SOP	Sample Volume	Containers (number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)

[1] Indicate critical field sampling locations with "1".
[2] Indicate background sampling locations with "2".

Worksheet 14

Sampling Equipment Checklist

(Adapt for range-specific study)

___Bagged/blue ice
___Calibration log
___Chain of custody forms
____Contamination control equipment
___Continuous flow sampler with peristaltic pump
___Cooler
___Custody seals
___Depth gauge
___Dissolved oxygen meter
___Double bagged, pre-preserved, pre-labeled sample bottles:
___Field log book
___Gloves, no talc
    ___Wrist length
    ___Arm length
___GPS
___In-line, pre-cleaned, 0.45 micron tortuous path filters
___Map
___Packing material
___pH meter
___pH Buffer solutions
___Pre cleaned Teflon and flouropolymer sample tubing, hose connectors, Y-splitters
___Tarp for clean area
___Scoops
___Stainless steel bowls
___Water level indicator
___Preservatives:
    ___Ascorbic acid
    ___HNO_3
    ___HCl
    ___NaOH
    ___H_2SO_4
    ___$CuSO_4$
    ___H_3PO_4
    ___Zinc acetate
___Reagent (ASTM Type I) water vessel for field blanks
___Wash/rinse bottle containing ASTM Type I water
___Sampling SOP/ SAP
___Shipping bags (Ziploc)
___Shipping boxes/coolers
___Temperature gauge/thermometer
___Teflon weight
___Turbidity meter
___Tyvek suits
___Waste carboy
___Waterproof pens
___pH paper to verify preservation (wide range)
___Sample Labels
___Sample seals / Cooler seals
___Sealing tape
___Plastic bags to line cooler
___Waste collection bags
___Safety glasses
___Aluminum foil
___Tape

Worksheet 15

Field Equipment Calibration Table

[To be completed by Sampling Crew Chief to reflect actual equipment to be used.]

Equipment	Calibration SOP	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA

Field Quality Control Summary Table
(Planning Document)

Complete a separate worksheet for each combination of sample matrix, sampling procedure and analytical procedure, as appropriate.

Sampling SOP*	
Medium/Matrix	
Analytical Parameter[1]	
Concentration Level	
Analytical Method/SOP Reference	
Sampler's Name	
Field Sampling Organization	
No. of Sample Locations	

Field QC:	**Frequency/Number**	**Method/SOP QC Acceptance Limits[2]**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria[3]**
Equipment Blanks/ Rinsate Blanks					Bias-Contamination control	
Cooler Temperature Blanks					Bias-preservation	
Other: (e.g. field duplicates, matrix spike duplicates (if the laboratory requires extra sample volume), etc.) –Do we need to spell all of these out?					Overall precision and bias	

Worksheet 17 **Chain of Custody Form**

Shipping record or air bill # _____

Contact information:

Range:	**Sampling contact:**	**Analytical contact:**
Location:		

Sampling release signature:

Laboratory release signature:

Sample #/ Description	Date	Time	Latitude	Longitude	Depth of sample (ft below surface)	Field measurements: Explosives Residue	PH	Temperature °F	Dissolved oxygen, mg/L	✔ Analyses to be performed: 8330	8095	Metals								Preservative	Lab use

Metals 1: Total and Dissolved Arsenic, Barium, Boron, Cadmium, Chromium (Total), Copper, Iron, Lead, Manganese, Mercury, Selenium, Silver, Zinc
Metals 2: Total and Dissolved Arsenic, Selenium
Metals 3: Total and Dissolved Hexavalent Chromium

Preservative types:
1 - cool to 4C
2 - HNO3, pH<2
3 - H2SO4, ph<2
4 - NaOH, pH>12
5 - HCl, pH<2
6 - H3PO4 to pH 4-5
7 - CuSO4
8 - ascorbic acid
9 - zinc acetate
10 - field filter
11 - none

Remarks:

1. Relinquished by:	Date:	Time:	Received by:	Date:	Time:
2. Relinquished by:	Date:	Time:	Received by:	Date:	Time:
3. Relinquished by:	Date:	Time:	Received by:	Date:	Time:
4. Relinquished by:	Date:	Time:	Received by:	Date:	Time:

Worksheet 18

Analytical Methods and SOPs

[To be completed by the Project Chemist after laboratories have been selected.]

SOP Reference Number	Laboratory	SOP Title and Revision Date	Analytical Parameter	Instrument	SOP Modified for Project? Y or N

Worksheet 19

Laboratory-Specific Method Detection Limits and Quantitation Limits

[To be completed by analytical laboratory for all target analytes.]

Analyte	Abbreviation	CAS Number	Method	Method Detection Limit		Quantitation Limit*	
				Water (µg/L)	Soil (mg/kg)	Water (µg/L)	Soil (mg/kg)
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4					
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0					
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7					
Perchlorate		7601-90-3					
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4					
1,3-Dinitrobenzene	1,3-DNB	99-65-0					
2,4-Dinitrotoluene	2,4-DNT	121-14-2					
2,6-Dinitrotoluene	2,6-DNT	606-20-2					
2-Amino-4, 6-dinitrotoluene	2-Am-DNT	355-72-78-2					
2-Nitrotoluene	2-NT	88-72-2					
3-Nitrotoluene	3-NT	99-08-1					
4-Amino-2,6-dinitrotoluene	4-Am-DNT	1946-51-0					
4-Nitrotoluene	4-NT	99-99-0					
Nitrobenzene	NB	98-95-3					
Nitroglycerin	NG	55-63-0					
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8					
Antimony	Sb	7440-36-0	6010B				
Arsenic	As	7440-38-2	6010B				
Barium	Ba	7440-39-3	6010B				
Boron	B	7440-42-8	6010B				
Cadmium	Cd	7440-43-9	6010B				
Chromium	Cr	7440-47-3	6010B				
Copper	Cu	7440-50-8	6010B				
Lead	Pb	7439-92-1	200.7				
Mercury	Hg	7439-97-6	6010B				
Nickel	Ni	7440-02-0	6010B				
Selenium	Se	7782-49-2	6010B				
Silver	Ag	7440-22-4	6010B				
Nitrate							
Nitrite							
Phosphorus							

* The QL cannot be less than the concentration of the lowest calibration standard and must be less than or equal to the range specific screening level.

Worksheet 20a

Analytical Quality Control Summary Table

[To be filled out by the laboratory and verified as part of laboratory selection process.
Examples for Explosives and Metals are provided]

Medium/Matrix: Soil, Groundwater, Surface water, Sediment

Sampling SOP:

Analytical Parameter: Explosives

Concentration Level:

Analytical Method/ SOP Reference: SW-846 8330/8095

Laboratory Name:

No. of Sample Locations:

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	None	Identify source of contamination, then reanalyze affected batch samples or qualify data		Lab bias – contamination control	Method blank < ½ Reporting Limit
Reagent Blank	N/A					
Storage Blank	N/A					
Instrument Blank	N/A					
Laboratory Duplicate	N/A					
Laboratory Matrix Spike	1 per batch	None	None. MS/MSD to be evaluated during data usability phase		Lab Precision – Matrix bias	None. MS effects to be evaluated during Data usability phase
Matrix Spike Duplicates	1 per batch	None	None. MS/MSD to be evaluated during data usability phase		Lab Precision – Matrix bias	RPD < 30% for MS/MSD pair
LCS/LFB	1 per batch	Within generated QC control limits	If LCS outside control limits, reanalyze affected batch samples or qualify data		Lab Accuracy	Within DoD LCS Study control limits or lab generated, whichever is more restrictive
LFB	N/A					
Surrogates	As applicable; each sample	Within generated QC control limits	If surrogates outside control limits, reanalyze affected samples or qualify data		Lab Accuracy – Matrix bias	Within DoD LCS Study control limits or lab generated, whichever is more restrictive
Internal Standards	N/A					
Other:_____ _____ _____	N/A					

Worksheet 20b

Analytical Quality Control Summary Table

[To be filled out by the laboratory and verified as part of laboratory selection process.]

Medium/Matrix: Soil , Groundwater, Surface water, and Sediment

Sampling SOP:

Analytical Parameter: Metals

Concentration Level:

Analytical Method/ SOP Reference: SW846- 6010B

Laboratory Name:

No. of Sample Locations:

Laboratory QC:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	None	Identify source of contamination, then reanalyze affected batch samples or qualify data		Lab bias – contamination control	Method blank < ½ Reporting Limit
Reagent Blank	N/A					
Storage Blank	N/A					
Instrument Blank	N/A					
Laboratory Duplicate	N/A					
Laboratory Matrix Spike	1 per batch	None	None. MS/MSD to be evaluated during data usability phase		Lab Precision – Matrix bias	MS recovery 80 - 120%
Matrix Spike Duplicates	1 per batch	None	None. MS/MSD to be evaluated during data usability phase		Lab Precision – Matrix bias	RPD < 25% for MS/MSD pair
LCS/LFB	1 per batch	Within generated QC control limits	If LCS outside control limits, reanalyze affected batch samples or qualify data		Lab Accuracy	Within DoD LCS Study control limits or lab generated, whichever is more restrictive
Internal Standards	N/A					
Other:_____ _____ _____	N/A					

Worksheet 21

Quality Assurance and Assessment Reports

[To be completed by the Project Manager: Identify the frequency and type of planned QA reporting, the projected delivery date, responsible personnel, and report recipients.]

Type of Report [examples]	Frequency (daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date	Responsible Personnel (Title and Organization)	Report Recipients (Title and Organization)
QA Management Report				
QAPP Modification				
SOP Modification				
Field Assessment				
Laboratory Assessment				
Data Verification				
Data Validation				
Data Usability				

Worksheet 22

Data Quality Assessment

Type of Assessment	Responsible Person	Procedure/Checklist
Data Verification		
Data Validation		
Data Usability		

Worksheet 23

Project Documents and Records

Identify the document and records that will be generated for all aspects of the project.
[Examples are shown]

Sample Collection Records	Field Analysis Records	Laboratory Records	Assessment Records	Other _____
Field Notes	Sample Receipt, Custody, and Tracking Records	Sample Receipt, Custody, and Tracking Records	Field Sampling Assessment Checklist	
Chain-of-Custody Records	Equipment Calibration Logs	Equipment Calibration Logs	Laboratory Assessment Checklist	
Air Bills	Sample Prep Logs	Sample Prep Logs	Data Assessment Reports	
Boring Logs	Corrective Action Forms	Corrective Action Forms	Corrective Action Reports	
Well Completion Diagrams	Field Sampling Results	Laboratory Report		
Custody Seals		Instrument Printouts (raw data) for Field Samples, Standards, QC Checks, and QC samples		
Telephone Logs		Laboratory Internal Data Package Completeness Checklist		

8. REFERENCES

ANSI/ASQC E4-1994, *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*, American National Standards Institute, 1994.

ASTM E 1689-95, *Standard Guide for Developing Conceptual Site Models for Contaminated Sites,* American Society for Testing and Materials, 1995.

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EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation*, QA/G-8, November 2002, (www.epa.gov/quality1/qs-docs/g8-final.pdf)

EPA/540/R-97/501, *Field Sampling and Selecting On-site Analytical Methods for Explosives In Soil.* November 1996. (NTIS /PB97-186613 or NEPIS / (www.epa.gov/clariton/)

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ATTACHMENT A

Selection of Marker Constituents for RSEPA Studies

John Dow
NOSSA OESO N51
dsn 354-4906
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Selection of Indicators (Marker Constituents) for Initial Screening of Sites for Explosives Contamination from Munitions Use

Purpose of paper: Deliberative document for discussion purposes only. Recommendations for rapid, economic screening of soil and water samples for purposes of range management, monitoring, and detection of off-site transport.

Background: Use of munitions on ranges can result in contamination from ordnance constituents: metals, coatings, plastics, and explosives. Sources of explosives and related compounds (e.g. binders, fillers, plasticizers, stabilizers) are incomplete reaction of energetic material (in both high and low order detonations) and leaching of intact fill from dud munitions.

History of ordnance use on any given range is often fragmentary, so a site-specific list of expected contaminants is often not available. As a result, many sampling designs default to the use of EPA Method 8330[(a)], often including tests for SVOCs and metals[(b)]. This approach can result in high costs[(c)] for a relatively limited number of samples.

Discussion: Sampling strategies for broad screening need not default to a screening for every explosive and its many breakdown products. A limited number of explosives are found in bulk in all classes of munitions. Of these even fewer are commonly found at explosives sites[(d)]. Of these, three species[(e)] (TNT, RDX, and HMX)[(f)] have been found to occur in nearly all cases where contamination is present. Well-tested field analytical methods are available[3,4] for these explosives. Because explosives are distributed as fine solid particles, relatively insoluble, and show much heterogeneity in the soil, incremental sampling coupled with field analysis has been demonstrated to reduce sampling error and increase the likelihood of finding explosives during screening if they are present[6,7].

Recommendation: For sampling plans focused on detecting whether or not explosives contamination is present in a given area, target analytes may be limited to three "marker constituents", with others added based on local information. Incremental sampling and on-site analytical methods should be used to reduce costs and ensure the highest possibility of detection.

Notes:

(a) EPA Method 8330[5] detects: HMX, RDX, TNB, DNB, Tetryl, NB, TNT, 2-AM-DNT, 4-AM-DNT, 2,6-DNT, 2,4-DNT, 2-NT, 4-NT, and 3-NT.

(b) A good summary of the many analytical options is available in the Army's guidance for RCRA closure, at Table 6-11, "Analytical requirements for OB/ OD target analytes."[18] Complete suites of analysis tend to be negative for a large percentage of samples (up to 80%)[3]. Well-documented examples include: in a major study[20], the Army analyzed for 8330 explosives+, metals and SVOAs at three ranges, and found only the usual TNT+daughter products and RDX. Studies referenced at Note (f) also had extensive analysis with few findings aside from TNT/RDX/HMX in all detect samples for explosives.

(c) 1998 costs were cited[3] from $250-350 per sample for 30-day turnaround, up to $1000 per sample for 3-day turnaround.

(d) See Table 1 of Walsh et. al. (1993)[16] for a typical "summary of explosive chemicals present in various military munitions". See Table 1 of Crockett et al.[3] for a typical list of "commonly occurring explosives, propellants, and impurities/ degradation products".

(e) In addition to the TNT, RDX, and HMX, DNT is often noted where propellant was burned or detonated. Fortunately, DNT can be detected by the TNT field method via a cross-reaction. Nitroglycerin, ammonium picrate, and tetryl are sometimes found but are associated with TNT+daughter products and/or TNT/HMX. (For example References 10 and 19 from among those cited here.

(f) Justification for the “marker” constituents: Walsh et al. (1993) [16] are oft-cited for their finding that most samples from arsenals, depots, and ammunition plants contained TNT and/or RDX. "Since almost all (94%) the soil samples with explosives detectable with Method 8330 contained TNT and/or RDX, testing soils for these two compounds would be an efficient way to screen for explosives residue contamination. Of the contaminated soils that did not have TNT and/or RDX, all had tetryl, TNB, DNB, or 2,4-DNT, all of which are detectable by the field screening procedure described in the Experimental section." Crockett et al.[3,4] concluded from this that it is feasible to screen "for one or two compounds or classes of compounds to identify the initial extent of contamination at munitions sites". TNT and RDX are widely recognized as the two most widespread explosives contaminants.[8,11, 17,18] As discussed in Reference 9, Canadian DRE found only TNT, RDX, and HMX with extensive Method 8330 analysis at several ranges: Valcartier, WATC and Dundurn[1,14], Tracadie[15], CFAD Rocky Point, and Chilliwack.[2]. They found either no residues, or the TNT, RDX, and/or HMX. After extensive sampling at Camp Edwards, the National Guard found TNT and/or daughter products, and/or RDX, HMX in all samples with detects for explosives.[10] The same can be said for an unpublished study[19] by the Marine Corps at MCAGCC 29 Palms.

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ATTACHMENT B

Development of Target Analyte List

Development of Target Analyte List

The screening values for the development of the Target Analyte list shown in Figure 3.1 (Section 3) and Worksheet 9 (Section 7) were obtained from a number of different sources. Values have not been provided for all of the munitions constituents because of the limited amount of data concerning the human impacts of these compounds. Because health risk data on perchlorate and other munitions constituents continue to be developed, and because state and local jurisdictions may have their own regulatory requirements, the RSEPA Technical Team will determine actual range-specific screening values at the time the Preliminary Screening is conducted.

The U.S. EPA Region 9 Preliminary Remediation Goal Tables[1] (PRG) levels were used to for the screening values for soil. These values are equal to, or more stringent than, those found in the EPA Region 6 Human Health Medium-Specific Screening Levels[2] (SSL). The PRG concentrations are risk-based values that were developed to address common human health exposure pathways. Because these values are generic and intended for screening sites early in the investigation process, the industrial soil values were calculated using conservative assumptions (i.e. 100 mg/day soil ingestion).

Most of the groundwater screening values found in the Figure 3.1 and Worksheet 9 were obtained from both PRG and SSL. In five cases (1,3-dinitrobenzen, 2,4-dinitrotoluene, 2,6-dinitrotoluene, HMX, and nitroglycerin), more conservative values were identified in the EPA Drinking Water Health Advisories[3,4] and thus are provided in the screening tables.

The screening values used for ambient water were obtained from the Army Environmental Centers (AEC) Regional Range Study, QAPP for Jefferson Proving Ground (August 02). The AEC used data from published ecological risk reports (published by Oak Ridge National Laboratory[4] and U.S. Army Biomedical Research and Development Laboratory[5]) and the 1994 Water Quality Standards[6] to derive these values. The screening values are broken into two sections: the criteria maximum concentration (CMC) and criteria continuous concentration (CCC). The CMC values are designed to protect against acute effects in aquatic life, while the CCC values are designed to protect against chronic effects in aquatic life. It should be noted that there is a large amount of uncertainty associated with the ambient water screening values due to the limited data on this potential exposure pathway.

Notes:

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ATTACHMENT C
STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURE (SOP) FOR SOIL SAMPLING WITH A TROWEL (S-1)

Procedural Section

1.0 Scope & Application

1.1 This method involves the use of a plastic scoop or trowel for soil sample collection. This method is designed to provide representative soil samples for subsequent analyses.
1.2 This method is intended for the collection of soil samples from 0-2 inches.

2.0 Method Summary

2.1 Sampling transect line is partitioned into segments with 5 sampling points each designated by VSP and located by GPS.
2.2 Around each sampling point along the sampling transect line segment, 5 increments are collected.
2.3 Using a non-metallic scoop, the top 2 inches of soil are collected at each increment location and placed in an aluminum foil-lined mixing bowl. The aliquot from each increment location will be as equal in volume as possible.
2.4 All rocks and organic debris are to be removed from the samples.
2.5 The increments are then thoroughly mixed using gloved hands and the sample scoop. Any clumps of soil are to be broken up. Remove any remaining rocks and debris.
2.6 The sample is then transferred to the sample container.
2.7 The sample container is assigned a unique serialized identification number that associates the collected sample with the sampling transect line segment.
2.8 Sample containers are stored and transported in a cooler at $4 \pm 2^{o}C$.

3.0 Health and Safety Warnings

3.1 The Range Safety Officer must approve sampling of the Operational Range. The sampling area must be free from unexploded munitions and no sampling can occur unless the range activities do not pose a threat to the health and safety of sampling team.
3.2 Sampling team must be briefed prior to sampling in accordance with the site specific Health and Safety Plan and the Range Safety Plan if applicable.
3.3 To eliminate worker injury from detonation of unexploded munitions, unexploded munitions detection technicians must survey the site and a safety area must be delineated as the boundary of area free from unexploded munitions.
3.4 Only workers trained in sampling and handling soil with explosive residue constituents shall participate in sampling activities.
3.5 A minimum of 2 people must be assigned to a sampling team to promote safety and expedite the process of collecting samples, labeling container, and completing field records.
3.6 The minimum required Personal Protection Equipment (PPE) includes:

- Leather shoes or boots, long pants, long-sleeved shirt, and hat.
- Disposal gloves to avoid skin contact with contaminated soils and prevent cross-contamination. Disposable latex/nitrile unpowered gloves are recommended.
- Eye protection such as safety glasses or face shields.

- Protective leather gloves to prevent cuts and scratches in heavy wooded areas.

4.0 Apparatus & Materials

1. Plastic scoop or trowel
2. Map of the Operational Range with plotted sampling points
3. GPS to locate sampling points
4. Tape measure
5. Survey stakes or flags
6. Camera and film or equivalent where permitted
7. Stainless steal, plastic, or other appropriate homogenization-mixing bowl, 2-liter capacity
8. Roll of aluminum foil to line mixing bowl
9. Precleaned, glass wide-mouth sample containers, 1-liter capacity with PTFE lined caps
10. Bubble Wrap
11. Resealable plastic bags
12. Field logbook, field worksheets, and Chain of Custody (CoC) records
13. Black-ink waterproof pen
14. Sample labels (moisture resistant) and clear tape
15. Sample cooler(s) and ice
16. Plastic sheeting
17. Tap water
18. Storage/disposal bags
19. Personnel Protection Equipment (PPE) i.e.: protective gloves, eye protection, and disposable latex/nitrile gloves

5.0 Sampling Procedure

5.1 Soil Sample Increment Location

5.1.1 VSP designates the sampling transect line, transect line segments, and sampling points along the transect line segment.

5.1.2 Using GPS, locate a sampling point designated by VSP for a specific transect line segment. Routinely, 5 sampling points are designed by VSP per transect line segment and 5 increments are collected per sampling point.

5.1.3 Stake the sampling point location and record in the sampling logbook the following:

- Project Name
- Sampler(s) identification.
- Date and time sample collection was completed.
- Sample transect line location and site of sampling event.
- GPS coordinates of each sampling point and distance of each increment from sampling point
- Weather conditions
- Site conditions and observations

5.1.4 Each data page must be signed and dated at the bottom upon completion

5.1.5 Spread plastic sheeting on the ground near the sampling point location to keep sampling equipment decontaminated and prevent cross-contamination.

5.1.6 Don PPE, and prepare sampling equipment and containers. (Use the same plastic scoop or trowel for sampling the transect line segment).

5.1.7 Select a location for collecting a soil increment no more than ½ foot from the stake.
5.1.8 Sketch or photograph the sample area and note any recognizable features for future reference.

5.2 Sample collection
5.2.1 Clear the sample area of any debris (leaves, rocks, twigs).
5.2.2 Cut grass down to the level of the soil and remove the grass clippings.
5.2.3 Using a plastic trowel, remove the thin layer of soil that contacted the debris that was removed.
5.2.4 Using the trowel, dig a trench at least 2 inches deep around a 2-inch by 2-inch sample block.
5.2.5 Remove the sample block by cutting it loose from the ground using the plastic trowel
5.2.6 Place the soil into an aluminum foil lined mixing bowl.
5.2.7 Remove all roots and other debris, rocks and pebbles. Describe the amount and kind of material that is removed in the Field Log Book.
5.2.8 Measure 10 feet north from the stake and collect another increment. Repeat increment collection for 10 feet east of stake, 10 feet south of stake, and 10 feet west of stake. Each soil increment is placed in the foil lined mixing bowl.
5.2.9 Using GPS, proceed to the next sampling point and collect 5 increments as in 5.2.8. Continue to the other designated sampling points and repeat the collection of 5 increments per sampling point.
5.2.10 Collect multiple increments into the same mixing bowl (25 increments). Representing the soil for each transect line segment. Remove all roots and other debris, rocks and pebbles as in 5.2.7.

5.3 Sample Homogenization
5.3.1 The sample in the mixing bowl should be mixed with a plastic scoop and/or gloved hands.
5.3.2 This soil should be disaggregated to less than a 6mm diameter as the sample is mixed using gloved hands and sample scoop.
5.3.3 Gather the soil into a pile in the middle of the container and divide into quarters.
5.3.4 Mix each quarter, and then combine soils from opposite corners and mix together.
5.3.5 Partition the soil into quarters again.
5.3.6 Mix each quarter, and this time combine and mix quarters from adjacent sides.
5.3.7 Combine and mix the whole sample.
5.3.8 Repeat the mixing procedures in steps 5.2.3 through 5.2.7 until the sample achieves a consistent physical appearance.
5.3.9 Increment sample should be collected into a single labeled sample container to represent the soil for each transect line segment.
5.3.10 Use a new set of clean gloves, scoop, and foil liner for each transect line segment sampled.

5.4 Documentation
5.4.1 Record on the sample container label a unique serialized identification number that is traceable to the transect line segment from which the sample was collect, sampler(s) identification, date and time of sample collection.
5.4.2 Recorded in the sampling logbook the following: Sampler(s) identification. Sample preservation information. Date and time sample collection was completed. Sample transect line location and site of sampling event. GPS coordinates of each sampling point and distance of each increment from sampling point. Each data page must be signed and dated at the bottom upon completion.

6.0 Handling and Preservation

6.1 Soil samples must be stored in a cooler at 4 $\pm 2^{o}$C.
6.1.1 Check that a PTFE liner is present in the container cap, and secure the cap tightly.
6.1.2 Wrap the sample container with "Bubble Wrap" and seal in an airtight re-sealable plastic bag and place in storage cooler.
6.1.3 Complete chain of custody (CoC) form for each container. Place CoC inside protective airtight re-sealable plastic bag and tape to inside lid of shipping container.
6.1.4 Place Temperature blank labeled "Temperature Control Bottle" in Cooler and seal cooler with shipping tape. Ensure cooler is labeled for identification.

7.0 Records Management

7.1 Sample containers must be labeled, record label information on Field Sampling Form and in Field Log Book.
7.2 Complete a chain of custody (CoC) record for each shipping container.

8.0 Quality Control

8.1 Equipment
8.1.1 Equipment used must be made of material that is compatible with explosive residue constituents and provide the correct geometry for representative samples.
8.1.2 A new pair of gloves, plastic scoop or trowel, mixing bowl aluminum foil liner must be used per sampling segment of the transect line to prevent cross-contamination between segments.
8.1.3 Single use spatula, scoop, aluminum foil mixing bowl liner must be disposed of in a plastic bag.
8.1.4 Any equipment that is reused must be cleaned, rinsed with deionized water, methanol, and air-dried before reuse.

8.2 Co-located Field Sample
8.2.1 A co-located field sample must be collected for every 20 transect line segment samples or at least 5 co-located samples must be collected per sampling event. VSP designates the transect line segment that must be selected for collecting co-located field samples.
8.2.2 A co-located field sample is acquired by collecting 25 increments from the specified transect line segment 0.5 to 3.0 feet from the original 25 increment locations collected for the same transect line segment field sample.
8.2.3 Record the approximate distance in the field logbook.
8.2.4 Each field sample and the co-located field sample containers must be uniquely identified.

8.3 Data Review
8.3.1 A member of the sampling team must be designed as the sample custodian and peer reviewer with responsibilities for taking notes in field logbook, completing field worksheets, and CoC records.
8.3.2 The sampler conducting the work and peer reviewer must check raw data and calculations recorded on the Worksheet.
8.3.3 The sampler conducting the work and peer reviewer must initial and date Worksheets.

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STANDARD OPERATING PROCEDURE (SOP) FOR GROUNDWATER SAMPLING (S-2)

Procedural Section

1.0 Scope & Application

1.1 This method involves the use of a low flow pump or a bailer to collect ground water samples for munition constituents.

2.0 Summary of Method

2.1 Where practical, monitoring wells will be sampled using a low flow purging and sampling procedure.
2.2 When collecting samples using the low flow purging and sampling procedure a dedicated, low flow pump and tubing will be used.
2.3 If conditions dictate that bailers be used for purging and sample collection, decontaminated, disposable bailers with a clean line that allows the bailer to be lowered from the surface into the monitoring well will be used.
2.4 Prior to sample collection, wells will be adequately purged.
2.5 An adequate purge volume is normally achieved when three to five well volumes of standing water in the well have been removed.
2.6 Field sampling personnel will monitor pH, specific conductance, dissolved oxygen, temperature, and turbidity of the ground water removed during purging and will record these parameters and the volume of water removed.
2.7 If low flow purging techniques are used, the parameters may stabilize before three well volumes, negating the need to purge a full three to five well volumes.
2.8 Slow recharging wells are discouraged from use, but if the well recovery is slow a hydrogeologist must be consulted to determine the appropriate purge volume.

3.0 Health and Safety Warnings

3.1 The Range Safety Officer must approve sampling of the Operational Range. The sampling area must be free from unexploded munitions and no sampling can occur unless the range activities do not pose a threat to the health and safety of sampling team.
3.2 Sampling team must be briefed prior to sampling in accordance with the site specific Health and Safety Plan and the Range Safety Plan if applicable.
3.3 To eliminate worker injury from detonation of unexploded munitions, unexploded munitions detection technicians must survey the site and a safety area must be delineated as the boundary of area free from unexploded munitions.
3.4 Only workers trained in sampling and handling ground water with explosive residue constituents shall participate in sampling activities.
3.5 A minimum of 2 people must be assigned to a sampling team to promote safety an all roots and other debris, rocks and pebbles d expedite the process of collecting samples, labeling container, and completing field records.
3.6 The minimum required Personal Protection Equipment (PPE) includes:

- Leather boots, long pants, long-sleeved shirt, and hat.
- Disposal gloves to avoid skin contact with contaminated soils and prevent cross-contamination. Disposable latex/nitrile unpowered gloves are recommended.
- Eye protection all roots and other debris, rocks and pebbles such as safety glasses or face shields.
- Protective leather gloves to prevent cuts and scratches in heavy wooded areas.

4.0 Apparatus and Materials

1. Water level indicator
2. Low flow pump or bailer
3. Sample containers- Pre-cleaned amber glass, wide-mouth 1 L capacity
4. Gloves, Disposalable latex/nitrile
5. Safety glasses
6. Tools (for opening the well)
7. Keys to locked wells
8. Field measuring instruments for: temperature, specific conductance, pH, dissolved oxygen, and turbidity and calibration standards
9. Plastic sheeting
10. Calculator
11. Field logbook, field worksheets, and Chain of Custody (CoC) records.
12. Timer
13. Shipping materials
14. Ice or ice packs
15. Indelible marker
16. Distilled water
17. Soap
18. Tap water
19. Volumetric container
20. Pre-cleaned tubing
21. Clear tape
22. Duct tape
23. Trash bags
24. Drums for purged water if necessary
20. Map of the Operational Range with plotted sampling points.
21. GPS to locate sampling points
22. Distilled water wash bottles
23. Temperature Blank Bottles
24. Tape Measure
25. Portable Work Table

5.0 Field Measuring Instruments

5.1 The dissolved oxygen, pH, specific conductance, temperature, and turbidity meters will be calibrated each morning prior to use. All calibrations and calibration checks will be documented in the field logbook.

5.2 The accuracy of the field measurements of pH, temperature, specific conductance, dissolved oxygen, turbidity, and water levels will be addressed through pre-measurement calibrations and post-measurement verifications in the field.

5.3 The calibration will be checked after eight hour of use or at the end of the sampling workday and recorded in the field logbook.

5.4 The pH will be calibrated through performing two measurements on three standard buffer solutions.

5.4.1 Each measurement will be within ±0.05 standard unit of buffer. The electrode will be withdrawn, rinsed with distilled water and re-immersed between each replicate. The instrument used will be capable of providing measurements of 0.01 standard units.

5.5 Temperature will be measured by using a thermometer with a range of -2 to 50º Centigrade (C).

5.5.1 Accuracy of measurement will be ±1 ºC. The thermometer will be calibrated against a certified NIST mercury thermometer. Temperature may also be measured with a pH or conductivity meter that is also calibrated to measure temperature.

5.6 Specific conductance will be measured using a calibrated conductivity meter.

5.6.1 The meter will be read to the nearest 10 µmhos/cm. A three-point standard curve will be developed for the conductivity meter. Fresh laboratory-prepared conductivity standards will be used for the calibration. The standards should be in the range of 10 and 1000 Ömhos/cm.

5.6.2 The calibration curve will be used to correct the value measured in the water sample by the meter.

5.7 Dissolved Oxygen (DO) will be measured using a calibrated DO meter.

5.7.1 The meter will be read to the nearest 0.1 mg/L. The meter will be calibrated by standards obtained from the manufacturer or distributor.

5.7.1.1 If necessary, to ensure a 0% oxygen environment to calibrate the dissolved oxygen meter, a solution of 300 milliliters of warm water and a pack of bakers yeast (15-30 minutes setting time) may be used.

5.8 Turbidity will be measured using a turbidimeter. Calibration will be performed with instrument cell standards and a sample cell filled with distilled water.

5.8.1 The calibration sequence outlined in the turbidimeter user's manual will be followed.

5.8.2 The sensitivity will be to 0.1 nephelometric units (NTUs). Users must ensure that they wipe off excess water and streaks on sample and calibration cells with a non-abrasive lint-free paper or cloth (laboratory wipes preferred).

6.0 Sampling Procedure

6.1 Prepare the work area outside the well by placing plastic sheeting on the portable work table to avoid cross-contamination.

6.2 Determine the saturated water column in the well using a water level indicator.

6.3 Calculate the fluid volume in the casing and determine the amount of water to be removed for purging by the following equation:

$$\text{Number of gallons} = 5.8752 * C^2 * H$$

Where: C = casing diameter in feet and H = height of water column in feet.

6.4 Purge the well using a bailer (section 6.4.1) or using low flow pump (section 6.4.2)

6.4.1 Using a bailer

6.4.1.1 In the field logbook record: water level, start time of well purge.

6.4.1.2 Attach a decontaminated bailer to a cable or line for lowering, and lower the bailer slowly until it contacts the water surface.

6.4.1.3 Allow the bailer to sink and fill with a minimum of surface disturbance.

6.4.1.4 Slowly raise the bailer to the surface. Do not allow the bailer line to contact the ground.

6.4.1.5 Collect water from the first purge bailer and measure temperature, specific conductance, pH, dissolved oxygen, and turbidity. Record in Log Book

6.4.1.6 Purge the well of 3 times the volume of water contained in the well

6.4.1.7 Collect sample and measure dissolved oxygen, pH, specific conductance, temperature, and turbidity.

6.4.1.8 Continue to bail water from the well and measure dissolved oxygen, pH, specific conductance, temperature, and turbidity until equilibrium is established by making three consecutive readings.

6.4.1.9 Equilibrium is established as follows: ± 10% for DO, ± 0.2 units for pH, ± 3% for specific conductance, ± 1°C for temperature, and ± 10% for turbidity.

6.4.1.10 If equilibrium has not stabilized by three well volumes according to the criteria in 6.4.1.9, additional well volumes will be removed. If the parameters have not stabilized within five (5) well volumes, the sample will be collected at that point, unless the field geologist decides that purging should continue. If a well is purged dry after purging one or two well volumes, the well will be considered adequately purged, allow to recover, and will be sampled within 24 hours.

6.4.2 Purging the well using a low flow pump
6.4.2.1 In the field logbook record: water level, start time of well purge
6.4.2.2 Attach any clean hoses and lines that might be necessary to the low flow pump
6.4.2.3 Attach clean disposable sample tubing to the pump
6.4.2.4 If necessary attach pump to a cable or line for lowering, and lower the pump slowly until it contacts the water surface.
6.4.2.5 Lower the pump or the tubing (depending on type of low flow pump used) until it is positioned across the well screen
6.4.2.6 Start the pump
6.4.2.7 The discharge rate should be less than 500 mL/minute.
6.4.2.8 Collect samples and measure the temperature, specific conductance, pH, dissolved oxygen, and turbidity.
6.4.2.9 In the field logbook record readings of temperature, specific conductance, pH, dissolved oxygen, and turbidity.
6.4.2.10 Continue to collect samples and measure dissolved oxygen (DO), pH, specific conductance, temperature, and turbidity until equilibrium is established by making three consecutive readings where: Equilibrium is established as follows: ± 10% for DO, ± 0.2 units for pH, ± 3% for specific conductance, ± 1°C for temperature, and ± 10% for turbidity.
6.4.2.11 If equilibrium has not stabilized by three well volumes according to the criteria in 6.4.1.10, additional well volumes will be removed. If the parameters have not stabilized within five (5) well volumes, the sample will be collected at that point, unless the field geologist decides that purging should continue. If a well is purged dry after purging one or two well volumes, the well will be considered adequately purged, allow to recover, and will be sampled within 24 hours.

6.5 Sample collection
6.5.1 Sample collection using a Bailer
6.5.1.1 In Field Log book record the start time of sampling
6.5.1.2 Once the well has been purged, the bailer is lowered into the well slowly, taking care not to disturb the surface of the water.
6.5.1.3 Retrieve the bailer and fill the sample containers. If a bottom drain valve is present, the water can be released from the valve slowly and steadily to avoid sample aeration. If no drain valve is present then the bailer should be tipped to allow for slow discharge of the water from the top of the bailer to flow gently down the side of the sample container.
6.5.1.4 Repeat this procedure until the required number of sample containers to be sent to the laboratory have been filled and enough sample has been collected to perform field sampling methods.
6.5.1.5 After samples are collected measure and record the dissolved oxygen (DO), pH, specific conductance, temperature, and turbidity

6.5.2 Sample collection using a Low Flow Pump
6.5.2.1 In Field Log book record the start time of sampling

6.5.2.2 Fill the sample containers by allowing the pump discharge to flow gently down the side of the bottle with minimal entry turbulence. The pump discharge rate should be less than 500 ml/minute.
6.5.2.3 Repeat this procedure until the required number of sample containers are filled.
6.5.2.4 After samples are collected measure and record the dissolved oxygen (DO), pH, specific conductance, temperature, and turbidity

7.0 Handling and Preservation

7.1 Check that a PTFE liner is present in the container cap, and secure the cap tightly.
7.2 Label the container with the appropriate sample label. Complete the label carefully and clearly. Place clear tape over label.
7.3 Wrap the sample container with "Bubble Wrap" and seal in an airtight re-sealable plastic bag.
7.4 Place sample in insulated container filled with ice and stored at 4 $\pm 2^{o}$C.
7.5 Complete chain of custody (CoC) form for each container. Place CoC inside protective airtight re-sealable plastic bag and tape to inside lid of container.
7.6 Place Temperature blank labeled "Temperature Control Bottle" in Cooler and seal cooler with shipping tape. Ensure cooler is labeled for identification.
7.7 Decontaminate the sampling equipment after use and between sample locations.
7.8 Wash the equipment with water and laboratory grade detergent. Rinse generously with tap water after use
7.9 Any equipment that is reused must be cleaned, rinsed with deionized water, methanol, and air-dried before reuse.
7.10 Close and seal the well.

8.0 Records Management

8.1 Sample containers shall be labeled. Label information shall be recorded in the Field Log Book.
8.2 Complete a chain of custody (CoC) record for each shipping container.

9.0 Quality Control

9.1 A new pair of disposable glove must be worn for each sample collection, and all used gloves should be discarded immediately after sampling in a trash collection container.
9.2 All work should be conducted on a clean surface.

9.3 Data Review
9.3.1 A member of the sampling team must be designed as the sample custodian and peer reviewer with responsibilities for taking notes in field logbook, completing field worksheets, and CoC records.
9.3.2 The sampler conducting the work and peer reviewer must check raw data and calculations recorded on the Worksheet.
9.3.3 The sampler conducting the work and peer reviewer must initial and date the Worksheet.

References

1. US Department of the Navy (1997) Navy Environmental Compliance Sampling and Field Testing Procedures Manual, NAVSEA T0300-AZ-PRO-010, Chapter 8.

2. US Army Corps of Engineers (2001) Requirements for the Preparation of Sampling and Analysis Plans, EM-200-1-3.

3. US Army Environmental Center (2002) Regional Range Study QAPP Jefferson Proving Ground, Madison, Indiana

4. American Society for Testing and Materials (1997) ASTM Standards on Environmental Sampling, Second edition. D 4448 Standard Guide for Sampling Groundwater Monitoring Wells. West Conshohocken, PA.