NOTICE

Operational Range Assessment Program

Version 3.0

This document is currently under revision to primarily address changes in roles and responsibilities associated with recent Air Force transformation efforts. Version 3.0 shall continue to be utilized to conduct operational range/training area assessments until ORAP, Version 4.0 is officially issued.

Questions or Comments may be directed to
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U.S. AIR FORCE

OPERATIONAL RANGE ASSESSMENT PROGRAM

Version 3.0

HQ USAF/A7CAN
1260 Air Force Pentagon
Washington, DC 20330-1260

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1.0 INTRODUCTION

U.S. Air Force (USAF) operational ranges are essential to the mission of defending the United States and protecting its interests through air and space power. USAF mission readiness relies on several interdependent factors: the right people, the right weapons, and the right support infrastructure. Support infrastructure includes assets, grouped by function, that are managed holistically to support people and weapons systems as they test and train for the conduct of military operations. The installation managers' abilities to provide natural resource infrastructure sufficient to meet military needs have become more challenging over time, due in part to increased competition for these resources. When the natural resource infrastructure is not capable or available to support current operations due to inadequacies or constraints on usage, joint military and USAF-specific testing, evaluation, training, and readiness are threatened.

The Air Force Range Sustainment Program sets forth a framework for addressing and integrating mission, operational, and training requirements with environmental, safety, and facility infrastructure needs to maintain accessibility, enhance capabilities, minimize restrictions, and ensure long-term availability of operational range resources (USAF, 2006). The Operational Range Environmental Program focuses on the environmental responsibilities portion of the Air Force's range sustainability framework which addresses natural resource infrastructure. The primary mission of the Air Force's Operational Range Environmental Program is to sustain, restore, optimize, and modernize natural infrastructure assets in order to mitigate environmental encroachment and balance environmental stewardship with operational requirements (USAF 2005). One aspect of this program is environmental resource management, which consists of operational range assessments (ORAs). The knowledge obtained through operational range assessments, in conjunction with infrastructure assessments, compliance assessments, and management programs will allow for informed decision making on environmental resource management and comprehensive planning in support of range sustainability and mission readiness.

1.1 PURPOSE

This Operational Range Assessment Program (ORAP) was developed by Headquarters U.S. Air Force, Office of the Civil Engineer, Asset Management and Operations Division, Environmental Branch (HQ USAF/A7CAN) in order to comply with the Department of Defense (DoD) policy to assess the environmental impacts of munitions use on operational ranges. Department of Defense Directive (DoDD) 4715.11 requires DoD components to assess the potential for munitions constituents (MCs) to migrate off-range from range operations. MCs are any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. Department of Defense Instruction (DoDI) 4715.14 establishes and implements procedures for conducting these assessments.

The ORAP outlines USAF procedures and provides range, installation, and Major Command (MAJCOM) personnel involved in supporting the initiative to evaluate potential munitions constituent migration beyond the operational range boundary with guidance on implementing

ORAs in a consistent and defensible manner. To accomplish an assessment of potential MC migration, the USAF will:

- Determine whether there has been a release or a substantial threat of a release of MCs of concern from an operational range or range complex to off-range areas; and

- Determine whether the release or substantial threat of a release of MCs of concern from an operational range or range complex to an off-range area creates an unacceptable risk to human health or the environment.

Based on assessment findings, the USAF will perform an appropriate response and report in accordance with applicable statutes, regulations, and policy if there has been a release or substantial threat of release of MCs of concern from an operational range or range complex to an off-range area that creates an unacceptable risk to human health or the environment (DoD 2005).

1.2 GOALS AND OBJECTIVES

The ORAP will collect, leverage, and integrate accurate data in order to provide installation managers with information to make informed planning and management decisions on ranges having the potential to release MCs beyond the range boundary so that current use may be preserved. The knowledge obtained under the ORAP regarding possible off-range releases of MC will assist USAF decision-makers in implementing appropriate mitigation measures and/or corrective actions to ensure environmental compliance as well as long-term viability of the range to support the USAF mission.

1.3 PROGRAM OVERVIEW

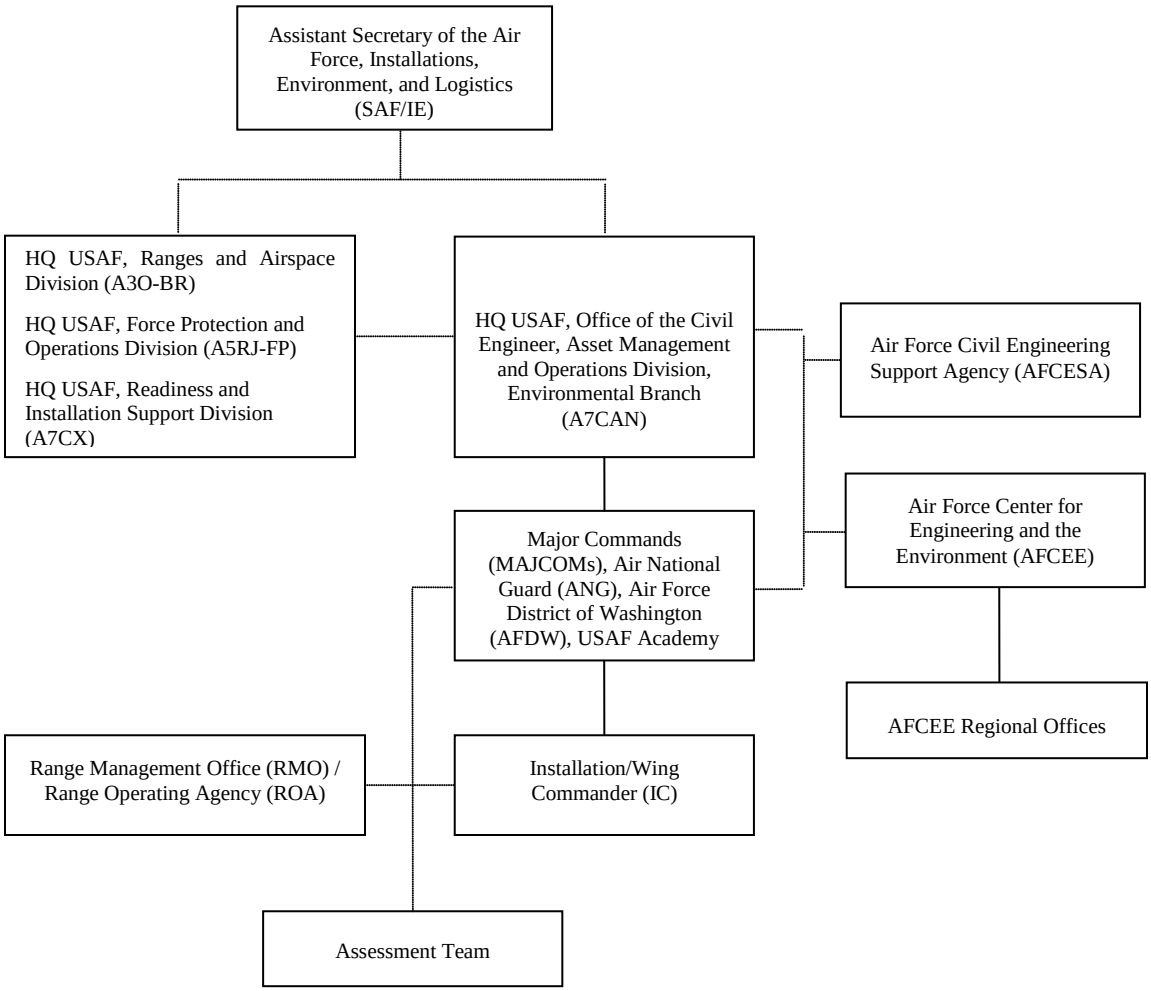
This ORAP provides requirements and establishes an approach for conducting ORAs. The ORA process will provide a basis for making informed decisions about managing mission requirements and environmental requirements in support of range sustainability. The ORAP is divided into the following sections:

- Section 1: Introduction
- Section 2: Roles and Responsibilities
- Section 3: Eligibility and Prioritization
- Section 4: ORAP Methodology Overview
- Section 5: Qualitative Assessment
- Section 6: Quantitative Assessment
- Section 7: Response Planning
- Section 8: Reporting Requirements
- Section 9: Stakeholder Involvement

2.0 ROLES AND RESPONSIBILITIES

The successful execution of ORAs conducted under the ORAP requires a cooperative approach among all involved parties to minimize the impact on facility resources while effectively collecting and evaluating the data needed to achieve assessment goals. The USAF organizations involved in implementation of the ORAP are presented in Figure 2-1. The overall ORAP organizational responsibilities are listed in Sections 2.1 through 2.11.

Figure 2-1: Operational Range Assessment Program Level Organization



2.1 ASSISTANT SECRETARY OF THE AIR FORCE, INSTALLATIONS, ENVIRONMENT, AND LOGISTICS

The Assistant Secretary of the Air Force, Installation, Environment, and Logistics (SAF/IE) shapes policy direction, conducts oversight and liaisons with the Office of the Secretary of Defense, Congress, federal agencies and external organizations. SAF/IE will:

- Provide policy and oversight of matters pertaining to the execution of plans, policies, programs and budgets for the ORAP.

- The Deputy Assistant Secretary of the Air Force (Environment, Safety , and Occupational Health) is the office of primary responsibility in SAF/IE.

2.2 HEADQUARTERS U.S. AIR FORCE, OFFICE OF THE CIVIL ENGINEER

HQ USAF/A7C is responsible for execution of the Operational Range Environmental Program for the USAF. HQ USAF/A7C will:

- Establish and maintain the ORAP and monitor development of or changes to applicable statutes, regulations, DoDDs, instructions, manuals, or other policies that affect the content of the ORAP, as well as update this guidance document whenever significant changes occur;
- Notify the SAF/IE of any discovery of a release or substantial threat of release of MCs from an operational range or range complex to off-range areas that creates an unacceptable risk to human health or the environment;
- Prepare and submit an annual report (at the end of the fiscal year) to SAF/IE indicating the progress made in implementing the ORAP;
- Coordinate with HQ USAF, Ranges and Airspace Division (A3O-BR) to ensure Operational Range Environmental Program requirements support the Air Force's Sustainable Range Program and are integrated into operational range guidance, such as Air Force Instruction (AFI) 13-212;
- Coordinate with HQ USAF, Force Protection and Operations Division (A5RJ-FP) to ensure requirements are integrated into operational range guidance affecting management and operations of small arms ranges (SARs) and grenade ranges;
- Coordinate with HQ AFCESA, EOD Division to ensure explosive ordnance disposal (EOD) procedures and requirements are integrated into operational range guidance; and
- Coordinate with HQ USAF/A3O-BR, HQ USAF/A7CX, and HQ USAF/A5RJ-FP to ensure changes to the USAF-wide inventory, of operational ranges and range complexes subject to the requirements of this document, are reviewed at least annually.

2.3 HEADQUARTERS U.S. AIR FORCE, ASSOCIATE DIRECTORATE FOR AIRSPACE, RANGES AND AIRFIELD OPERATIONS, RANGES AND AIRSPACE DIVISION

HQ USAF/A3O-BR is responsible for the implementation of the Air Force Sustainable Range Program. HQ USAF/A3O-BR will:

- Develop, maintain, and annually review a complete, up-to-date, USAF-wide inventory of operational air-to-air and air-to-ground ranges and range complexes; and
- Facilitate coordination and information collection with operational units and Range Management Offices (RMOs) and Range Operating Agencies (ROAs) to support execution of the ORAP with minimal effect on range operations.

2.4 HEADQUARTERS U.S. AIR FORCE, OFFICE OF THE CIVIL ENGINEER, READINESS AND INSTALLATION SUPPORT DIVISION

HQ USAF/A7CX oversees deployment of Air Force engineers, firefighters, and explosive ordnance personnel to support conflict and peacetime operations. HQ USAF/A7CX will:

- Assist in ensuring the operational range inventory, identified in the ORAP, accurately includes any EOD proficiency training and demolition operations areas utilized by military EOD; and
- Facilitate coordination and information collection with operational units and ROAs to support execution of the ORAP to ensure minimal effect on EOD and demolition range operations such that each EOD flight incurs no degradation of capability to maintain EOD proficiency in explosive tools and techniques and demolition range operations.

2.5 HEADQUARTERS U.S. AIR FORCE, ASSOCIATE DIRECTORATE FOR AIRSPACE, FORCE PROTECTION AND OPERATIONS DIVISION

HQ USAF/A5RJ-FP develops policy for force protection, law enforcement, air base defense operations, and small arms training programs. HQ USAF/A5RJ-FP will:

- Assist in ensuring the operational range inventory, identified in the ORAP, accurately includes any combat arms/small arms ranges utilized by the Air Force Security Forces; and
- Facilitate coordination and information collection with operational units and ROAs to support execution of the ORAP with minimal effect on combat arms/small arms ranges operations.

2.6 AIR FORCE CENTER FOR ENGINEERING AND THE ENVIRONMENT

The Air Force Center for Engineering and the Environment (AFCEE) is responsible for providing technical expertise, contract services, and strategic planning in support of USAF sustainability efforts for ranges/installations, MAJCOMs, and the Air Staff as requested. AFCEE will:

- Review MAJCOM programs and budgets to execute the ORAP based on the validated requirements submitted by MAJCOMs;
- Provide technical and contracting staff to assist, as needed, in the planning, implementation, and/or review of ORAs as a Technical Expert and/or Service Center in support of HQ USAF/A7CAN, MAJCOMs, and installations;
- Interface with other Military Services in the execution of responsibilities as a center of expertise in range sustainability;
- Provide technical expertise and support for ORAP peer reviews; and
- Maintain a repository of all final reports generated from ORAs conducted under the ORAP.

2.7 AIR FORCE CENTER FOR ENGINEERING AND THE ENVIRONMENT

As organizations within AFCEE, the regional offices are responsible for providing regional representation to federal, state, and local agencies to facilitate regional environmental compliance and management for USAF installations, MAJCOMs, and the Air Staff. In addition, AFCEE regional offices will:

- Serve as regional points of contact (POCs) for liaison activities with state and federal agencies for range assessments, as required, in coordination with Air Staff, AFCEE, MAJCOMs, and installations;
- Provide support to MAJCOMs and installations on environmental compliance and regulatory interaction, including assistance in notifying regulatory authorities of ORAP results;
- Provide stakeholder involvement and environmental risk communication support for MAJCOMs and installations; and
- Support strategic and program planning and negotiations with regulators.

2.8 HEADQUARTERS, AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Headquarters, Air Force Civil Engineer Support Agency (HQ AFCESA) provides subject matter expertise on all aspects of munitions, UXO, operational range clearance procedures, and EOD operations and requirements. AFCESA will:

- Provide EOD and UXO technical and procedural guidance/assistance, as needed, in the conduct of range assessments;
- Provide expertise, as appropriate, on development of operational and support guidance and/or standards for equipment, design, construction, operations, and maintenance of ranges;
- Assist in ensuring the operational range inventory, identified in the ORAP, accurately reflects any proficiency training or disposition ranges associated with an active EOD unit; and
- Maintain a repository of EOD incident and range clearance reports (per AFI 32-3001).

2.9 MAJOR COMMANDS, AIR NATIONAL GUARD, AIR FORCE DISTRICT OF WASHINGTON, AND U.S. AIR FORCE ACADEMY

MAJCOMs, Air National Guard (ANG), Air Force District of Washington (AFDW), and USAF Academy will:

- Ensure ORAP guidance is disseminated to, and implemented by, subordinate field units and installations;
- Develop command-specific guidance, as appropriate, for the implementation and management of ORAs at installations and ranges within their purview, including whether or not the ORA is to be executed centrally from the MAJCOM or at the installation level;
- Serve as the focal point for procedural issues associated with their ranges;

- Assist with coordination of reporting to local, state, and federal agencies, if necessary;
- Review and coordinate on ORAP documents from the installation;
- Report ORAP implementation progress to HQ USAF/A7CAN as requested (for Office of Secretary of Defense reporting);
- Validate and program, if not devolved to the installation, ORAP funding requirements in Automated Civil Engineering System–Program Management (ACES-PM), Enterprise, Environmental, Safety & Occupational Health Management Information System (EESOH-MIS), or current system;
- Notify USAF/A7CAN, immediately in coordination with AFCEE and the Regional Offices, if results of the ORA indicate release or substantial threat of release of MCs to an off-range area that creates an unacceptable risk to human health or the environment; and
- Maintain a repository of ORA results and provide an electronic copy of final report(s) to AFCEE/TD, if responsibility is not assigned to the installation.

2.10 INSTALLATION / WING COMMANDER

All USAF installations will comply with the assessment process and reporting requirements contained herein. The Installation/Wing Commander (IC) will:

- Plan and program for ORAs under the ORAP. ORAs are an environmental requirement conducted as an element of the Environmental Quality Compliance Program;
- Conduct and/or facilitate implementation of ORA contracts, as directed by and in coordination with MAJCOMs. If designated by MAJCOM to execute at the installation level, maintain a repository of assessment results and provide an electronic copy of final report(s) to AFCEE/TD;
- Confirm installation inventory and coordinate ORAs, as described in this program document, with appropriate installation offices and tenant organizations;
- Designate a POC to coordinate necessary personnel (e.g., ORA team), safety procedures, range access, and actions to implement the ORAP;
- Coordinate with local, state, and federal agencies before, during, and/or after the ORA, as appropriate;
- Determine (if directed by MAJCOM to execute the ORA) whether a release or substantial threat of release of MCs from an operational range or range complex to off-range areas creates an unacceptable risk to human health or the environment based on information collected during the assessment process; and
- Notify MAJCOM immediately if a release or substantial threat of release of MCs from an operational range or range complex to off-range areas that creates an unacceptable risk to human health or the environment is discovered.

2.11 RANGE MANAGEMENT OFFICE / RANGE OPERATING AGENCY

For installations with a RMO or ROA, the respective office will provide information regarding issues such as range access, escort, safety, scheduling, and maintenance in support of the ORAP.

2.12 ASSESSMENT TEAM

A multidisciplinary team of USAF personnel and contracted technical staff will work together to successfully implement and execute the ORAP methodology. The assessment team shall consist of personnel that will gather/generate the data (e.g., contractors), the organizations that will approve and use the data to make decisions (e.g., range, installation, and MAJCOM), those potentially affected by the decisions made based on the data (e.g., stakeholders), and the entities that will approve precedent-setting recommendations, findings and/or actions (e.g., HQ USAF). USAF roles and responsibilities are outlined above. The following information outlines the basic roles and responsibilities of contractors performing ORAs for the USAF.

The contractor physically conducts the research, provides subject-matter expertise for the ORA project, and develops contract deliverables in accordance with the project-specific scope of work. The size and composition of the contractor team will vary based on complexity and scope. In general the contractor will:

- Conduct a project 'kick-off' meeting with the USAF project manager, Contract Service Center, and other USAF stakeholders to discuss project scope, identify range and installation contacts, data collection requirements, and schedule;
- Develop project planning documents (e.g., work plan, health and safety plan, data quality assurance plan, sampling plan, etc.) for USAF review and approval prior to initiation of work. Planning documents should focus on the goals, objectives, and data requirements of the project to ensure sufficient information is obtained for decision-making;
- Coordinate with identified range and installation contacts and work to identify other stakeholders (e.g., safety officers, EOD personnel, environmental, planning, real property, etc.), as appropriate, in order to discuss data collection requirements, installation specific support, and schedule on-site activities. Based on the level of understanding of the ORAP at the installation level, the contractor may be required to conduct an 'in-brief' to discuss the ORAP methodology and scope of the project, and/or an 'out-brief' to discuss preliminary findings;
- Conduct research, collect data, and perform data analysis. Existing data will be assessed for completeness and accuracy, and any inconsistencies or data gaps will be addressed. Newly collected data will be of sufficient quality and quantity to attain project objectives. Collected data shall be in a format compatible with identified USAF information management systems and global positioning systems to facilitate integration of data; and
- Develop an assessment report documenting activities, findings, and recommendations for USAF review and approval. Review of contractor deliverables provides an opportunity for stakeholders to evaluate findings and recommendations. The accepted final report will document USAF decisions (i.e., concurrence with draft or draft final assessment report recommendations).

3.0 ELIGIBILTY AND PRIORITIZATION

The following section present information on operational ranges subject to the requirements of this document, USAF assessment prioritization tiers, MAJCOM and/or installation sequencing within tiers, and assessment completion goals.

3.1 ELIGIBLE RANGES

All areas used for range activities which are owned, leased, or operated by the USAF are subject to the requirements of the ORAP unless specifically excluded (see Section 3.2).

- Military Range. A designated land or water area that is set aside, managed, and used for range activities by the DoD. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration (10 USC §101).
    - Range activities can include research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems, and training of armed forces personnel in the use and handling of military munitions, other ordnance, and weapons systems (10 USC §101).

- Operational Range. A military range that is used for range activities; is not currently being used, but is still considered by the DoD Component to be a range area; is under the jurisdiction, custody, or control of the DoD; or has not been put to a new use that is incompatible with range activities. Term also includes operating areas, and active and inactive ranges (DoD 2003a).
    - Operating Area: Specifically bounded geographic areas that may encompass a landmass, body of water (above or below the surface), and/or airspace used to conduct operations, training, research and development, and testing and evaluation of military hardware, personnel, tactics, munitions, explosives, or electronic combat systems (DoD 2003a).
    - Active Range: A military range that is currently in service and is being regularly used for range activities (40 CFR §266).
    - Inactive Range: A military range that is not currently being used, but is still under military control and considered by the military to be a potential range area, and has not been put to a new use that is incompatible with range activities (40 CFR §266).

- Range Complex. An area which consists of multiple ranges and/or areas to include all facilities, impact or maneuver areas, and safety zones located within a single boundary or located in close proximity to each other and have similar environmental conditions (USAF 2009).

3.1.1 Non-Overseas Ranges

Application of the ORAP is limited to those operational ranges under the jurisdiction, custody, or control of the DoD (i.e., land identified on real property records as a range or area used for conducting range activities). Land or water under other jurisdiction, custody, or control and not

set aside, managed, and used for military testing and training is not an operational range subject to the ORAP.

Operational ranges operated by the USAF but owned or leased by other Military Services are subject to the ORAP. The Military Service owning the real estate on which the range is present, shall conduct the assessment, unless an alternate agreement is prepared in writing for the operator of the range to conduct the assessment. If there is uncertainty about responsibilities or a compelling reason to enter into an agreement to conduct an ORA on a range owned by another Military Service or agency, the HQ USAF/A7CAN Program Manager will be contacted for guidance.

3.1.2 Overseas Ranges

All overseas ranges subject to the ORAP will be assessed through the documented qualitative Conceptual Site Model (CSM) process to identify known contamination and potential risk to human health and the environment. If the CSM shows a risk is imminent, the next step in the process is a quantitative analysis, requiring coordination as prescribed in the Final Governing Standards (FGS) and the host nation's agreement with the DoD.

DoDI 4715.8, "Environmental Remediation for DoD Activities Overseas," Section 5.4.1 states, "The decision as to whether a contaminated site poses an imminent and substantial endangerment shall be made by the in-theater commander of the DoD Component after consultation with the appropriate DoD medical authority and the DoD Environmental Executive Agent, if any, for the respective host nation."

For each host nation, there is a Status of Forces Agreement (SOFA). The SOFA specifies that the DoD must prepare an Operations Environmental Baseline Guidance Document (OEBGD). The DoD developed the OEBGD by reviewing U.S. law and determining applicability of U.S. laws to the host nation. The OEBGD is combined with host nation laws and U.S. environmental laws and regulations to form the FGS. Based on the FGS, the in-theater commander will determine further assessment and response needs upon coordinating with the appropriate host nation authority. OEBGDs are reviewed every two years, and FGSs are reviewed every two years thereafter. Interservice working groups compare each section of the OEBGD to any new U.S. laws in order to determine whether new U.S. law strengthens or relaxes guidance.

3.2 EXCLUDED RANGES

The following operational ranges are excluded from the ORAP:

- Indoor ranges (range located within a building with no exposure to the elements);
- Operational ranges composed entirely of water (these operational ranges will be reviewed to determine feasibility for testing; however, the likely conclusion of most feasibility evaluations will exclude water ranges from assessment);
- Operational ranges subject to an assessment program substantively equivalent to the ORA process prescribed in this program document. Under the ORAP it is not necessary to duplicate scientifically valid data collection efforts. As such, if a range is required to

evaluate MCs due to state-specific laws and regulations the existing data may be used to substantively meet and/or supplement ORAP requirements; and

- Recreational ranges such as skeet, trap, rod and gun if not used for military testing and/or training. Recreational ranges are often under non-military management and are not used for military testing or training purposes.

There is often confusion about whether certain mission- or munitions-related facilities meet the definition of an operational range. The following facilities do not meet the definition of operational range and are, therefore, not subject to the ORAP:

- Munitions manufacturing facilities;
- Munitions or explosives storage areas;
- Munitions demilitarization or treatment facilities, such as permitted open burn/open detonation (OB/OD) sites, unless they are co-located on operational ranges or are also set aside, managed, and used for munitions testing and training activities; and
- Former military ranges (e.g., other than operational ranges) which are subject to the Defense Environmental Restoration Program. Areas taken out of service as an operational range and officially determined to be permanently removed from range activity use may be eligible for the Military Munitions Response Program (MMRP).

3.3 BASELINE INVENTORY

In 2000, the Air Force Office of Civil Engineer, Environmental Division initiated an accurate, comprehensive accounting of military ranges under past or present control of the USAF. A 2001 update and validation effort provided input to the Fiscal Year 2002 Defense Environmental Restoration Program Annual Report to Congress for all ranges that were declared other than operational and hence, eligible for the MMRP. The remaining military ranges, determined not eligible for the MMRP, were utilized to populate the USAF Operational Range Environmental Database. In 2005, information contained within the database was updated and validated. The data collected in 2005 was utilized to compile the ORAP baseline operational range inventory for assessment prioritization (USAF 2003a).

3.4 RANGE PRIORITIZATION

The USAF prioritized ORAs into three tiers based on the following factors: relationship of range type to the USAF mission; expenditures of munitions with the potential to leave unconsumed MC; and the presence of management controls to prevent potential MC migration. Air-to-ground ranges were determined to be the most integral operational ranges to the USAF combat mission; and where, therefore, of the highest priority for assessment. Upon completing assessments for air-to-ground test and training ranges, assessing other ranges involving munitions greater than .50 caliber, including but not limited to EOD facilities, mortar ranges, grenade ranges, and contingency, combat skills, or training areas will become the priority. After completing assessments for ranges involving munitions greater than .50 caliber, all areas used solely for training with small arms ammunition will become the priority (USAF 2003b).

3.4.1 Tier Completion Goals

MAJCOMs will oversee the execution of ORAs within all three tiers to meet the suspense goals shown in Table 3-1. Assessments at all eligible ranges, identified in the baseline inventory, shall be completed by September 2012. Ranges determined to be subject to the ORAP and not identified on the baseline inventory shall have assessments completed during the next scheduled installation-wide ORA.

Ranges subject to the ORAP are required to have reassessments conducted. Reassessments shall be completed within five years of the prior assessment. Additionally, a reassessment may take place earlier if significant changes (e.g., changes in policies) occur that affect determinations made during the previous assessment. The USAF has determined issuance of a subsequent version of the ORAP does not require an earlier reassessment as any changes in USAF guidance on conducting assessments will be incorporated into the next scheduled ORA.

Table 3-1: Operational Range Assessment Priorities

Priority	Goal[a]	Included Ranges
Tier 1	**September 2008**	Air-to-ground ranges within the United States and all types of ranges within the boundaries of Tier 1 ranges.
Tier 2	**September 2010**	Ranges involving munitions greater than .50 caliber; maneuver and training areas using smoke, pyrotechnics and/or simulators; and overseas air-to-ground ranges (e.g., EOD proficiency, demolition ranges, mortar ranges, and grenade ranges that are not co-located on ranges included in Tier 1).
Tier 3	**September 2012**	All ranges and training areas used exclusively for firing small arms ammunition (.50 caliber and below) to include blanks and dye-marking rounds.

[a] Ranges subject to the ORAP and not identified in the baseline inventory will have assessments incorporated into the next scheduled ORA. Ranges are required to have reassessments conducted every five years.

3.4.2 Sequencing Measures

MAJCOMs, in coordination with installations, may further prioritize assessment of operational ranges, if necessary. Further prioritization for assessing operational ranges shall be based on the following factors:

- Mission requirements;
- Operational use and capabilities;
- Existing facility management controls;
- Probability of unconsumed MCs on the range;
- Coverage under existing environmental quality programs; and
- Local community/regulatory interest on range operations and management.

After evaluating these factors, the results may be used to further rank ranges within USAF established priority tiers. The sequencing process, if utilized, shall be documented and will serve as a record of the analysis.

3.4.3 Progress Tracking

MAJCOMs will track status and report annually on the progress made toward implementation of the ORAP. A data call consisting of a pre-populated spreadsheet, or other designated format, shall be forwarded out prior to the end of each fiscal year requesting confirmation of inventory data, an update on completed assessments and findings, and a revised schedule for meeting established assessment and reassessment goals. Updated data shall be utilized to respond and report to the Secretary of the Air Force and the Office of the Secretary of Defense on changes to the USAF operational range inventory, schedule and progress made in accomplishing ORAs, an accounting for not meeting established assessment goals and path forward to address ORAP implementation and execution concerns, and summary of assessment findings to include a list of operational ranges known or suspected of having an off-range release of MC.

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4.0 ORAP METHODOLOGY OVERVIEW

In order to ensure the long-term viability of operational ranges, a standardized and scientifically defensible methodology is required for assessing potential off-range MC migration and responding to any associated threats to human health or the environment. To identify a release or substantial threat of a release of MCs from an operational range or range complex to an off-range area that may present an unacceptable risk to off-range receptors, the USAF has developed the assessment process detailed in this program document (see Figure 4-1). The investigative methodology prescribed in this document is similar to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process to promote defensibility of the methodology and provide a scientific basis for data collection and environmental media analysis.

- Off-range, under the ORAP, is beyond the defined range boundary. The term "range" includes various areas such as firing lines and positions, maneuver areas, test and detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. A range's boundary should be accurately and consistently defined in range operation and planning documents, and in base planning and real property records.

- MCs are materials originating from UXO, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

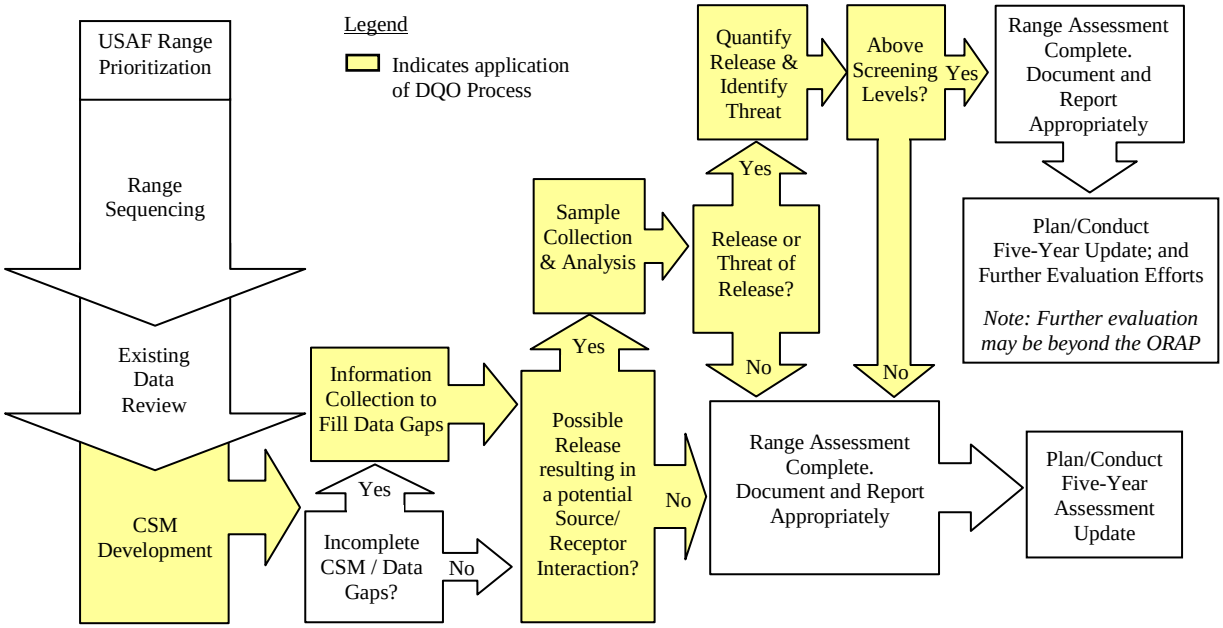
- MCs of concern are those MCs having the potential to migrate from a source area to a receptor (human or ecological) in sufficient quantity to cause an unacceptable risk to human health or the environment.

- Release, under the ORAP, is when MCs escape into the environment beyond the defined range boundary. A substantial treat of release is when MCs deposited into the on-range environment are migrating, unconstrained, towards the defined range boundary and/or are detected on-range in close proximity to the boundary.

- A potential risk to off-range receptors is identified when MCs are detected at the range boundary. An unacceptable risk to off-range receptors may be identified when MCs are detected at concentrations above established screening levels at or beyond the range boundary and/or risk characterization studies verify exposure in sufficient frequency and duration.

The approach to the USAF operational range assessment includes a two-phase process: a qualitative effort and a quantitative effort (conducted if necessary). The qualitative effort is based on review of existing information only. The quantitative effort consists of collecting and analyzing new information obtained through sampling. Upon completion of the assessment, regardless of what phase it is a part of, a report summarizing the results will be provided to USAF decision-makers.

Figure 4-1: Operational Range Assessment Flow Diagram



4.1 QUALITATIVE ASSESSMENT

The Qualitative Assessment, Phase I, objective is to evaluate whether or not a potential exists for a release or substantial threat of release of MCs to off-range areas, and to determine if further analysis is required to assess potential release, threat of release, and/or risk to off-range receptors. This initial ORAP phase (refer to Section 5) is focused on gathering and reviewing as much existing environmental compliance, facility management, and operational activity data pertinent to a range as possible prior to conducting a site visit. This information shall be used to develop an understanding of the physical and environmental conditions present; identify applicable laws, regulations, and operating standards; and draft a CSM prior to a site visit. The on-site visit shall confirm information, address data inconsistencies and/or gaps, and be used to revise the CSM through interviews, additional records review, and visual survey of the range.

4.1.1 Records Review

A records search and review shall be conducted of readily available documents and resources from the range, installation, and MAJCOM as well as other organizational data archives and information repositories. A record of all data sources reviewed shall be maintained and pertinent documents obtained in electronic formats if possible. Existing data shall be assessed for completeness and accuracy, and any inconsistencies or data gaps identified. As much information as possible shall be collected, prior to the site visit, in order to minimize interruption of installation and range activities, and develop a draft CSM to identify data collection needs.

- Information on the overall condition of a subject range's natural and built infrastructure; existing environmental compliance requirements, laws, regulations, and standards; and associated historic and current environmental, maintenance, and/or safety compliance efforts

shall aid in establishing the "health" of the on-range environment and facilities, identify suspected source areas, and discern activities, past and current, that may directly or indirectly increase or decrease MC availability, deposition, and redistribution in the on-range environment and its potential to migrate to areas outside the defined range boundary.

4.1.2 Site Visit

A site visit shall be conducted to resolve information inconsistencies, address identified data gaps, and confirm the overall condition of the range's natural and built infrastructure through personnel interviews, additional records review, and a range survey. Interviews shall be documented in a consistent format and additional data sources reviewed cataloged and obtained in electronic format, if possible. All access and safety requirements shall be followed during the range survey. Pertinent on-range and off-range features shall be digitally recorded and/or geo-referenced, and this data shall be in a format compatible with USAF systems. Information collected shall be utilized to evaluate infrastructure conditions (built and natural); assess the potential impact of range activities (specifically associated with munitions use and identified MCs of concern) on the environment; and revise the CSM based on data reconciliation with actual site conditions.

- The USAF developed MC Master Lists of chemical compounds to be initially considered and evaluated during implementation of the ORAP. The MC Master Lists shall be revised and compounds added or removed as appropriate, based on data collected and reviewed in order to develop range-specific MCs of concern.

- The CSM tool shall be implemented throughout the ORA process to assist the assessment team in organizing information on a range and identifying data gaps. An effective CSM will integrate information on the built and natural infrastructure, factors affecting contaminate release, fate and transport; and the surrounding land use to identify receptors and resources in order to assess all possible exposure scenarios and evaluate source-receptor interaction. As knowledge and understanding of a range changes based on additional data, the CSM is revised to accurately communicate conditions to stakeholders and decision-makers.

4.1.3 Reporting

A determination is made regarding if further analysis is warranted or no further evaluation required based on the results of the Qualitative Assessment. If no further analysis is required the ORA process is concluded, findings documented (i.e., no off-range MC release, no substantial threat of an off-range MC release, and/or no potential risk to off-range receptors) in an assessment report, and then the range is scheduled for a five-year qualitative reassessment. However, if the potential exists for a viable transport mechanism between suspected MC source areas and off-range receptors, or there is not enough information available to make a determination on source-receptor interactions an assessment report is issued and a Quantitative Assessment planned. A determination to conduct a Quantitative Assessment, upon the completion of the Qualitative Assessment, is not considered precedent setting by the USAF.

4.2 QUANTITATIVE ASSESSMENT

The objective of the Quantitative Assessment, Phase II, is to evaluate whether a release or substantial threat of release of MCs to off-range areas exists; assess if the potential release creates an unacceptable risk to off-range receptors; and determine if further evaluation is warranted to address a release, threat of release, and/or risk to off-range receptors. This secondary ORAP phase (refer to Section 6) utilizes systematic planning and is focused on obtaining updated information on a subject range, collecting environmental sampling data, and analyzing data to verify release or threat of release of MCs and characterize associated risk. The data shall be used to better understand suspected source areas, possible transport mechanisms, exposure points, and off-range receptor interactions. Information from the Quantitative Assessment shall be used to determine specific of MCs of concern, revise the range-specific CSM, evaluate off-range releases, and assess potential risks.

4.2.1 Systematic Planning

Project-specific data quality objectives and quality assurance measures shall be developed to ensure the appropriate type, quantity, and quality of data are collected to make technically sound and defensible decisions. Systematic project planning shall be utilized to identify decision goals, ensure data objectives are clearly defined and support decision goals, and the most resource-effective approach is used to reach data objectives. Systematic project planning tools include the data quality objectives process and quality assurance planning. Range-specific project plans shall be developed which incorporate systematic planning strategies and tools.

- Qualitative Assessment phase data shall be confirmed and new data obtained and reviewed. Depending on changes in reported range conditions, a reconnaissance visit may be necessary in order to update the CSM developed during the Qualitative Assessment, discuss project objectives and planned sampling activities, and identify operational range restrictions and access constraints due to terrain and/or safety.

4.2.2 Sampling Methodology

The sampling methodology prescribed under the ORAP is not intended to be a source characterization or an exhaustive site characterization study to assess the potential impact of range activities on the environment. The sampling methodology outlined in this program document focuses on obtaining knowledge of suspected source areas and potential migration routes between sources and the range boundary in order to assess potential MC migration and make a determination of a possible off-range release or threat of release. The methodology consists of field screening techniques and a dynamic sampling approach to use real-time data to refine sampling collection locations for off-site laboratory analysis. The use of dynamic sampling strategies, in conjunction with real-time field screening technologies, provides flexibility in the field to maximize the amount of data collected during a single sampling event or mobilization.

A range-specific sampling approach, to evaluate whether a release or substantial threat of release of MCs to off-range areas exists, will be developed as the level of effort shall vary based on a range's size and complexity as well as Qualitative Assessment data, findings, and associated CSM data gaps.

- All range access and safety requirements shall be followed during sampling efforts. The level of explosive safety support for sampling efforts is dependent on the range type as well as areas anticipated to be accessed. In some cases, it may be necessary to include a qualified UXO technician as a member of the sampling team.

- Field screening and sample locations as well as pertinent features not previously documented shall be digitally recorded and/or geo-referenced. This and other assessment data (e.g., analytical) shall be in a format compatible with USAF information management and global positioning systems.

- The range-specific CSM shall be revised, throughout the ORA process, as knowledge and understanding of a range changes based on additional data. In order to accurately communicate conditions to stakeholders and decision-makers the CSM shall be provided in both graphical and pictorial formats.

4.2.2.1 Release Analysis

Evaluation of a MC release or a substantial threat of release to off-range areas involves comparing sampling results to associated media screening values. If the maximum reported concentration and associated sample location exceed the screening values, then risk evaluation is performed.

4.2.3 Risk Evaluation

The implemented sampling approach shall support the collection of representative data to evaluate the relative risks that off-range contamination may pose to human health and the environment. Sample data shall be used to perform a preliminary human health risk assessment and screening level ecological risk assessment to evaluate whether a release or substantial threat of release of MCs to areas beyond the range boundary poses a potential risk and/or creates an unacceptable risk to off-range receptors.

- The human health evaluation prescribed under the ORAP is limited to a preliminary assessment. The assessment shall utilize available human-health risk based screening levels, chemical toxicity information, naturally occurring levels or background concentrations (as appropriate), and evaluate against maximum detected concentrations to determine if potential unacceptable risk exists.

- The ecological evaluation prescribed under the ORAP is limited to a screening level assessment. The screening level assessment shall utilize available chemical toxicity data and compare detected concentrations in environmental media to established and appropriate ecological screening levels in order to determine the likelihood that a potential unacceptable risk exists.

4.2.3.1 Risk Analysis

Off-range human health and ecological risk evaluation involves various risk assessment inputs and are based on MC release evaluations, CSM source-receptor interactions, and established risk-based screening levels. These evaluations will have one of three possible findings: Acceptable Risk; Potential Risk; or Unacceptable Risk.

4.2.4 Reporting

Based on the results of the Quantitative Assessment a determination is made regarding if further analysis is warranted or if no further evaluation required. If a no further analysis determination is made, the ORA process is concluded and findings documented (i.e., no off-range MC release, no substantial threat of an off-range MC release, and/or acceptable risk to off-range receptors) in the final assessment report. The range is scheduled for a five-year qualitative and quantitative reassessment. During implementation of the Quantitative Assessment the ORA team may recommend, due to identified concerns, an independent environmental, health, and/or safety compliance study. As appropriate, the MAJCOM in coordination with the range and installation shall program and plan for any recommended compliance study.

If findings from the risk analysis indicate Potential Risk or Unacceptable Risk, then further evaluation is warranted to fully evaluate a release or threat of release; assess potential risks to off-range receptors; study possible mitigation measures; and/or consider corrective actions. A final assessment report is issued documenting findings as well as the associated release and risk determinations. A further evaluation recommendation at the completion of the Quantitative Assessment phase is considered precedent setting by the USAF. Precedent setting recommendations require notification of the Civil Engineer, A7C and/or approval, which encompasses additional internal as well as external reporting (refer to Section 8).

5.0 QUALITATIVE ASSESSMENT

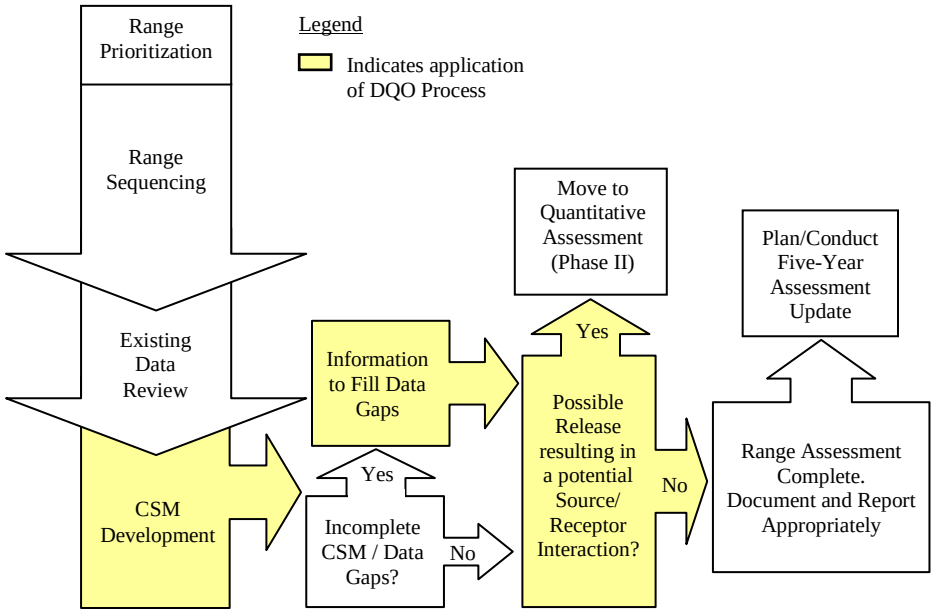
The ORA process begins with the Qualitative Assessment, Phase I (refer to Figure 5-1). The purpose of the Qualitative Assessment is to gather and review as much existing environmental, facility, and operational information about a subject range in order to determine whether or not a potential exists for an off-range release or substantial threat of release of MCs to areas beyond the range boundary, and if further analysis is required to assess potential risk to off-range receptors.

The Qualitative Assessment consists of records review, interviews, and a site visit in order to obtain an understanding of current as well as historic conditions at a subject range (EPA 1991). Information from the Qualitative Assessment shall be used to develop a range-specific CSM and will be evaluated to answer the first key question:

> *Is there a possible release or threat of release resulting in a potentially complete exposure pathway between suspected MC sources on a subject range and off-range human and/or ecological receptors?*

Based on the results of the Qualitative Assessment, recommendations are made to the USAF in the form of a draft report regarding if further analysis is warranted or if no further evaluation is required. Upon USAF approval of recommendations, a final report is issued documenting the Qualitative Assessment evaluation and finding determination.

Figure 5-1: Qualitative Assessment Process Flow Diagram



5.1 RECORDS COMPILATION AND REVIEW

The records compilation and review portion of the Qualitative Assessment is focused on gathering and reviewing as much existing environmental compliance, range management and operational activity information as possible pertinent to a subject range or range complex. As much information as possible shall be collected, prior to the site visit, in order to identify data gap collection needs and minimize interruption of installation and range activities. The purpose is to collect sufficient data to establish the overall condition of the natural and built infrastructure in order to develop an accurate CSM. Refer to Appendix C for a CSM template.

The assessment team will conduct a records search, collection, and review of readily available documents and resources from the range, installation, and MAJCOM as well as other organizational data archives and information repositories. Data sources that should be included in the records compilation and review are discussed further in Section 5.1.1. The information obtained from existing records compilation and review will be used by the assessment team to identify surrounding area and pre-range activity land use(s); the physical setting (facilities and environment) of the range; applicable environmental regulations and governing operational standards; previous environmental investigations and facility assessments; historic and current range activities (to include types of munitions used, quantities of munitions used, frequency of use, and test and/or training activities); and historic and current operations and management activities (to include environmental, maintenance, and/or safety compliance efforts).

The collected data will be evaluated to discern potential MC source areas and range-specific MCs of concern; potential MC transport mechanisms as well as any design features and/or maintenance efforts that may directly or indirectly increase or decrease MC deposition and transport; and the proximity of potential off-range human and ecological receptors. This existing knowledge shall be further utilized to develop a draft range-specific CSM to identify data gaps or inconsistencies to be addressed during the site visit

5.1.1 Data Sources

Data sources that should be included in the existing records compilation and review are presented in Table 5-1. These data sources are for reference purposes only and should not be considered a complete listing. The ORAP categorizes sources into two classes as detailed in Table 5-1. Data sources under Class 1 are deemed likely to provide the most benefit; however, the assessment team will obtain as much information as possible from both Class 1 and Class 2 data sources. No matter the source, all data should be assessed for completeness and accuracy, and any inconsistencies or data gaps identified.

Not all documents or resource types will be available for each range; however, as many of the listed documents as possible will be acquired during the review. Electronic copies should be made of all applicable documents, if possible, and marked using standard archival techniques to provide information on the location of the original data source. A record of all data sources reviewed shall be documented. The documented listing of all records reviewed and associated pertinent records compiled shall be provided as an appendix in the final report.

Table 5-1: Class 1 and Class 2 Data Sources

Class 1 Data Sources	
• Aerial Photographs • Archives Search Reports (ASRs) • Base Comprehensive Plan • Comprehensive Range Plan • Environmental Safety and Occupational Health Compliance Assessment and Management Program (ESOHCAMP) Documents • Environmental Restoration Program Studies and Documents (i.e., IRP, CRP, and MMRP) • Emergency Planning and Community Right-to-Know Act (EPCRA) Toxics Release Inventory (TRI) Reports • Environmental Baseline Surveys • EOD Clearance and Response Records • Historical Records Reviews (HRRs) • Infrastructure Assessments (built, facility safety, and natural) • Installation Compatible Use Zone Studies • Installation Geographic Information System (GIS)	• Integrated Cultural Resources Management Plans (ICRMPs) • Integrated Natural Resources Management Plans (INRMPs) • Munitions Allocation Records • Monitoring Records from Groundwater Wells • National Environmental Policy Act (NEPA) Documents • Permits and Compliance Reports • Range Construction and Siting Records • Range Complex Management Plans • Range Manuals and Range Regulations • Range Maps (Historic and Current) • Range Frequency of Use Data (Range Control Scheduling Data) • Real Property Records • Unit Training Documentation • USAF Safety Center layout approvals for EOD proficiency and demolition ranges
Class 2 Data Sources	
• Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Assessments • Coastal Zone Management Act Determinations • Endangered Species Consultations, Biological Assessments, and Biological Opinions • Installation Weather Station Data • Master Plans • Munitions Item Disposition Action System (MIDAS) • National Archives, Washington, D.C.	• National Resources Conservation Service County/State Soil Surveys • National Weather Service, National Oceanic and Atmospheric Administration (NOAA) Data • Programmatic Agreements for Historic Properties • Spill Reports • U.S. Census Bureau (Population Data) • U.S. Geological Survey (USGS) Streamflow Data, Groundwater Reports • Water Quality Reports (local, regional) • Wetlands Surveys

5.2 SITE VISIT

The site visit portion of the Qualitative Assessment is focused on interviewing key personnel, performing additional records research, and conducting a range survey. To the maximum extent possible all available documents and records shall be reviewed prior to conducting the site visit in order to minimize interruption of installation and range activities, and to identify data collection needs. The purpose is to address identified data gaps, resolve information inconsistencies, and confirm the overall condition of the range's natural and built infrastructure.

The assessment team shall coordinate sufficiently in advance with identified stakeholders in order to discuss data collection requirements, ascertain personnel availability and range accessibility, installation-specific support, and range survey activities. A point paper identifying outstanding data collection needs and anticipated meetings with key personnel may be developed to facilitate scheduling and planning efforts. Based on the level of understanding of the ORAP at the installation level, the assessment team may conduct an 'in-brief' to discuss the ORAP methodology and the scope of the project as well as an 'out-brief' summarizing activities and assessment report development schedule.

5.2.1 Interviews / Records Research

Interviews and additional records search will be conducted to address identified data gaps, resolve information inconsistencies, and supplement previously collected information. Interviews shall be conducted with key personnel involved in range operations and environmental management to expand on information in documented records, address data gaps or inconsistencies, and to identify any other pertinent records or resources not previously provided for review. Key personnel to be interviewed may include, but may not be limited to, individuals from the following organizations: range operations, range support, environmental, natural/cultural, bioenvironmental, EOD, Weapons Safety, Combat Arms Training and Maintenance, and real property/base planning. For ranges transferred to the Air Force under Joint Basing agreements, the previous operating and management personnel should be interviewed, if available. Records of interviews will be documented in a consistent format and provided as an appendix in the final report.

The assessment team will continue to search and review pertinent data resources in order to provide a more comprehensive representation of past and current range operations and environmental management actions. Information from existing range databases, as well as other data management systems, will be reviewed prior to the range survey to obtain additional information on current and historic operations, use, and maintenance. Documenting the current and historical management practices at a range will assist in identifying potential MC source areas, other environmental concerns, and any actions taken to address on-range contaminants or other identified range issues. The age of the range, past and current (as well as planned future) activities, types and quantities of munitions used, frequency of use, and facility design all contribute greatly to the potential for MC to be present in the on-range environment. The physical setting and environmental aspects of the range help to identify potential transport mechanisms for MC to migrate off-range. Range management and maintenance activities, past and current, may directly or indirectly impact MC availability and migration potential.

5.2.2 Range Survey

A visual survey of the range will be conducted to confirm the overall reported infrastructure condition (built and natural), reconcile any data inconsistency with actual site conditions, and assess the potential impact of range activities (specifically associated with munitions use and remnant MC) on the environment. The range survey may identify undocumented munitions use areas; unknown range related environmental contamination; and/or maintenance, safety and health, or environmental compliance concerns. Non-MC migration-related concerns should be identified by the assessment team to the range, installation, and MAJCOM to address, as appropriate. The range survey shall be conducted when the range is not in use or at a time that limits interruption of scheduled activities. The level of effort in conducting the range survey may vary based on range type, size, and location. The survey is not anticipated to obtain 100% coverage due to access restrictions and possible safety concerns; however, as much of the range property as possible should be viewed.

During the range survey, the assessment team will confirm range layout and boundary. Range conditions to be identified and examined, which indicate current or historic munitions activities, include but are not limited to the presence of munitions fragments or intact bullets on the ground; craters from previous bombing impacts or detonations; depressions, elevations, or soil or vegetation disturbance indicating potential past burials or possible bullet pockets; and/or presence of munitions or explosive packaging. The team shall identify suspected contamination source areas, potential transport mechanisms, on-range environmentally sensitive areas, visible signs of possible environmental impacts from range activities, and locations of possible off-range receptors.

The assessment team should visually inspect the perimeter of the range and off-range areas, if accessible to further assess potential off-range transport mechanisms, surrounding habitat and land use, and proximity of off-range receptors. Additionally, the team should look for evidence of off-site areas potentially affected by range activities as well as identify any adjacent uses which may have the potential to impact range use (e.g., contamination migrating onto the range).

The assessment team shall, if permissible, digitally record and geo-reference the extent of the range, general range layout, suspected MC source areas and transport mechanisms, and any visual evidence of other potential range environmental concerns noted during the visual survey. The locations of existing monitoring wells and other sampling devices shall also be geo-referenced and digitally recorded. This data shall be cataloged and provided, in compatible formats, as an appendix in the final report for planning and reporting purposes.

5.2.2.1 Access and Safety

The assessment team must comply with all range access and safety requirements. Range access and determination on the appropriate level of safety support are inherent functions of the range, safety, EOD, and the installation ORA contact (USAF 2007). The level of explosive safety support is dependent on the range type as well as areas to be accessed. Generally an escort by range personnel and implementation of avoidance techniques is acceptable; however, in some cases military EOD may be present to ensure anomaly avoidance protocols are followed. The assessment team will work with the MAJCOM, installation, and range to ensure the appropriate level of explosive safety support is in-place prior to conducting a range survey.

5.3 DATA ANALYSIS AND EVALUATION

Data from the records review, interviews, and site visit shall be used to establish the physical and environmental conditions present, revise the MC Master List, and update the range-specific CSM to evaluate the potential for MCs to be present in the on-range environment; possible mechanisms present to transport MCs from suspected source areas; and potential exposure of off-range receptors to MC contaminated media.

5.3.1 Range Infrastructure

The current physical setting and environmental aspects of a subject range will be documented to develop a comprehensive representation and understanding of past and current infrastructure. Knowledge on a subject range's governing environmental regulations and operational standards, and the natural and built infrastructure shall assist in identifying potential range related environmental contamination concerns as well as any maintenance, safety and health, or environmental compliance concerns, and those actions taken to address on-range contaminants or other identified range issues. Non-MC migration related concerns should be identified by the assessment team, to be addressed by the range, installation, or MAJCOM. Refer to Appendix A for a survey checklist to assist in identify governing requirements.

Facility design and range layout as well as management and maintenance activities (past and current) may directly or indirectly increase or decrease MC availability, deposition, and redistribution in the on-range environment as well as potentially result in adverse effects on safety and health. The environmental features and characteristics, and any alteration of the on-range environment due to activities or maintenance efforts may also directly or indirectly increase or decrease MC deposition and its potential to migrate to areas outside the defined range boundary.

Information on the overall condition of a subject range's natural and built infrastructure; existing environmental compliance requirements, laws, regulations, and standards; and associated historic and current environmental, maintenance, and/or safety compliance efforts shall aid in establishing the “health” of the on-range environment and facilities; identify any current or foreseeable adverse effects on operations or range use due to compliance; and evaluate the proximity of suspected source areas to the range boundary and migration routes to transport contamination beyond the range boundary. Migration from an operational range maybe through the air, soil (surface and subsurface), surface water/sediment, and groundwater.

5.3.2 Munitions Constituents of Concern

MCs are any materials originating from UXO, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. DoDI 4715.14, Operational Range Assessments, states that, “DoD Components shall identify and evaluate munitions constituents of concern. The DoD will, at a minimum, determine whether RDX, HMX, TNT, or perchlorates may have been deposited on an operational range and, if deposited, whether the deposit meets the definition of munitions constituent of concern.” MCs of potential concern are those MCs having the potential to migrate from a source area to a receptor (human or ecological) in sufficient quantity to cause an unacceptable risk to human health or the environment.

The USAF reviewed existing literature documenting the potential presence of explosives and other energetic material in the environment. Available munitions expenditure data were also compiled from USAF operational ranges as reported through the DoD Toxics Release Inventory Data Delivery System (TRI-DDS) to assess which MC should be evaluated as part of the USAF ORA process. Based on the evaluation of munitions used across the Air Force, the USAF developed MC Master Lists. The rationale for selecting the MCs, identified in these Master Lists for investigation under the ORAP, is documented in an Air Force Memorandum for Record (USAF 2003b).

5.3.2.1 MC Master Lists

The USAF-developed MC Master Lists will be used as the starting point for identification of MC of potential concern during ORAs. The types of training, number of years of use, and missions can account for the presence of different MCs. If there is significant history of use by other services using different munitions, or of foreign munitions being used, this may affect the list of MCs to be evaluated for a given range. The MC Master Lists will be screened against the munitions recently and historically used at a subject range, and MCs will be added or deleted from the master list based on the type and/or quantity of munitions used at a subject range. The programmatic decision rule for whether to identify an MC of potential concern and include in the assessment is:

> *If a munitions type and its associated MC have been used or are currently used on a subject range, the MC will be included in the ORA and added to the MC Master List for that range. Conversely, an MC may be removed from the MC Master List if data indicates munitions containing the MC were never used at the subject range.*

5.3.2.2 Ranges using Munitions Greater than .50 Caliber

The USAF reviewed literature documenting the potential presence of explosives and other energetic material in the environment at air-to-ground ranges and other ranges using munitions greater than .50 caliber (e.g., hand and rifle grenade ranges, artillery ranges, mortar ranges, proficiency areas, and detonation areas). The two most prevalent secondary explosives used by the U.S. military over the past 70 years are RDX and TNT. With their manufacturing impurities and environmental transformation products, these two compounds account for the majority of the explosives contamination at active military installations (USAF 2003a). Table 5-2 lists the MCs to be initially considered and evaluated during the ORAP for air-to-ground ranges (priority category Tier 1) and ranges using munitions greater than .50 caliber (priority category Tier 2).

5.3.2.3 Ranges using Munitions .50 Caliber and Below

The USAF reviewed literature documenting primary potential contaminants in the environment at ranges and training areas used exclusively for firing small arms ammunition (.50 caliber and below). The documents reviewed indicate primary potential contaminants include arsenic, chromium, copper, lead, tungsten, and zinc. Based on review of ammunition within the USAF inventory, arsenic and chromium were deemed not to be constituents of primary concern warranting inclusion on the MC Master List. Table 5-3 lists the MCs to be initially considered and evaluated during the ORAP for small arms ranges involving ammunition .50 caliber and below (priority category Tier 3).

Table 5-2: MC Master List for Ranges using Munitions Greater than .50 Caliber

Munitions Constituents[a]	CAS Number
4-Amino-2,6-dinitrotoluene (4ADNT)	1946-51-0
2-Amino-4,6-dinitrotoluene (2ADNT)	355-72-78-2
Chromium, total	7440-47-3
2,6-Diamino-4-nitrotoluene	59229-75-3
2,4-Diamino-6-nitrotoluene	6629-29-4
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
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4
Lead	7439-92-1
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8
Nitrobenzene (NB)	98-95-3
Nitrocellulose (NC)	9004-70-0
Nitroglycerin (NG)	55-63-0
Nitroguanidine (NQ)	556-88-7
3-Nitrotoluene (m-Nitrotoluene)	99-08-1
2-Nitrotoluene (o-Nitrotoluene)	88-72-2
4-Nitrotoluene (p-Nitrotoluene)	99-99-0
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0
Pentaerythritol tetranitrate (PETN)	78-11-5
Perchlorate	14797-73-0
1,3,5-Trinitrobenzene (TNB)	99-35-4
2,4,6-Trinitrotoluene (TNT)	118-96-7
White Phosphorus	7723-14-0

[a] The MC Master List shall be revised, and compounds added or removed as appropriate, based on data collected during an ORA in order to develop range-specific MCs of concern.

Table 5-3: MC Master List for Ranges using Munitions .50 Caliber and Below

Munitions Constituents[a]	CAS Number
Copper	7440-50-8
Iron	7439-89-6
Lead	7439-92-1
Tungsten	7440-33-7
Zinc	7440-66-6

[a] The MC Master List shall be revised, and compounds added or removed as appropriate, based on data collected during an ORA in order to develop range-specific MCs of concern.

5.3.3 Range-Specific Conceptual Site Model

A CSM is a description of a site and its environment based on existing knowledge. It describes sources of contamination or potential contamination and receptors, as well as the interactions between sources and receptors. A CSM serves as a planning tool to integrate and interpret information from a variety of resources, evaluate the information with respect to project objectives and data needs, and identify data gaps and actions required to address data gaps. It represents an iterative development process and requires continual refinement. As knowledge and understanding of the site changes based on additional data collected, the CSM is revised to accurately communicate site conditions to decision-makers (USACE 2003).

The objective of the CSM, under the ORAP, is to develop a model that accurately describes the relationships between suspected MC source areas, transport mechanisms or exposure routes, and off-range human and ecological receptors. An effective CSM integrates information on the built and natural infrastructure, factors affecting contaminate release, fate and transport; and the surrounding land use to identify activities, resources, and receptors. Decisions needing to be addressed include determining the elements that comprise the CSM, incorporating physical features of the range into the CSM, and ultimately, evaluating all potential exposure pathways.

5.3.3.1 Source

A source is an area where a contaminant has been deposited or is expected to be found in the environment. MCs in the environment most likely originate from military weapons training, weapons testing, and/or munitions treatment, demilitarization or destruction activities. Specific locations where operational range activities are suspected of having the potential to deposit MCs in the on-range environment include but are not limited to current or historic firing points, target or impact areas, ordnance proficiency training areas, and munitions destruction sites. Secondary source locations may include the media where the MC deposition occurred or was identified, based on the fate of MC in the environment.

Operational ranges may be co-located with landfills, solid waste management units, and compliance clean-up or environmental restoration sites. These regulated units will be identified as source areas and included, as appropriate, in the assessment process prescribed under this document. Knowledge of prior land use, current and historical training activities, types of munitions and weapons systems utilized, frequency of use, munitions expenditure rates, and length of operation shall be evaluated to identify potential munitions (source) areas to include the location and general dimensions of each area, and type and distribution (including depth) of munitions within each area.

The assessment team shall evaluate weapons training, weapons testing, and/or munitions treatment or destruction activities to identify potential source areas by reviewing existing information and use the following programmatic decision criteria to assess whether a suspected source area should be included in the ORA:

> *If data sources examined and/or current site conditions indicate 1) an area was previously investigated (for any constituent on the MC Master List) but did not obtain unrestricted use or unlimited exposure; or 2) an area was/is used routinely or in a single, but large-scale event purportedly resulting in MC escaping into the environment.*

5.3.3.2 Transport Mechanism

The CSM shall identify suspected deposition mechanisms and transport routes through which MC may migrate from suspected MC source areas. Primary deposition mechanisms are those actions or activities which may leave MC in the on-range environment such as but not limited to weapon system firing or dropping; munitions functioning as designed or failing to function; and/or complete or incomplete ordnance detonations. A secondary deposition mechanism which may result in the potential distribution of MCs in the on-range environment is the degradation, over time, of expended munitions, UXO, and/or mishandled unfired munitions.

A transport route is the environmental medium or matrix through which a contaminant moves or makes contact with a receptor. MC may migrate from an operational range source area through the following pathways: air, soil (both surface and subsurface), surface water (to include sediments), and groundwater. MC migration pathways will be identified by evaluating the range's environmental features and characteristics, the fate of MC in the environment, and historic and current maintenance or management activities having the potential to affect MC deposition and/or distribution.

The migration pathways and programmatic evaluation metrics cited in Sections 5.3.3.2.1 through 5.3.3.2.4 are guidelines. Site-specific factors, regional or local guidance, and the assessment team's professional judgment will be used to evaluate and determine whether a potentially viable transport mechanism exists.

5.3.3.2.1 Air Migration

There are two potential routes of migration via the air pathway. The first is the potential for MCs produced during weapon system firing or dropping; munitions functioning as designed or failing to function; and/or complete or incomplete ordnance detonations to escape into the environment and be carried from potential source areas on wind currents. The second is migration by wind entrainment of MC particles deposited at, on, or near the source area and/or MCs absorbed to soil particles. A wind entrainment (i.e., dust) transport mechanism assumes a readily transportable source of contamination within the top inch of soil, and sorption to soil particles.

The assessment team shall evaluate potential air migrations routes and use the following programmatic approach to assess whether to include potential air transport of MC in the assessment:

> *If the data sources examined and/or conditions indicate 1) activities on the range may cause significant production of MC emissions/particulates during weapon system, munitions, or ordnance use; 2) conditions consistently deposit MC emissions/particulates in a localized area; and 3) the range has conditions (e.g., wind, limited vegetation, flat terrain, etc.) that support a vigorous surface soil/dust transport mechanism.*

5.3.3.2.2 Surface and Subsurface Soil Migration

MCs may be produced and deposited in soils during weapon system firing or dropping; munitions functioning as designed or failing to function; complete or incomplete ordnance

detonations, and/or munitions demilitarization and ordnance destruction activities. Additionally, the fate of MCs deposited in surface and/or subsurface soils may result in further distribution of MCs from suspected source areas. The primary mechanisms for soil transport are wind entrainment, runoff during precipitation events (transport by storm water), and by mechanical (human) means. The lateral extent of surface soil migration by wind or storm water depends on topography, vegetation, soil conditions, and weather; surface and subsurface soil transport by mechanical mechanism varies based on activities performed. As subsurface soil is unlikely to move by natural means in the environment, it is not considered a significant MC transport route.

The assessment team shall evaluate potential soil migrations routes and use the following programmatic approach to assess whether to include potential soil transport of MC in the assessment:

> *If the data sources examined and/or conditions indicate 1) activities on the range may cause significant deposition or redistribution of MCs in surface soils; or 2) range activities currently or historically include munitions burial and/or disposal efforts directly affecting subsurface soils; and 3) the range has soil conditions that support degradation of munitions, munitions fragments, and/or MC (e.g., corrosion, dissolution, leaching, etc.).*

5.3.3.2.3 Surface Water / Sediment Migration

Surface water can transport MCs from a range to off-range areas when MCs are deposited directly in surface water or when MCs are subsequently transported via wind entrainment, storm water flow, or groundwater discharge to surface water bodies. In evaluation of surface water and sediment transport of MC, the assessment team shall identify the probable point at which soil or groundwater from a suspected source area most likely enters the surface water body (i.e., the distance from a potential source area at which the surface water body probably receives MC).

The assessment team shall evaluate potential surface water/sediment migrations routes and use the following programmatic approach to assess whether to include potential surface water transport of MC in the assessment:

> *If the data sources examined and/or conditions indicate 1) a surface water body or feature (e.g., intermittent stream, seasonal creek, dry drainage collection pond, etc.) is present within a suspected source area; 2) surface water body or feature is present on-range or adjacent to the range and receives runoff or wind entrained particles from a potential source area; or 3) surface water is fed by a groundwater seep/spring that is itself a viable mechanism for MC transport.*

5.3.3.2.4 Groundwater Migration

Evaluation of groundwater as a viable transport route for MCs is based on a myriad of site-specific conditions. When evaluating the potential for groundwater to transport MCs to off-range areas, the assessment team will consider the depth to groundwater, as well as the depth at which range activities deposit munitions or MC. However, the depth to groundwater alone is insufficient to determine the viability of groundwater as a pathway; rates of evaporation and precipitation shall also be considered. Movement of MCs through groundwater is affected by

recharge rates of the aquifer in question, which depends on the rates of evaporation, transpiration to plants, runoff, and soil permeability. The presence of non-permeable geological formations may rule out groundwater as a potential pathway.

The assessment team shall evaluate potential groundwater migrations routes and use the following programmatic approach to assess whether to include potential groundwater transport of MC in the operational range assessment:

> *If the data sources examined and/or conditions indicate: 1) permeable geologic formations or groundwater recharge zones are present within or in close proximity of the range; 2) the range has conditions that support MC degradation (dissolution) and efficiency (leaching) of MCs to groundwater; or 3) seeps and/or springs discharge groundwater to surface water on-range or in the vicinity of the range.*

5.3.3.3 Receptors

A receptor is any human being or ecological organism which is currently or may come in contact with contaminates deposited into the environment. Off-range human and ecological receptors, current and future, exposed to or that may be exposed to MC contaminated media outside the range boundary, will be considered in developing the CSM. An accurate account of surrounding land use, population centers, human activities, natural resources, and ecosystems in the vicinity of a subject range will be documented.

Human receptors are categorized by their ability to access contaminated media, combined with the activities that potentially allow contact with MCs. Ecological receptors are essentially any species, population, or community which has the potential to be in contact, directly or indirectly, with MC-contaminated media. USAF military, civilian, and contractor personnel, community and industry workers, construction workers, and nearby residents are examples of potential off-range human receptors. Examples of potential off-range ecological receptors include listed, candidate, or proposed threatened, endangered, rare, or special consideration species; species with a religious, cultural, or economic value; and environmental areas that provide critical or distinct habitat.

5.3.3.3.1 Receptor Identification

The following decision criteria will be used to evaluate and identify potential off-range receptors during the ORA. Off-range human receptor identification is based on the MC transport media and distance from a suspected source area:

- MC transport by air. Off-range human receptors must be within 4-miles downwind (i.e., prevailing direction) of a source area.
- MC transport by soil. Off-range human receptors must be within 200-feet of a source area.
- MC transport by surface water. Off-range human receptors must be within 15-miles (downstream) of a source area in which there are intakes supplying drinking water.
- MC transport by groundwater. Off-range human receptors must be within 4-miles (down gradient) of a source area in which there are identified drinking groundwater wells.

Off-range ecological receptor identification is based solely on the distance from a suspected source area: Off-range ecological receptors must be within 1- mile of a source area.

Personnel that use or maintain the operational range and their environment are not considered receptors for the purposes of the ORAP assessment. The operational range activities and environment, related to human health and safety are addressed under various Air Force programs which are designed to ensure the protection of operational range environmental resources, and personnel health and safety. However, knowledge and information on a subject range's existing and past maintenance, safety and health, or environmental concerns, shall aid the ORA team in ascertaining the overall "health" of the range natural and built infrastructure. Evaluation of various operational and management assessment findings, and those actions planned or implemented to address on-range issues, further assist the team in determining if management practices and/or maintenance activities have not only resolved the initial concern but have not and will not result in deposition or redistribution of MC in the on-range environment, or increase the potential for MC to be transported beyond the range boundary.

5.3.3.4 Source-Receptor Interaction Analysis

Interaction describes all possible ways a potential receptor may come into contact with contamination at a source area and/or other areas were source contamination has migrated. Source-receptor interaction requires two closely connected elements: access and activity.

- Access is the ability of a receptor to enter the area and/or media in which MCs are present and come into contact with MCs (exposure media).

- Activity is any action by a receptor that may result in contact (ingestion, inhalation, or dermal absorption) with the media containing MCs (exposure route).

DoDI 4715.14 specifies existing technical data be evaluated, "to determine if there is a potential source-receptor interaction." The qualitative CSM interaction analysis will aid in determining if a release or substantial threat of a release of MCs from an operational range to an off-range area creates an unacceptable risk to human health or the environment. The assessment team shall utilize professional judgment based on existing data, range-specific factors, and regional or local guidance in evaluation of MC exposure pathways and analysis of source-receptor interactions. The interaction analysis will include an assessment of the existence of complete or potentially complete exposure pathways to off-range receptors:

- Incomplete Exposure Pathway: May be identified when data indicates no potential source-receptor interaction exists (e.g., cases where a release from an operational range to an off-range area is not possible or not taking place due to other factors).

- Potentially Complete Exposure Pathway: May be identified when there is insufficient data to determine if there is a potential source-receptor interaction, or data indicates there is a potential source-receptor interaction (e.g., cases where a release from an operational range to an off-range area is possible and such a release may create a potential risk to receptors).

- Complete Exposure Pathway: May be identified when data indicates a source-receptor interaction exists (e.g., cases where prior data shows a probable release from an operational range to an off-range area and the suspected release may create an unacceptable risk to receptors).

5.4 REPORTING

Based on the results of the Qualitative Assessment, recommendations are made to the USAF in the form of a draft report regarding if further analysis is warranted or if no further evaluation is required. Upon USAF approval of recommendations, a final report is issued documenting the Qualitative Assessment evaluation and finding determination.

5.4.1 Team Recommendations

The assessment team shall document Qualitative Assessment data collection efforts and survey findings to present information on the overall "health" of a subject range's natural and built infrastructure, and an understanding of current as well as historic range activities. All knowledge obtained from the Qualitative Assessment and the range-specific CSM shall be analyzed and used to evaluate:

- If there is a potential for MCs to be present in the on-range environment from current and/or historic range activities;

- If there are mechanisms present to transport MCs from suspected source areas to areas beyond the range boundary; and

- If there are off-range human and/or ecological receptors that could potentially be exposed to off-range, MC-contaminated media.

Based on the results of the above evaluation, the assessment team shall make a recommendation regarding whether there has been a release or a substantial threat of release of MCs from an operational range to an off-range area; and whether there is a potentially complete exposure pathway between suspected MC sources on a range and off-range human and/or ecological receptors.

If data analysis and findings support no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors, a recommendation of no further analysis may be identified. In the case of a no further analysis recommendation, the ORA process is concluded and the subject range scheduled for a five-year qualitative reassessment. A finding of no further analysis does not preclude the assessment team from recommending compliance studies to address other identified range concerns. Compliance studies may be recommended to further evaluate and identify potential measures to resolve possible non-MC range related environmental contamination concerns, as well as any environmental, maintenance, safety and health compliance concerns.

If the potential exists for a viable transport mechanism between suspected MC source areas and off-range receptors, and existing data provides convincing evidence which indicates a possible

off-range release, or there is not enough information available to evaluate potential source-receptor interactions, a recommendation of further evaluation may be made. A recommendation to conduct a Quantitative Assessment, at the completion of the Qualitative Assessment phase, is not considered precedent setting by the USAF and, as such, does not require headquarters approval or additional internal and/or external reporting.

5.4.2 Assessment Report

A draft assessment report shall be developed to provide all compiled data and present assessment findings. The Qualitative Operational Range Assessment Report will consist of information on current and past range activities; describe the physical and environmental setting; document data collection activities; discuss data analysis and results; and present recommendations based on data analysis. A sample report format is provided in Appendix D and will include, but not be limited to the following:

- Data file on records reviewed and compilation of pertinent records;
- Record of personnel interviews and completed survey checklists;
- CSM in graphical and/or pictorial format;
- Range-specific MC list of concern;
- Digital photographs and photographic log; and
- Positional data collected on the range or salient features that indicate past environmental or munitions related activities should be geo-referenced, digitally recorded, and presented on maps.

If the assessment team recommends to proceed to a Quantitative Assessment in order to further investigate a potential release or substantial threat of a release of MCs and assess possible risk to off-range receptors, then an abbreviated field sampling approach and objectives will be included in the Qualitative Assessment Report.

5.4.3 Air Force Determination

A draft version of the Qualitative Assessment Report will be submitted to the appropriate range, installation, and MAJCOM personnel for review and concurrence on recommendations prior to finalization. Upon range, installation, and MAJCOM concurrence with reported data analysis and conclusions, a determination is made in the recommendations regarding either no further evaluation or further evaluation of a subject range.

- If a no further evaluation determination is made, the ORA process is concluded and the Qualitative Assessment findings and determination are documented in the final report. The MAJCOM or installation, if designated, programs and plans for a five-year qualitative reassessment at the subject range. As appropriate, the MAJCOM in coordination with the range and installation shall program and plan for any identified compliance study.

- If further evaluation warranted to fully evaluate potential release or threat of release (MC migration) and possible risks to off-range receptors, a final Qualitative Assessment report

documenting findings and determination is issued along with planned sampling objectives and approach. The MAJCOM or installation, if designated, schedules and programs the subject range for the next phase under the ORAP (refer to Section 6).

A determination to conduct a Quantitative Assessment, at the completion of the Qualitative Assessment phase, is not considered precedent setting by the USAF and as such does not require headquarters approval or additional internal and/or external reporting. It is not anticipated, based on information collected during the Qualitative Assessment to determine a release, substantial threat of release, and/or potential risk. If prior data indicates a possible off-range release of MCs, the suspected release shall be verified during the Quantitative Assessment and associated risk characterized.

6.0 QUANTITATIVE ASSESSMENT

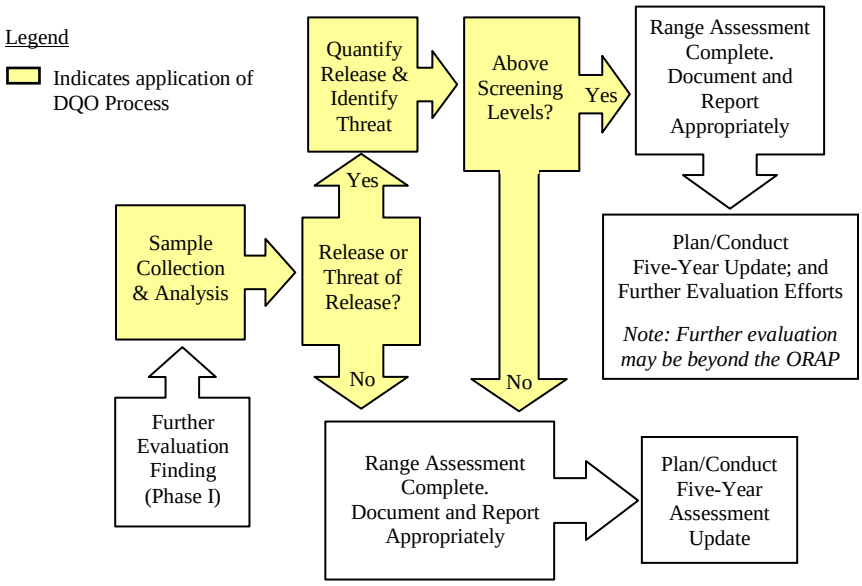
The ORA process continues with a Quantitative Assessment, Phase II, based on Qualitative Assessment findings indicating a potential exists for a viable transport mechanism between suspected MC source areas and off-range receptors; a suspected, possible, or probable off-range release; or there is not enough information available to evaluate potential source-receptor interactions. The purpose of the Quantitative Assessment is to collect and analyze new data on a subject range in order to determine whether a release or substantial threat of release of MCs to areas beyond the range boundary exists, if a potential risk or unacceptable risk to off-range receptors exists, and if further study is required (refer to Section 7.2).

The Quantitative Assessment (refer to Figure 6-1) consists of media sampling, data analysis, baseline/screening level risk assessments, and risk characterization in order to obtain a better understanding of source areas, migration routes, exposure points and interactions, and threats to off-range receptors (EPA 1992). Information from the Quantitative Assessment shall be used to revise the range-specific CSM and evaluated to answer the second key question:

> *Are off-range human and/or ecological receptors possibly exposed to MCs at concentrations above established screening values at sufficient frequency and duration that creates an unacceptable risk?*

Based on the results of the Quantitative Assessment, recommendations are made to the USAF in the form of a draft report regarding if further investigation is warranted, or if no further evaluation is required. Upon USAF approval of recommendations, a final report is issued documenting the Quantitative Assessment evaluation and finding determination.

Figure 6-1: Quantitative Assessment Process Flow Diagram



6.1 PLANNING PROCESS

This portion of the Quantitative Assessment is focused on project planning, and development of data quality objectives and quality assurance measures to ensure the appropriate type, quantity, and quality of data are collected to make decisions that are technically sound and defensible. The assessment team will implement systematic project planning to identify decision goals, ensure data objectives are clearly defined and support decision goals, and the most resource-effective approach is used to reach data objectives. Project goals and data objectives shall focus on suspected source areas and transport mechanisms, known or possible off-range receptors, and potentially complete or complete source-receptor interactions identified during the Qualitative Assessment.

Systematic project planning integrates technical and quality aspects through the use of innovative tools and strategies to identify and manage project uncertainties. One such tool is the data quality objectives (DQO) process. The DQO process is a series of seven planning steps based on the scientific method, designed to ensure the type, quantity, and quality of the environmental data used in the decision-making process are appropriate for the intended application (EPA 2006). ORAP developed programmatic DQOs may assist in understanding individual ORA goals and data needs (refer to Section 6.2); however, range-specific DQOs will be developed and included in project plans.

The Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) is another systematic planning tool which should be implemented, as appropriate, for efforts under the ORAP. The UFP-QAPP is a structured and documented management system to implement systematic project planning. The UFP-QAPP describes the policies, organizational authority and responsibilities, DQOs, standard operating procedures, and specific quality assurance (QA) and quality control (QC) activities to ensure the validity of analytical data generated during dynamic sampling activities (EPA 2005). An ORAP programmatic QAPP is provided in Appendix B; however, a range-specific quality assurance plan, compliant with the UFP-QAPP, will be developed to identify project QA/QC efforts.

The assessment team shall coordinate, sufficiently in advance, with identified installation personnel in order to discuss data collection efforts; range accessibility, restrictions, and support; and planned range sampling activities. A point paper identifying data collection needs may be developed to facilitate scheduling and planning efforts. Based on the level of understanding of the ORAP at the installation level, the assessment team may conduct an ‘in-brief’ to discuss the ORAP sampling methodology and scope of the project, as well as an ‘out-brief’ summarizing activities.

6.1.1 Qualitative CSM

The assessment team shall utilize data obtained and the CSM developed during the qualitative effort to aid in designing a range-specific sampling approach. Prior to establishing DQOs, the assessment team shall review this existing data, and coordinate with range and installation personnel to ensure no changes have occurred at the range since the Qualitative Assessment. If new documents and/or records are available, the team shall collect, review, and evaluate the new

information and update the CSM, as appropriate. If revised, the updated CSM shall be briefed to stakeholders during project planning.

6.1.1.1 Range Reconnaissance

A range reconnaissance may be necessary, prior to finalization of project plans, DQOs, and/or conducting field activities, when substantial changes have occurred at a range since completion of the Qualitative Assessment. Additionally, reconnaissance may be required due to changes in assessment team members (i.e., different contractor) in order to verify range conditions documented during the Qualitative Assessment. Data from the range reconnaissance, if conducted, shall be utilized to update the CSM.

6.1.2 ORAP Programmatic DQOs

Range-specific DQOs shall be developed to ensure Quantitative Assessment goals and data needs will be met and identified CSM data gaps addressed. The ORAP programmatic DQOs, discussed below, may assist in understanding overall assessment goals and data needs:

1) *State the Problem:*
   Assess operational ranges in order to determine whether there has been a release or a substantial threat of a release of MCs of concern from an operational range or range complex to off-range areas; and whether the release or substantial threat of a release of MCs of concern from an operational range or range complex to an off-range area creates an unacceptable risk to human health or the environment.

2) *Identify the Decision:*
   Decide whether there is a release or substantial threat of release of MCs beyond the range boundary; and if a release or substantial threat of release is at sufficient concentrations and exposure frequencies/durations to pose a potentially unacceptable risk to human health or the environment. Assessment results may include no further evaluation, or further evaluation.

3) *Identify Inputs to the Decision:*
   Inputs to the decision are operational range data obtained during the qualitative and quantitative, if conducted, assessment. The qualitative effort obtains existing environmental compliance, facility management, and operational activity information, adjacent/regional land use, and other background information obtained through personnel interviews and range survey to develop a CSM. The quantitative effort consists of collecting and analyzing MC sampling data where the developed CSM indicates a potentially complete or complete exposure pathway (source/receptor interaction) in order to confirm an off-range release, threat of release, and potential risk.

4) *Define the Study Boundaries:*
   The initial study boundary is the entire range or range complex area, and all possible MC transportation routes to off-range areas. Refinement of study boundaries (e.g., source area) and MC sampling area (e.g., along a specific drainage) will be defined by the range-specific CSM. In general, a range's built infrastructure, environmental parameters, range constraints as well as location and sensitivity of off-range receptors will be evaluated during development of the CSM, to identify the sources, migration routes, and media to analyze.

5) *Develop a Decision Rule:*
The approach to the USAF ORA includes a two-phase process: a qualitative effort and a quantitative effort (conducted if necessary).

- Qualitative Decision. If the Qualitative Assessment findings indicate no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors, the ORA process is concluded. However, if findings indicating a potential exists for a viable transport mechanism between suspected MC source areas and off-range areas; a suspected, possible, or probable off-range release; or there is not enough information available to evaluate potential source-receptor interactions, further evaluation is required in the form of a Quantitative Assessment.

- Quantitative Decision. If the Quantitative Assessment findings indicate no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors the ORA process is concluded. However, if findings confirm MC migration or threat of release, an off-range release, and/or a potential risk to off-range receptors, then further evaluation is identified. Further evaluation efforts upon the conclusion of the Quantitative Assessment shall be addressed under an appropriate existing environmental quality program and/or environmental restoration program (refer to Section 7.2).

6) *Specify Limits on Decision Errors:*
No specific decision error limits apply to this DQO, as the decision is either no further evaluation due to no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors based on MCs of concern not being detected or detected at concentrations below applicable environmental and risk-based screening levels; or further evaluation based on comparison of maximum detected MC concentrations against appropriate environmental and risk-based screening levels. In general, a 95% upper confidence limit will be applied, as appropriate to address uncertainty and indicate acceptable sampling criteria.

7) *Optimize Design for Obtaining Data:*
Elements presented in this ORAP provide the design for obtaining the data needed to complete the ORA and report any release or substantial threat of release, and associated risks to off-range human health or the environment.

6.1.3 Analytical Requirements

Analyses for MCs will be conducted by a laboratory accredited under the DoD Environmental Laboratory Accreditation Program to perform the methods identified in Table 6-1. The tested analytes will mirror the list of MCs of concern developed during the Qualitative Assessment, or any additions to the list based on changes in range activities since completion of the Qualitative Assessment.

Table 6-1: Analytical Methods

Munitions Constituent	CAS Number	Analytical Methods
METALS		
Chromium (total)	7440-47-3	6020
Copper	7440-50-8	6020
Iron	7439-89-6	6020
Lead	7439-92-1	6020
Tungsten	7440-33-7	3020
Zinc	7440-66-6	6020
EXPLOSIVE COMPOUNDS		
2-Amino-4,6-dinitrotoluene	355-72-78-2	8330
4-Amino-2,6-dinitrotoluene	1946-51-0	8330
2,6-Diamino-4-nitrotoluene	59229-75-3	8330
2,4-Diamino-6-nitrotoluene	6629-29-4	8330
1,3-Dinitrobenzene (1,3-DNB)	99-65-0	8330
2,4-Dinitrotoluene (2,4-DNT)	121-14-2	8330
2,6-Dinitrotoluene (2,6-DNT)	606-20-2	8330
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	8330
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	8330
Nitrobenzene (NB)	98-95-3	8330
Nitrocellulose (NC)	9004-70-0	8330
Nitroglycerin (NG)	55-63-0	8332
Nitroguanidine (NQ)	556-88-7	8832
2-Nitrotoluene (o-Nitrotoluene)	88-72-2	8330
3-Nitrotoluene (m-Nitrotoluene)	99-08-1	8330
4-Nitrotoluene (p-Nitrotoluene)	99-99-0	8330
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	8330
Pentaerythritol tetranitrate (PETN)	78-11-5	8330
1,3,5-Trinitrobenzene (TNB)	99-35-4	8330
2,4,6-Trinitrotoluene (TNT)	118-96-7	8330
White Phosphorus	7723-14-0	7580
Perchlorate	14797-73-0	331/331 or 6850/6860

6.1.4 Data Management

Data obtained under the ORAP shall be incorporated by the range, installation, and/or MAJCOM into existing range and installation information management systems and planning documents, as appropriate, to capture relevant encroachment, sustainment, compliance, mapping, sampling, and environmental data.

- Mapping elements of sampling locations and relevant range features generated during the ORA process will comply with Spatial Data Standards for Facilities, Infrastructure, and the Environment or other Air Force designated standards and format. Geographical positioning data and associated shape files used in figure development shall be provided to the Air Force.

- Analytical data shall meet submission requirements of the Environmental Resources Program Information Management System (ERPIMS) or other Air Force designed system for validation and management of data from environmental projects.

6.1.5 Access and Safety

The assessment team must comply with all range access and safety requirements. Range access and determination on the appropriate level of safety support is an inherent function of the range, safety, EOD, and the installation ORA contact (USAF 2007). The level of explosive safety support is dependent on the range type, as well as areas to be accessed and planned sampling activities. Planned sampling locations may require relocation while in the field due to access restrictions and possible safety concerns.

In general, sampling shall be conducted in areas with no or a low probability of encountering munitions or UXO on the surface or in the subsurface. For low probability areas, an escort by range personnel and implementation of avoidance techniques, or military EOD being available to provide limited oversight to ensure anomaly avoidance protocols are followed is acceptable. However in some cases, sampling efforts employing intrusive activities and/or devices may be necessary in areas with a moderate or high probability of encountering munitions or UXO on the surface or in the subsurface. In such instances the assessment team may include, as part of the sampling team, a qualified UXO technician to implement determined safety measures based on the installation's review of planned field activities and associated range-specific risks.

6.2 SAMPLING METHODOLOGY

The Quantitative Assessment sampling methodology prescribed under the ORAP is not intended to be a source characterization or an exhaustive site characterization study to assess the potential impact of range activities, specifically associated with munitions use and remnant MC, on the environment. The purpose of the Quantitative Assessment is to confirm a suspected off-range release or determine whether a substantial threat of a release of MCs to areas beyond the range boundary exists in order to evaluate potential risks to off-range human and ecological receptors.

The sampling methodology outlined in this program document focuses on obtaining knowledge of suspected source areas and potential migration routes between sources and the range boundary in order to make a determination of a possible off-range release or threat of release. The sampling data obtained will provide for a general understanding of potential exposure points beyond the range boundary and source-receptor interactions to enable an evaluation of risk or potential risk to off-range receptors. The prescribed methodology consists of field screening techniques and a dynamic sampling approach to use real-time data to refine sampling locations in order to obtain sufficient off-site laboratory data to support decision-making. The use of dynamic sampling strategies, in conjunction with real-time field screening technologies, provides

flexibility to maximize the amount of data collected during a single sampling event or mobilization.

The level of the quantitative effort will depend on the size and complexity of a range or range complex. Due to range property size and complexity it may not be reasonable or feasible to assess the entire range; likewise, a less complex range with limited property may not require the entire range area to be evaluated. The assessment team will develop a range-specific sampling approach based on Qualitative Assessment data, findings, and associated CSM to focus sampling efforts on addressing data gaps and further evaluate suspected sources, transportation routes, off-range release or substantial threat of release, and off-range receptors to assess environmental and human health risks.

6.2.1 MC Fate and Transport

The U.S. Army Corp of Engineers, Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory (ERDC/CRREL) has conducted various characterization studies on munitions constituents at military ranges. A 2001 study focusing on firing points and impact areas indicates concentrations of MCs in soil samples associated with high-order detonations were often very low, while MC concentrations in soil samples associated with low-order detonations were extremely high and MC distribution spatially heterogeneous (CRREL 2001). In 2003, a study on explosive residue resulting from detonations further confirmed explosives are efficiently consumed during high-order detonations. Although the study confirmed explosive materials are efficiently consumed, it also shows that fine MC particulates are produced and escape into the environment. Data from the study also illustrates that blow-in-place/consolidated disposition, partially detonated munitions, or damaged (broken open) ordnance often results in unconsumed explosive residue randomly dispersed in soils (CRREL 2003).

A 2006 report summarizes data obtained from research focused on fate and transport properties of MCs. MCs are expelled during weapons firing as emissions (gasses) and particulate matter, associated MC deposition is generally found in low concentrations in surface soil at firing points. MCs that escape into the environment during munitions functioning or failure to function are deposited down range at targets or impact areas. As previously indicated high-order detonations efficiently consume MC; however, failure to function (e.g., partial detonations and duds) leave MC particulates and whole unconsumed MC in soils near the target or impact areas. The random distribution of unconsumed MC as well as fine particulates in soils results from inaccurate firing, firing from multiple firing points or positions, firing at multiple targets, and/or relocation of targets. Another source of MCs results from the breakdown (corrosion) of partially detonated munitions or UXO resulting in unconsumed explosive residue escaping into surface soils (CRREL 2006).

The deposition of MC emissions, particulates, or unconsumed residue in surface soils and surface water, under limited circumstances, begins the MC fate and transport process. The fate of MCs deposited or redistributed on-range depends on various factors such as but not limited MC chemical properties and site-specific environmental factors (weather, soil characteristics, etc). MCs once in the environment may be either transported by physical processes or transformed by chemical/biological processes (CRREL 2006).

- Sorption. Many MCs adsorb onto soil particles or absorb into organic material. The sorption of MCs varies substantially based on chemical composition and range-specific soil conditions such as organic matter content. Although reversible to a degree, once MCs are adsorbed/absorbed these compounds are generally immobile (CRREL 2006). Although generally immobile in soil, MC sorbed to soil may be transported by wind entrainment and/or storm water runoff. Wind entrainment may redistribute MC deposited in surface soils; however, air transport will not be directly evaluated under the ORAP but assessed by evaluating the areas identified as probably receiving wind entrained particles. Additionally, the transport of potentially contaminated soil by storm water runoff shall be evaluated with the surface water/sediment pathway.

- Volatize. The majority of MCs are not subject to significant volatilization due to low vapor pressures and as such MC volatilization is a negligible environmental fate mechanism (CRREL 2006). Therefore, volatilization will not typically be included in the ORA process.

- Solubility. As a result of contact with precipitation, MCs may dissolve and migrate from surface soils to subsurface soils or water. The fraction of dissolved MC depends on many factors including but not limited to weather conditions (intensity/duration of precipitation events); soil characteristics; and surface water drainage patterns. Under appropriate conditions, certain MCs (i.e., RDX, HMX, and perchlorate) are rapidly transported through the soil column with little or no sorption. Therefore, limited to no detection of certain MCs in soil samples, may not preclude MC groundwater contamination (CRREL 2006). Since soil (surface and/or subsurface) has limited mobility in the environment it is not considered a significant MC transport mechanism under the ORAP. However, soil is likely to be a secondary source and has been shown to be a viable transport mechanism to water. Although soil sampling may be conducted during the assessment to evaluate the general availability and distribution of MCs, the potential for MC transport from soil to water media shall be further evaluated through assessment of these other media.

- Chemical/Biological. Chemical transformation of MC to other compounds may occur as a result of photolysis, hydrolysis, and/or reduction. Chemical reduction of MCs (nitro groups) may occur depending on site-specific conditions. The resulting transformation products may be further metabolized by microbial processes or may adsorb to soil constituents. Biological transformation depends on many site-specific environmental factors including soil conditions and water characteristics resulting in transformation of MCs by microorganisms and/or plants. These reactions are controlled by the type of microorganisms and/or vegetation present, their adaptation to the chemical of interest, concentration of the chemical (including potential toxic effects), and availability of nutrients. (CRREL 2006). Although the assessment under the ORAP shall consider MC movement through the food web, bioaccumulation or bioconcentration will not generally be directly evaluated (i.e., no flora/fauna sampling). However, such exposure should be appropriately addressed if MCs are known to bioaccumulate and sensitive receptors are present. The scarcity of bioaccumulation data for MCs and the lack of reliable screening values for food resources potentially impacted by MC concentrations do not make consideration of a bioaccumulation

scenario feasible. If specific, reliable bioaccumulation data becomes available in the future, it will be considered for inclusion in the ORAP.

6.2.2 Field Screening

Portable field analytical technologies or field screening devices provide flexibility to adapt to information generated by real-time measurement technologies and on-site observations. Real-time measurement technologies include portable field screening/analytical technologies such as X-Ray Fluorescence (XRF), immunoassays, and colorimetric methods, as well as, and rapid sampling techniques, rapid off-site laboratory turnaround times, and on-site mobile laboratories (EPA undated/EPA 1996). Field screening techniques and technologies have proven to provide accurate results of consistent and acceptable quality to support dynamic sampling strategies.

The assessment team, based on identified MCs of interest and environmental conditions, shall evaluate and, as appropriate, use cost-effective field screening devices and/or portable field analytical instruments to aid in evaluating suspected source areas and potential MC migration from source areas to the range boundary along transportation routes. Through the implementation of real-time measurement technologies, the assessment team shall focus field investigation efforts along viable migration pathways and refine the planned number and type of samples to be collected. Field screening shall typically be limited to on-range sampling of soils (surface and shallow subsurface) and/or sediments. The Quantitative Assessment process may not be concluded based solely on field screening technology results (e.g., XRF); a minimum of ten percent (10%) of samples must be collected for laboratory confirmation and verification.

6.2.3 Sample Design

Department of Defense's Strategic Environmental Research and Development Program (SERDP) and CERRL conducted an evaluation of existing operational range sampling and analysis plans. Many of the range characterization plans evaluated by SERDP/CERRL underestimated or failed to detect MCs present, did not acquire appropriate information to address risks to humans and the environment, and/or results were not repeatable. The evaluation resulted in a recommendation for the use of multi-incremental sampling to primarily investigate suspected source areas on operational ranges and potential MC migration into surface and groundwater systems (CRREL 2007). The assessment team shall consider the applicability of multi-incremental sampling against discrete sampling to evaluate suspected source areas (MC availability).

Under the ORAP, discrete sampling will be utilized in evaluation of water systems. The use of multi-incremental sampling of soil during assessment of on-range and off-range MC migration shall be considered by the ORA team. The range-specific sampling approach shall be scientifically defendable, economical, and provide appropriate information to assess potential MC releases beyond the range boundary and potential risks to off-range receptors.

6.2.4 Sampling Approach

The sampling methodology under the ORAP utilizes a dynamic sampling approach, which permits decision-making in the field thus providing flexibility for revising the planned sampling approach to accommodate new information from field observations and screening technologies. The assessment team shall modify the sampling approach prescribed in this document and

develop a range-specific dynamic sampling strategy based on the CSM and Qualitative Assessment information.

It may not be feasible to accomplish all steps outlined in Sections 6.2.4.1 through 6.2.4.3 based on funding resources, operational restrictions, or terrain accessibility or it may not be reasonable to accomplish the steps based on range complexity and identified data needs. At a minimum, representative surface soil, subsurface soil, groundwater, surface water, and sediment samples, as appropriate, shall be collected at the range boundary (refer to Section 6.2.4.3) to verify a possible release based on prior data, to confirm a potential release, and/or to evaluate if a substantial threat of release exits in order to identify migration routes and assess whether nearby receptors may have been affected by releases.

6.2.4.1 MC Availability

An evaluation of a possible off-range MC release or substantial threat of release, and the potential risk to off-range receptors can be answered without detailed characterization of a suspected source area. However, it may be necessary for those operational ranges with limited property between suspected source areas and the range (or installation) boundary to assess the potential availability and general distribution of MCs. Suspected source areas will only be characterized to the extent necessary to confirm or eliminate the area as a potential source. In general, sampling within a suspected source area (e.g., impact area or target area) will not be conducted due to access restrictions and potential safety hazards. Sampling may, however, be accomplished in close proximity to a suspected source area based on field observations of a potentially viable MC transportation route and safety.

This step of the prescribed approach, if conducted, calls for using field screening processes, rapid sampling techniques, and/or rapid sample analysis to obtain probable worst case MC surface and subsurface soil contamination data, and sediment data if appropriate (e.g., pooling of runoff from a source area). Information shall be used to confirm suspected source areas, ascertain availability, and general distribution of MC contamination to further focus field activities on potentially valid transportation routes.

6.2.4.2 MC Migration

A detailed site characterization study is not necessary in order to evaluate if remnant MC from munitions use has the potential to be transported from a known or suspected source area towards the range boundary. In order to evaluate MC on-range migration and determine a substantial threat of release of MCs of interest to an off-range area the ORAP advocates implementation of a "sentry area" sampling approach. The sentry area approach places primary emphasis on obtaining data from specific on-range areas such as along the most direct transportation routes to off-range receptors and/or sensitive environmental areas (e.g., wetlands, watersheds, recharge zones, critical habitat, etc.) at defined distances from a source area to the range boundary.

Due to range property size and complexity, it may not be reasonable or feasible to assess the entire range the sentry area approach combined with dynamic sampling provides flexibility and permits focused study in areas deemed most likely to receive and/or redistribute MCs from source areas through the on-range environment to support threat of release decision making without extensive sampling. Table 6-2 provides information on initially defined sentry areas to

focus MC migration characterization efforts. However, these initially defined areas shall be revised by the assessment team based on property size, complexity, and range-specific data to focus on known transportation routes, on-range sensitive areas, locations of off-range receptors, and/or off-range environmentally sensitive areas.

This step of the prescribed approach calls for using field screening processes, rapid sampling techniques, and/or rapid sample analysis to focus collection of representative surface soil, subsurface soil, surface water, sediment, and/or groundwater samples, as appropriate. MC migration sampling activities shall not seek to fully characterize the horizontal and vertical extent of contamination, if any. The data will be used to identify viable transportation routes, confirm if MCs have migrated from source areas and/or are migrating through the on-range environment towards the range boundary, and further focus boundary sampling efforts on known outlets and valid transportation routes.

Table 6-2: Sentry Area Decision Rules

Initially Defined Sentry Areas	Small Property Ranges (less than 0.5 miles from source to range boundary)	Large Property Ranges (more than 0.5 miles from source to range boundary)
Early Sentry Area	50% distance to range boundary (only one sentry area)	25% distance to range boundary (not to exceed 1 mile)
Late Sentry Area	50% distance to range boundary (only one sentry area)	75% distance to range boundary (not to exceed 4 miles)

6.2.4.3 MC at the Range Boundary

An evaluation of a possible off-range MC release or substantial threat of release, and the potential risk to off-range receptors can be answered without detailed characterization of the range perimeter. In order to assess a likely off-range release, a probable off-range release, and/or verify prior evidence of an off-range release, it may be necessary to sample not only at the range boundary but off-range areas. In general, off-range areas owned by the USAF may be sampled under the ORAP methodology as long as permission is obtained from the installation and/or MAJCOM. However, sampling of off-range areas not owned by the USAF is not permitted under the ORAP. As necessary, the assessment team shall identify the potential need to access off-range areas during project planning.

The final step of the prescribed sampling approach calls for use of field screening processes, rapid sampling techniques, and/or rapid sample analysis, as appropriate, to focus sampling efforts on the most direct off-range transportation route to off-range receptors (e.g., storm water outfalls) and/or further evaluate routes with confirmed MC migration from a source area. Representative surface soil, subsurface soil, surface water, sediment, and/or groundwater samples, as appropriate, shall be collected and analyzed. The data shall be used to confirm a release beyond the range boundary or a substantial threat of an off-range release, and assess potential exposure points and source-receptor interactions to enable an evaluation of potential risk to human health and the environment.

6.3 RELEASE ANALYSIS

Information from the Qualitative Assessment and sampling data from the Quantitative Assessment shall be utilized to revise the MCs of interest, update the CSM, and evaluate whether a release or substantial threat of release of MCs to areas beyond the range boundary exist. The primary questions involved in making a recommendation as to whether a release has occurred or a substantial threat of release exists include:

- *Are MCs suspected and/or known to be present in the on-range environment;*
- *Do mechanisms exist to transport MCs from a known or suspected source area;*
- *Have and/or are MCs being transported towards the range boundary; and*
- *Are MCs present in concentrations above screening values at the range boundary?*

6.3.1 Screening Levels

To promote consistency across the Military Services' range assessment programs, the DoD Range and Munitions Use Subcommittee (RMUS), developed a general list of MC screening levels (see Appendix F) to which all Military Services are required to compare surface water, groundwater, and sediment sampling data. The RMUS developed a hierarchy of sources for the most significant exposure scenarios: for human health, the consumption of either surface water or groundwater; and for ecological receptors, direct contact with surface water and sediment by aquatic organisms. The hierarchy of sources was used to develop prioritized lists of screening values in order of recognized authority and applicability. From the prioritized lists, the most appropriate screening level found for each MC was selected. Where there were multiple values for the same MC from the same hierarchy source, the RMUS selected the most conservative value (DoD 2009a). As new screening values become available, Appendix F will be updated.

Applicable soil screening values were selected for MCs on the Master Lists by the Air Force and are based on a number of sources, including the U.S. Environmental Protection Agency (EPA) (see Appendix F). In cases where more than one value was available, the more conservative value was used (USAF 2003a). For MCs where documented scientific evidence did not exist to develop a screening value, no values are provided. However, analytical data will be collected for these MCs and they will be carried forward for qualitative evaluation, if detected, but will not be used to make recommendations as to whether there has been an off-range release of MCs that create an unacceptable risk to receptors.

The assessment team shall update developed RMUS and USAF screening values, as appropriate, and identify established state-specific regulatory maximum contaminant levels for identified MCs of interest. Additionally the assessment team shall identify, as appropriate for the MCs of concern, any previously established levels which represent natural background conditions at the range, installation, or region.

6.3.2 Source Area Confirmation

The assessment team will compare identified MCs of interest concentrations in environmental media to corresponding and appropriate screening levels. The maximum detected concentrations

of MCs will be compared to identify those constituents above developed screening values, those constituents detected but below screening values, and constituents not detected. MCs detected and/or identified above screening values shall be retained for further sampling, while MCs not detected (excluding MCs known to be readily mobile such as but not limited to RDX, HMX, and perchlorate) may be identified for removal from the range-specific MCs of concern.

Evaluation of data obtained from within, if allowable, or in close proximity to a potential source area will aid in confirming the area as a source of MC, and analysis of occurrence and general distribution of MC will assist in evaluating availability and identify migration routes to further focus field activities.

6.3.2.1 Revision of MCs of Interest

The ORAP is not designed to develop site-specific background levels. However, the assessment team should plan to collect an on-range sample upgradient from suspected source areas to represent natural background conditions and validate any previously established range or installation background levels. Only installation or range-specific established background levels may be used to eliminate identified MCs of interest.

Based on sample analysis, the assessment team may revise, as appropriate, the list of MCs of interest developed during the Qualitative Assessment. The identified MCs of interest may be further refined based on laboratory confirmation of MC availability data. MCs known to be readily mobile in the environment (e.g., RDX, HMX, and perchlorate) and those MCs detected or identified above screening values shall be retained for further sampling and risk evaluation. MCs may be removed from the list if the constituent is not detected, thus allowing subsequent laboratory analysis to focus on those MCs known to be present and/or constituents likely to trigger a potential risk. However, specifically identified DoDI 4715.14 compounds RDX, TNT, HMX, and perchlorate shall be retained.

6.3.3 Threat of Release Validation

The assessment team will compare identified MCs of interest concentrations in environmental media from identified sentry areas to corresponding and appropriate screening levels. The maximum detected concentrations of MCs will be compared to identify those constituents above developed screening values, those constituents detected but below screening values, and constituents not detected. The identified MCs of concern may be further refined, refer to Section 6.3.2.1, to remove analytes based on data obtained from sentry area locations in order to focus range boundary laboratory analysis efforts on those constituents known to be present and/or MCs likely to trigger a potential risk.

Evaluation of data obtained from within designated sentry areas, at specific locations deemed most likely to receive, distribute, and/or transport MCs from source areas through the on-range environment, will aid in analysis of on-range MC migration and potential threat of release to off-range areas. The data will be used to confirm if MCs have migrated and/or are migrating from source areas through the on-range environment towards the range boundary, assist evaluating MC availability and general distribution in viable migration paths, and further focus boundary sampling efforts on known outlets and valid transportation routes.

6.3.4 Release / Substantial Threat of Release Verification

The assessment team will compare identified MCs of concern concentrations in environmental media from the range boundary to corresponding and appropriate screening levels. The maximum detected concentrations of MCs will be compared to identify those constituents above developed screening values, those constituents detected but below screening values, and constituents not detected. The identified MCs of interest may be further refined, refer to Section 6.3.2.1, to remove analytes based on data obtained from the range boundary and off-range sampling, if conducted, in order to focus risk analysis efforts on those constituents known to be present.

Evaluation of data obtained from the range perimeter and off-range areas, if sampled, will aid in analysis of MCs of interest migrating beyond the range boundary to off-range areas. The data will be used to confirm a release beyond the range boundary or a substantial threat of an off-range release, assist in evaluating MC availability and potential exposure points to off-range receptors, and assess possible source-receptor interactions to enable an evaluation of potential risks to human health and the environment.

6.4 RELEASE EVALUATION

MC release or a substantial threat of release evaluation involves comparing sampling results to associated screening values for the media in question. Based on the maximum reported concentration and associated sample location/depth, the evaluation will have one of three possible findings: No Release; Substantial Threat of Release; or Off-Range Release.

- **No Release** may be identified when MCs of interest are not detected or detected below background and screening levels. This finding may also be identified when MCs are detected above screening levels but data conclusively demonstrates MCs are not migrating through the on-range environment (i.e., movement restricted to and/or halted on-range) due to range infrastructure (built or natural), management practices, or maintenance activities.

- **Substantial Threat of Release** may be identified when MCs of interest are detected and data conclusively demonstrates MCs are migrating unconstrained through the on-range environment. This finding may also be identified when MCs are detected below screening levels at or in close proximity to the range boundary but are not suspected to be present beyond the range boundary and/or off-range sampling indicates no contamination beyond the range boundary.

- **Release** may be identified when MCs of concern are detected above screening levels at the range boundary and thus suspected to be present beyond the range boundary. This finding may also be identified when off-range sampling detects concentrations of MCs, even below screening levels, beyond the range boundary.

6.5 RISK ASSESSMENT METHODOLOGY

Information from the Qualitative Assessment and sampling data from the Quantitative Assessment shall be used to perform a preliminary baseline human health risk assessment and

screening level ecological risk assessment to evaluate whether an off-range release or substantial threat of release of MCs beyond the range boundary poses a potential risk and/or creates an unacceptable risk to off-range receptors. As such, the implemented sampling approach shall support the collection of representative data to evaluate the relative risk contamination may pose to off-range human health and the environment. The assessment team shall modify the assessment approach prescribed in this document, as appropriate, based on current DoD, EPA as well as applicable state-specific technical guidance to develop a range-specific risk assessment approach based on MCs of interest and CSM.

6.5.1 Human Health Risk Assessment

Human health evaluations are conducted in a manner similar to that contained in *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* (EPA 1989) as appropriate. The baseline human health risk assessment process is used to estimate the nature and probability of adverse health effects in humans who may be exposed to chemicals in contaminated environmental media and includes four basic steps: hazard identification; dose-response assessment; exposure assessment; and risk evaluation.

The human health evaluation prescribed under the ORAP is limited to a preliminary assessment based on available chemical toxicity information, comparison to naturally occurring levels or background concentrations (as appropriate), and evaluating maximum detected concentrations to established human health risk-based screening levels. The baseline assessment will evaluate sources, pathways, and potential off-range human receptors to determine if there are any unacceptable risks from complete exposure pathways which warrant further investigation.

6.5.1.1 Screening Values for Human Health Receptors

The most significant human health exposure scenario, as identified by RMUS, is the consumption of potentially MC-contaminated surface water or groundwater. Drinking water screening levels are typically applicable to established groundwater supply wells or surface water intakes. However, samples collected under the ORAP will generally not be from established wells or intakes; therefore, identified MC values are screening levels only and are not directly enforceable regulatory standards. Sample data will be technically evaluated on a case-by-case basis to determine the appropriateness of the drinking water values.

The drinking water screening values (see Appendix F) are based on applicable standards or benchmarks recognized or released by the EPA. When no EPA values were available, RMUS considered values from other government agencies. If values were still not available, scientifically peer reviewed published literature was researched. The assessment team shall update developed RMUS and USAF risk-based screening values, as appropriate, and identify any installation-specific negotiated values, established state-specific values, or other applicable regulatory criteria such as health advisories, for identified MCs of interest.

6.5.2 Ecological Risk Assessment

The EPA has established guidance for conducting an ecological risk assessment in *Guidelines for Ecological Risk Assessment* (EPA 1998) and *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA 1997)

The overall approach encompasses an eight-step process with five scientific and management decision points.

The ecological evaluation prescribed under the ORAP is limited to a screening level assessment which incorporates elements of the first two steps and initial decision point. The screening level assessment shall utilize available chemical toxicity data and compare detected concentrations in environmental media to the established and appropriate ecological screening levels in order to determine the likelihood that a potential unacceptable ecological risk exists. The screening level assessment will evaluate sources, pathways, and potential off-range ecological receptors to determine if there are any unacceptable risks from complete pathways which warrant further investigation.

6.5.2.1 Screening Values for Ecological Receptors

The most significant ecological exposure scenario, as identified by RMUS, is direct contact with surface water and sediment (fresh or marine) by aquatic organisms. Due to the sensitivity of some ecological receptors, these values are not intended to be applicable for every possible type of species. These values were selected as a conservative screening tool protective of a majority of species; therefore, the specific species type should be taken into consideration when comparing screening values and evaluating whether there is a potential unacceptable risk.

The fresh water and marine screening values (see Appendix F) are based on applicable standards or benchmarks recognized or released by the EPA. When no EPA values were available, RMUS considered values from other government agencies. If values were still not available, scientifically peer reviewed, published literature was researched. For brackish waters, state guidance on the use of fresh or marine screening levels for the specific water bodies (bays, estuaries, rivers, etc.) shall be followed. The assessment team shall update developed RMUS and USAF risk-based screening values, as appropriate, and identify any installation-specific negotiated values, established state-specific values, or other applicable regulatory criteria such as health advisories for identified MCs of interest.

6.6 RISK ANALYSIS / CHARACTERIZATION

Information from the Qualitative Assessment and sampling data from the Quantitative Assessment shall be utilized to revise the list of MCs of interest, update the CSM, and evaluate whether an off-range release or substantial threat of an off-range release creates an unacceptable risk to human health or the environment. The primary questions involved in making a recommendation as to whether a potential or actual threat exists to off-range receptors include:

- *Do off-range receptors have access to contaminated media;*
- *Do receptors engage in activities resulting in contact with contaminated media; and*
- *Are MCs of concern present in concentrations that exceed risk-based screening values?*

The assessment team shall estimate and describe risk in order to characterize the probability of adverse effects on receptors and explain the significance of results. The characterization should integrate information on existing and potential exposure and estimate the likelihood, severity,

and characteristics of adverse effects caused by MCs of concern present on identified receptors. Risk analysis and characterization are based on many factors which require the assessment team to utilize professional expertise and a 'weight-of-evidence' to evaluate if risk has occurred or is likely to occur as such the analysis of risk shall identify and discuss uncertainties in the risk assessment.

Sampling data will permit revision of the previously identified MCs of concern to focus risk analysis effort on those constituents known to be present at or beyond the range boundary and/or identified on-range constituents likely to trigger a potential risk. Data should enable assessment of MC detection frequency and concentrations, general spatial distribution, and environmental fate of contaminants, as well as identification of who may be exposed, area use, and activity patterns to ascertain any adverse effects of MCs of concern.

Risk analysis shall only be conducted on those complete or potentially complete exposure pathways related to range-specific MCs of concern, human and ecological receptors, and environmental conditions. The CSM shall be utilized to interpret data and conduct source-receptor interaction analysis.

6.6.1 Quantitative CSM

The objective of the CSM, under the ORAP, is to develop a model that accurately describes the relationships between MC source areas, transport mechanisms or exposure routes, and off-range human and ecological receptors. An effective CSM integrates information on the built and natural infrastructure, factors affecting contaminate release, fate and transport; and the surrounding land use to identify receptor use and activities. A CSM is an iterative development process that requires continual refinement as knowledge and understanding of a site changes based on additional data collected to accurately communicate conditions to decision-makers (USACE 2003).

The range-specific CSM will be revised to accurately describe all possible exposure pathways, to include food webs (i.e., who eats whom), and show how contaminants are transported from source areas to receptors in order to identify hazards and assess interactions.

6.6.1.1 Source

A source is any primary or secondary location where a contaminant has been deposited or is expected to be found in the environment. Primary deposition mechanisms are those actions or activities which may leave MC in the on-range environment, such as but not limited to weapon system firing or dropping; munitions functioning as designed or failing to function; and/or complete or incomplete ordnance detonations. A secondary deposition mechanism which may result in the potential distribution of MCs in the on-range environment is the degradation, over time, of expended munitions, UXO, and/or mishandled unfired munitions.

Suspected source areas shall be identified as confirmed if sampling data indicates MC deposition from weapons training, weapons testing, and/or munitions treatment or destruction. The list of MCs of concern shall be refined, as appropriate. The location of the source area and availability, general distribution (vertical and horizontal), environmental fate, and toxicity/hazard

characteristics of known constituents should be identified and incorporated into the source-receptor interaction analysis.

6.6.1.2 Exposure Pathway

A transport route is the environmental medium or matrix through which a contaminant moves or makes contact with a receptor. MC may migrate from an operational range source area through the following pathways: air, soil (both surface and subsurface), surface water (to include sediment), and groundwater. Potential MC migration routes will be identified as viable if sampling data indicates MCs are being transported or have been transported from known or suspected source areas towards the range boundary.

The programmatic risk evaluation metrics cited below, for MC exposure pathways, are guidelines. Site-specific factors, regional or local guidance, and the assessment team's professional judgment on situations most likely to cause an adverse effect will be used to assess if a viable transport mechanism exists. The exposure media in which receptors may contact MCs of concern, exposure routes, and duration (magnitude) of potential exposure to known constituents should be identified and incorporated into source-receptor interaction analysis.

6.6.1.2.1 Air Pathway

There are two potential routes of migration via the air pathway. The first is the potential for MCs produced during range activities to escape into the environment and be carried from potential source areas on wind currents. The second is migration by wind entrainment (i.e., dust) of MC particles deposited at, on, or near the source area and/or MCs absorbed to soil particles. Air transport of MC will not be directly evaluated under the ORAP, but indirectly assessed through the media which receives wind entrained emissions or particulates.

The Agency for Toxic Substances and Disease Registry (ATSDR) has evaluated air emissions and migration of MCs at operational DoD ranges and munitions treatment sites. These studies indicate MCs produced from ordnance disposition and weapons/munitions functioning disperse primarily in the prevailing wind direction, and are not at levels associated with adverse health effects (ATSDR 2003b). Additionally, ATSDR assessments show based on air samples that levels of particulate matter (wind-blown dust) are much lower than health-based air quality standards (ATSDR 2003a). Although MC may be transported off-range and direct exposure possible, existing evaluations conclude there is no health hazard. As such, exposure to MC emissions/particulates produced during ordnance disposition and weapon/munitions functioning through the air transport mechanism may only be evaluated in limited circumstances.

The assessment team may, based on professional expertise and a 'weight-of-evidence' evaluate possible direct air exposure source-receptor interactions and associated risk if situations exist that are likely to cause an adverse effect to off-range receptors (e.g., sensitive receptors located in the prevailing downwind direction). Indirect risk analysis associated with deposition or re-deposition in soils or surface waters by air/wind transport shall be evaluated through assessment of these other media.

6.6.1.2.2 Soil Pathway

MCs may be deposited in soils during range activities, as well as further distributed based on fate in the environment (refer to Section 6.2.1). The primary mechanisms for soil transport are wind entrainment, runoff during precipitation events (transport by storm water), and by mechanical (human) means. Due to relatively limited mobility, soil is not considered a significant MC transport mechanism and not a significant off-range receptor exposure pathway. However, soil is likely to be a secondary source and has been shown to be a viable transport mechanism to water. Although soil sampling may be conducted during the assessment to evaluate the general availability and distribution of MCs, the potential for MC transport (leaching) from soil to water media and associated risk to off-range receptors shall be fully evaluated through assessment of these other media. Additionally MC movement from soil through the food web will not generally be directly evaluated (i.e., no flora/fauna sampling) as detected concentrations in soil and other environmental media shall be utilized to assess potential off-range ecological risks.

The assessment team may, based on professional expertise and a 'weight-of-evidence' evaluate possible direct soil source-receptor interactions and associated risk to off-range receptors if situations exist that are likely to cause an adverse effect to off-range receptors (e.g., sensitive receptors have access to source areas, sensitive receptors have access to areas receiving MC from wind entrainment or water runoff, sensitive receptors are located in close proximity to the range).

6.6.1.2.3 Surface Water Pathway

MCs may be directly deposited in the surface water by range activities, or when range activities deposit MCs on or in the soil and are subsequently transported via wind entrainment, storm water flow, or groundwater seeps/springs to surface water bodies or intermittent surface water bodies. MCs may dissolve and migrate from surface soils to subsurface soils or water with little or no sorption to soils as such the potential for MC transport from soil to water media and associated off-range receptor risks shall be fully evaluated through analysis of surface water/sediment sampling.

The most probable and significant human health exposure scenario is the consumption of potentially MC contaminated surface water. Most eco-toxicological information is currently directed toward the quantification of exposure levels for direct contact of contaminated surface water by aquatic organisms. As such the ecological risk evaluation will focus on the surface water/sediment pathway as it has the maximum expected exposure potential (i.e., continuous lifecycle exposure to potentially contaminated media).

The assessment team shall evaluate potential source-receptor interactions and associated risk to off-range receptors for all viable surface water MC migrations routes potentially resulting in a MC release beyond the range boundary. Surface water/sediment exposure pathways may be eliminated based on professional expertise and a 'weight-of-evidence;' however, any elimination of a potentially complete exposure pathway must be fully documented and supported.

6.6.1.2.4 Groundwater Pathway

MCs may be deposited in soils or surface water during range activities and transported to groundwater based on site conditions and fate in the environment (refer to Section 6.2.1). MCs

may dissolve and migrate from soils or surface water/sediments to groundwater with little or no sorption to soils or organic matter; as such the potential for MC transport from soil to water media and associated off-range receptor risks shall be fully evaluated through analysis of groundwater sampling. Additionally, potentially contaminated groundwater could redistribute MCs to surface waters or soils through seeps or springs. The leaching of MCs from potentially contaminated groundwater to surface waters shall be considered during evaluation of the surface water/sediment pathway.

Groundwater is the transport media in which detection of MCs at sufficient concentrations to negatively affect off-range human receptors is most likely. The most probable and significant human health exposure scenario is the consumption of potentially MC contaminated groundwater. As previously indicated, the surface water/sediment pathway is anticipated to be the most viable exposure scenario for off-range ecological receptors. However, MC detected concentrations in groundwater shall be utilized to assess potential off-range ecological risks.

The assessment team shall evaluate potential source-receptor interactions and associated risk to off-range receptors for all viable groundwater MC migrations routes potentially resulting in a MC release beyond the range boundary. Groundwater exposure pathways may be eliminated based on professional expertise and a 'weight-of-evidence;' however, any elimination of a potentially complete exposure pathway must be fully documented and supported.

6.6.1.3 Receptors

A receptor is any human being or ecological organism which is currently or may come in contact with contaminates deposited into the environment. Off-range human and ecological receptors, current and future, exposed to or that may be exposed to MC-contaminated media outside the range boundary shall be evaluated during source-receptor interaction analysis. On-range personnel and the on-range environment are not considered receptors under the ORAP; however, information on the overall "health" of the on-range environment may be beneficial in evaluating the likelihood, severity, and characteristics of adverse effects on off-range receptors caused by MC present at or beyond the range boundary. The CSM should identify all off-range receptors potentially at risk in order to accurately perform source-receptor interaction analysis.

Human receptors are categorized by their ability to access the contaminated media combined with the activities that potentially allow contact with MCs. USAF military, civilian, and contractor personnel, community and industry workers, construction workers, and nearby residents are examples of potential off-range human receptors. Because the risk-based screening values used in the ORAP to determine whether MC concentrations create an unacceptable risk to human health are based on exposure frequencies and durations consistent with chronic residential and occupation exposures, activities causing only intermittent and short-term exposures will not generally be evaluated. These activities include most recreational uses and casual trespassing. However, if site-specific information indicates these activities are occurring near a range and concentrations of MCs exceed screening levels based on residential or occupational activity, potential risks to these receptors may be evaluated in the ORA.

Ecological receptors are essentially any species, population, or community which has the potential to be in contact, directly or indirectly, with MC-contaminated media. However,

evaluating the risks of known or suspected releases of MCs for every species present or suspected at a site is not possible. As a means of delineating among potential ecological receptors, the following will not typically be evaluated under the ORAP since military range activities are not anticipated to significantly influence these species, populations, or communities as a whole: domesticated species, transient populations, or communities which are widely abundant and distributed. Assessment of potential ecological risks shall focus on environmental areas that often provide protected habitat for species such as:

- Sensitive, rare, or critical habitats required for species conservation or biodiversity (e.g., breeding, hatching, spawning or feeding grounds, old-growth forests, etc.);
- Distinct or sensitive terrestrial and/or aquatic habitats (i.e., wilderness, refuges, sanctuaries, parks, natural areas, estuaries, wetlands, streams, tidal pools);
- Listed, candidate, or proposed threatened, endangered, rare, or special consideration species protected under state or federal law (e.g., Endangered Species Act, Migratory Bird Act, Marine Mammal Protection Act); or
- Species or attributes considered essential to the health/integrity of the habitat, or valuable ecological resources (subsistence game, recreational or commercial species, or species with a religious or cultural value) (EPA 1997).

6.6.1.4 Source-Receptor Interaction Analysis

Interaction describes all possible ways a potential receptor may come into contact with contamination at a source area and/or other areas were source contamination has migrated. Source-receptor interaction requires two closely connected elements: access to contaminated media and activities resulting in contact with contaminated media. The CSM interaction analysis will aid in determining if a release or substantial threat of a release of MCs from an operational range to an off-range area potentially creates an unacceptable risk to human health or the environment.

Consumption of contaminated water; either surface water or groundwater is the most probable exposure pathway to negatively impact human receptors, while the most probable exposure pathway for ecological receptors is direct contact with contaminated surface water/sediment. However, interaction analysis will be conducted on all complete or potentially complete exposure pathways. All critical CSM elements must be present including a source, mechanism of contaminant deposition and transport, exposure point where receptors can contact contaminated medium, direct (e.g., ingestion, inhalation, or dermal absorption) or indirect (e.g., movement through the food chain) exposure routes, and a receptor. The absence of any of these critical elements may invalidate the exposure pathway resulting in a conclusion of no unacceptable risk to the off-range receptors.

The assessment team shall utilize professional expertise and a ‘weight-of-evidence’ to identify situations most likely to cause an adverse effect and estimate the likelihood of adverse effects on off-range receptors caused by a release or substantial threat of a release of MCs of concern. The risk analysis and characterization shall document range-specific factors, uncertainties, and explain the significance of results in terms of exposure pathways, source-receptor interactions, and probability of adverse effects.

6.7 RISK EVALUATION

Off-range human health and ecological risk evaluation involves various risk assessment inputs and is based on MC release evaluations, CSM source-receptor interactions, and established risk-based screening levels. These evaluations will have one of three possible findings: Acceptable Risk; Potential Risk; or Unacceptable Risk.

- **Acceptable Risk** may be identified when off-range receptors are not currently exposed or in the future will not be exposed to MCs released outside the range boundary (no complete exposure pathway).

- **Potential Risk** may be identified when off-range receptors are not currently exposed but could be exposed, in the future, to MCs released outside the range boundary (potentially complete exposure pathway), or MCs released off-range (detected at or beyond the range boundary) are at concentrations below risk-based screening levels.

- **Unacceptable Risk** may be identified when off-range receptors are currently exposed to MCs released outside the range boundary (complete exposure pathway) and MCs released off-range (detected at or beyond the range boundary) are at concentrations above established background concentrations and risk-based screening levels.

6.8 REPORTING

Based on the results of the Quantitative Assessment, recommendations are made to the USAF in the form of a draft report regarding if further evaluation is necessary, or if no further evaluation is required. Upon USAF approval of recommendations, a final report is issued documenting the Quantitative Assessment evaluation and finding determination.

6.8.1 Team Recommendations

The assessment team shall document Quantitative Assessment data collection efforts and findings to present a better understanding of a range's source areas, migration routes, off-range release, exposure points and interactions, and risks to off-range human and ecological receptors. All knowledge obtained from the Qualitative Assessment, Quantitative Assessment, and the updated range-specific CSM shall be analyzed to evaluate:

- If the built infrastructure, natural infrastructure, management practices, and/or maintenance activities restrict or prevent potential MC transport from source areas, and/or has halted the progress of MC migration towards the range boundary;

- If MCs are migrating or have migrated unimpeded through the on-range environment towards the range boundary indicating a substantial threat of release, a probable release, or a confirmed release of MCs off-range; and

- If off-range human and/or ecological receptors are currently exposed to or could potentially be exposed to off-range MC contamination at levels which pose an unacceptable risk.

The ORA team shall, based on whether there has been a release or a substantial threat of release of MCs from an operational range to an off-range area, make a recommendation as to if a potentially complete or complete exposure pathway between MC sources on a range and off-range human and/or ecological receptors creates an unacceptable risk. The results of the evaluation may support one of two recommendations: No Further Evaluation or Further Evaluation.

6.8.1.1 No Further Evaluation

If data analysis and findings support no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors a recommendation of no further analysis may be identified. In the case of a no further analysis recommendation the ORA process is concluded and the subject range scheduled for a five-year qualitative and quantitative reassessment.

However, a recommendation of no further evaluation does not preclude supplemental studies. If data analysis indicates MCs deposited on-range have the potential to move, are being gradually transported through the on-range environment, or due to range management/maintenance activities being redistributed, the assessment team may recommend a supplemental study to evaluate and identify on-range measures to mitigate MC transport. Such a study would be beyond the scope of the ORAP.

6.8.1.2 Further Evaluation

If data analysis and evaluation verifies a substantial threat of release, confirms a release beyond the range boundary, and/or indicates a potential risk to off-range receptors or data results are inconclusive a recommendation of further analysis may be identified. Further evaluation studies are beyond the scope of the ORAP and shall be addressed under an appropriate USAF environmental quality program and/or environmental restoration program (refer to Section 7.2).

The ORA team's further analysis recommendations may include one or more of the following actions: additional on-range assessment in conformance with ORAP methodology and governing risk assessment processes; transition of on-range areas to an appropriate program for a supplemental MC migration mitigation study; transition of on-range areas to an appropriate program for additional on-range MC release and corrective action evaluation; and/or transition of off-range areas to an appropriate program for additional characterization and/or response action. General examples of further evaluation findings and potential efforts are highlighted below.

- In cases where data is inconclusive regarding a possible release, threat of release, and/or associated risk the assessment team may recommend an expanded site inspection under the ORAP quantitative assessment methodology to further assess sources, transport mechanisms, source-receptor interactions, and potential risk to off-range receptors. An expanded site inspection analysis under the ORAP shall include a discussion regarding prior inability to achieve overarching ORAP DQOs and measures to ensure the planned project will achieve data objectives.

- In instances where data indicates a substantial threat of release or conclusively demonstrates MCs are migrating unimpeded through the on-range environment, the assessment team may

recommend a supplemental study to evaluate and identify on-range measures to mitigate further MC transport and prevent an off-range release. Such a study would be beyond the scope of the ORAP. Measures implemented and MC migration should be monitored to ensure effectiveness. Monitoring could be a separate project or conducted as part of an accelerated ORA reassessment schedule.

- In situations where data confirms an off-range release or verifies a previously suspected release, but an unacceptable risk to off-range receptors is not substantiated, the assessment team may recommend an investigation to further characterize on-range site conditions. An on-range site characterization investigation should fully evaluate MCs at the range boundary and adjacent off-range areas (under DoD control) to assess potential risk and, if necessary, recommend corrective actions. The additional on-range site characterization investigation may incorporate and/or be conducted concurrently with a study to evaluate on-range measures to mitigate off-range MC migration. Measures implemented, actions taken, and MC migration should be monitored. Such study and/or monitoring would be beyond the scope of the ORAP.

- In situations where data confirms an off-range release, verifies a previously suspected release, and an unacceptable risk to off-range receptors is identified, the assessment team may recommend the off-range area for further investigation and action, if necessary, under an appropriate environmental cleanup, restoration, or response program. A recommendation on transitioning off-range areas to another program requires USAF decision-maker concurrence as well as associated Air Force program manager approval. An off-range further investigation conducted under an appropriate program, should fully characterize and evaluate MC contamination beyond the range boundary, associated risk to off-range receptors and, if necessary, identify off-range corrective actions to respond to off-range contamination. The off-range investigation should be conducted at the same time or upon completion of an on-range site characterization study and/or mitigation study in order to identify on-range corrective actions and/or mitigation measures necessary to contain a release and halt future off-range migration. On-range actions taken, measures implemented, and MC migration should be monitored to ensure effectiveness. Such off-range and on-range study and/or monitoring would be beyond the scope of the ORAP.

6.8.2 Assessment Report

A draft assessment report shall be developed to provide all compiled data and present assessment findings. The Quantitative Operational Range Assessment Report will consist of information on project objectives and sampling approach; characterization data on migration routes, data analyses and results in terms of release, affected media, and risk; quality assurance/control measures; and present recommendations based on data analysis. The report shall to the maximum extent possible, utilize the Qualitative Assessment Report to provide a summary of current and past range activities, describe the physical and environmental setting, etc. A sample report format is provided in Appendix D and will include, but not be limited to the following:

- Any additional pertinent records reviewed;
- MCs of concern and other suspected contaminants;

- Analytical methods, established background and screening criteria;
- Field screening and laboratory analysis data files;
- CSM in graphical and pictorial format;
- Any digital photographs and photographic log;
- Positional data collected on sample locations and/or pertinent range features; and
- Other support documentation such as updated checklists, maps, boring and/or well logs, etc.

If the assessment team recommends further evaluation of a release, possible release, potential risk, and/or mitigation study then a recommendation for the planned approach and data objectives will be included in the Quantitative Assessment Report.

6.8.3 Air Force Determination

A draft version of the Quantitative Assessment Report will be submitted to the appropriate range, installation, and MAJCOM personnel for review and concurrence on recommendations prior to finalization. Upon range, installation, and MAJCOM concurrence with reported data analysis and recommendations, a determination is made regarding either no further evaluation or further evaluation of a subject range.

- If a no further analysis determination is made, the ORA process is concluded and the Quantitative Assessment findings and determination documented in the final report. The MAJCOM or installation, if designated, programs and plans for a five-year qualitative and quantitative reassessment at the subject range. As appropriate, the MAJCOM, in coordination with the range and installation, shall program and plan for (under the appropriate program), if identified, a MC migration mitigation study.

- If further evaluation is warranted to fully evaluate a release or threat of release; assess potential risks to off-range receptors; consider corrective actions; and/or study possible mitigation measures a final Quantitative Assessment report documenting findings and determination is issued along with recommended follow-on effort approach and objectives. The MAJCOM or installation, if designated, coordinates with stakeholders to appropriately plan and program the follow-on effort(s) at the subject range (refer to Section 7).

A determination to conduct further evaluation, at the completion of the Quantitative Assessment phase, is considered precedent setting by the USAF and, as such, requires headquarters approval or additional internal and/or external reporting (refer to Section 8). Such efforts are considered beyond the scope of the ORAP.

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7.0 RESPONSE PLANNING

The ORAP seeks to collect, leverage, and integrate data in an effort to provide range and installation managers with information to make informed planning and management decisions in support of range sustainability and mission readiness. The assessment methodology prescribed under the ORAP is focused on identifying if a MC release or a substantial threat of release to off-range areas creates an unacceptable risk to off-range receptors.

At the conclusion of the Qualitative Assessment and/or Quantitative Assessment phase a finding of 'No Further Evaluation' or 'Further Evaluation' may be identified. If the Qualitative or Quantitative efforts result in a no further evaluation finding, the subject range is identified for reassessment in accordance with ORAP methodology. If the Quantitative Assessment results in a 'Further Evaluation' finding, the subject range may require a response that is beyond the scope of the ORAP. A further evaluation finding does not eliminate the five-year ORA assessment update requirement.

7.1 PRECEDENT SETTING RECOMMENDATIONS

Based on the results of the Qualitative and Quantitative Assessments a determination regarding further evaluation may be necessary. Recommending movement to a Quantitative Assessment, at the completion of the Qualitative Assessment, is not considered precedent-setting by the USAF. It is not anticipated to issue a determination of release, substantial threat of release, and/or unacceptable risk based on information collected during the Qualitative Assessment. If prior data indicates a possible off-range release of MCs, the suspected release shall be verified during the Quantitative Assessment.

A further evaluation recommendation at the completion of the Quantitative Assessment is considered precedent-setting by the USAF. Additional investigation may be necessary to further characterize on-range and off-range conditions in order to identify and implement appropriate mitigation measures and/or corrective actions to address risks, and to ensure environmental compliance and long-term viability of a subject range. Precedent-setting recommendations require notification and/or approval of A7CAN, which encompasses additional internal as well as external reporting (refer to Section 8).

7.2 NO FURTHER EVALUATION / REASSESSMENT PLANNING

If data analysis and findings support no off-range MC release, no substantial threat of an off-range MC release, and/or no potential risk to off-range receptors, a recommendation of no further analysis may be identified at the conclusion of the Qualitative Assessment or Quantitative Assessment. In the case of a 'No Further Evaluation' recommendation the ORA process is concluded and the subject range scheduled for reassessment. DoDI 4715.14 states that, "All operational ranges must be periodically reevaluated to determine if there is a release or substantial threat of release of munitions constituents of concern from an operational range to an off-range area. This reevaluation shall occur at least every five years, or whenever significant changes (e.g., changes in range operations, site conditions, applicable statutes, regulations, DoD

issuances, or other policies) occur that affect determinations made during the previous assessment."

Assessment updates will be accomplished in the same manner as the initial ORA. The update will include an existing records review and incorporate updated range munitions use information, surrounding land use information, and other data that indicate condition changes at a range over the previous five years (i.e., Qualitative Assessment). If sampling was conducted during the previous assessment, the update shall also encompass sampling to assess migration of MC (i.e., Quantitative Assessment). Available records and new data collected will be compared to information obtained during previous assessments to assess changes in: applicable laws, regulations, and operating standards; physical and environmental conditions; and range operations affecting known or creating new source areas, transportation routes, exposure points, and off-range receptor interactions. Information shall be used to confirm the list of MCs of concern, assess MC migration, revise the range-specific CSM, evaluate off-range releases, and assess potential risks.

Reassessment data will be used to make a recommendation regarding if further evaluation is warranted, or no further evaluation required. Findings will be documented in a reassessment report. If no further evaluation determined upon reassessment, the range is scheduled for another assessment update in five years unless an accelerated assessment schedule is warranted.

7.2.1 Accelerated Reassessment Schedule

Significant changes that may warrant an accelerated assessment schedule or warrant a revision in the timeframe to conduct the mandated five-year reassessment include:

- Changes in applicable federal or state laws or regulations, or revision of DoD policy. The USAF has determined issuance of a subsequent version of the ORAP does not require an earlier reassessment;

- Identification of a new MC as a result of the use of additional munitions type(s), and/or DoD initiatives regarding MCs (e.g., emerging contaminants);

- Discovery of data regarding MC source areas that were previously unknown and were not assessed;

- Changes in range operations, management, and/or maintenance activities that significantly alter known physical and environmental conditions (e.g., MC transportation routes)

- Discovery of data during an unrelated contaminant investigation indicating a potential release of MCs;

- Mitigation measures implemented due to prior assessment findings that may require more frequent monitoring to ensure effectiveness;

- Plans to alter and/or alteration of the surrounding land use that would create off-range receptors not previously identified; and

- Data from off-site commercial- or regulatory-driven investigations indicate a possible release of MCs from an operational range or range complex.

MAJCOMs, in coordination with the installation, may determine an accelerated reassessment schedule is necessary for a subject range based on the above factors. The timeframe for an accelerated assessment will depend on the nature and complexity of significant changes. The decision to accelerate a range's assessment schedule and associated timeframe shall be documented to serve as a record of analysis.

7.2.2 Compliance Studies

A finding of no further evaluation at the conclusion of the ORA process (either phase) does not preclude the assessment team from recommending compliance studies to address other identified range concerns. Potential concerns may include but are not limited to air or water quality, material management, natural and/or cultural resource management, environmental planning, and safety. Compliance studies may be recommended, by the assessment team, to further evaluate and identify potential measures to resolve any non-MC related environmental, maintenance, safety and health concerns discovered while conducting the range assessment. The ORA team's recommendation to conduct a compliance study is not considered precedent setting. Compliance study recommendations will be under separate cover, and included as an appendix in the assessment report.

7.3 FURTHER EVALUATION / RESPONSE PLANNING

This section discusses the possible further evaluation recommendations that may result from findings of the Quantitative Assessment (refer to Section 6.8.1.2). The assessment team shall outline, in the Quantitative Assessment report, anticipated actions and data needs to implement the recommended further evaluation approach, as well as expected results. This information shall aid the range, installation, MAJCOM, and other stakeholders with the identification of operational impacts and environmental liabilities associated with recommendations in order to make a determination regarding an appropriate response and plan for follow-on efforts.

Further evaluation efforts, upon the conclusion of the Quantitative Assessment, are beyond the scope of the ORAP and shall be addressed under an appropriate USAF environmental quality program and/or environmental restoration program. Transitioning to another program will require USAF decision-maker concurrence as well as the associated Air Force program manager approval. Responses to further evaluation recommendations shall be performed in conformance with the CERCLA process and, as appropriate, other applicable statutes, regulations, and policies. In general, efforts associated with further evaluation findings should be programmed to be conducted within one-year of the finding.

A further evaluation finding may be warranted at the conclusion of the Quantitative Assessment due to inconclusive data results regarding a release, substantial threat of release, and/or unacceptable risk; or data verifies a substantial threat of release, confirms a release beyond the range boundary, and indicates a potential risk to off-range receptors. Recommended further analysis may include one or more of the following: On-Range Inspection/Characterization;

Mitigation Study; and/or Off-Range Investigation. The following sections provide further discussion on anticipated follow-on efforts, which may be conducted concurrently, to address MC migration and ensure the long-term viability of a range. Each of the follow-on efforts described below will require planning and reporting before and after execution of the corrective action and/or mitigation measure. Detailed response planning will be range-specific and is outside the scope of the ORAP. Installations and/or MAJCOMs may request AFCEE (TD and/or ER) assist in range-specific response planning activities.

7.3.1 On-Range Inspection / Characterization

Unconfirmed migration of MCs through the on-range environment prevents the USAF from identifying appropriate actions to mitigate MC transport towards off-range receptors. Additional on-range investigation efforts may be warranted when Quantitative Assessment data is inconclusive regarding a suspected release, threat of release, and/or associated risk. If there is not enough information available to evaluate potential source-receptor interactions, an expanded site inspection may be necessary; if there is not enough information available to evaluate risks associated with complete exposure pathways, an in depth site characterization study and risk assessment may be necessary. Any additional on-range assessments shall be conducted in conformance with ORAP methodology and governing risk assessment processes.

Further on-range inspections and/or characterizations are anticipated to focus on confirming sources; validating transport mechanisms; verifying off-range human and ecological receptors; fully evaluating MCs at the range boundary and/or adjacent off-range areas; and analyzing source-receptor interactions in order to confirm an off-range release, verify a substantial threat of release, and assess potential risk. Results may indicate no further evaluation or further evaluation efforts such as an off-range investigation and/or an on-range corrective (remedial, removal, or treatment) response action. In general, an on-range inspection and/or characterization effort shall be conducted in conjunction with a mitigation study. Any on-range actions taken, measures implemented, and MC migration should be monitored to ensure effectiveness.

The USAF decision-makers, at their discretion, may perform an aforementioned range inspection and/or characterization effort prior to the required five-year reassessment and/or before consideration of transfer to another program for further off-range investigation and analysis. Any supplemental on-range assessments shall augment existing ORA data and could include off-range samples between the suspected MC source and the installation boundary or nearest receptor, and fate or transport modeling to estimate MC availability and/or demonstrate the status of a potential exposure pathway to a receptor. If implemented, these efforts would be of limited scope and cost.

7.3.2 Mitigation Study

When possible, the USAF will manage MCs prior to migration beyond the range boundary. Mitigation studies may be identified to further assess 1) migration mechanisms that are slowly transporting MC through the on-range environment; 2) situations in which activities or conditions significantly redistribute MCs; or 3) instances where MCs are migrating unimpeded through the on-range environment. In general, a mitigation study is anticipated to be conducted in conjunction with additional on-range and/or off-range investigations under a program other than the ORAP.

Mitigation studies are anticipated to focus on range operations, management, and maintenance activities, as well as the condition of range facilities and environment in order to assess, evaluate, and identify measures, practices, or controls as may be necessary to minimize or prevent further MC redistribution, transport, and/or an off-range release. Recommended mitigation measures may include changes in operational parameters; however, any recommended measures should be assessed to ensure no impact on range viability and/or mission as well as include an evaluation of implementation and maintenance costs.

Any mitigation measures implemented should be monitored for continued effectiveness of implemented measures should be reported. Monitoring could be a separate project or conducted as part of an accelerated ORA reassessment schedule. Implemented measures may be eliminated and/or revised and replaced with new recommended measures, upon approval, based on monitoring information. Additionally, monitoring of mitigation measures may indicate a need to consider accelerated corrective actions.

7.3.3 Off-Range Investigation

Migration of MCs beyond the range boundary increases the likelihood of mission constraints. An off-range investigation may be warranted when Quantitative Assessment data confirms and/or verifies an off-range release, and an unacceptable risk to off-range receptors is identified or an unacceptable risk cannot be substantiated. Off-range investigation and corrective response action, if necessary, may be conducted under an appropriate environmental cleanup, restoration, or response program. Transitioning of off-range areas to another program requires USAF decision-maker concurrence as well as associated Air Force program manager approval. Follow-on efforts at overseas ranges will be determined by the appropriate MAJCOM, overseas installation, and the host nation, and will be based on the FGS agreement. Although an off-range area investigation may be transitioned to another Air Force program for responsibility and action as the lead, any associated effort should be coordinated and conducted in cooperation with ORAP stakeholders (refer to Section 2).

Off-range investigations are anticipated to focus on sampling at the range boundary and adjacent off-range areas to fully characterize the nature and extent of contamination beyond the range boundary and assess potential risk to off-range human health and the environment. Results may indicate no further evaluation; no further evaluation pending implementation of on-range mitigation measures and/or corrective actions to contain a release or halt future migration; and/or further off-range evaluation to identify, select, and implement an appropriate corrective (management, remedial, or removal) response action to address unacceptable risks.

In general, an off-range investigation shall be conducted at the same time or upon completion of an on-range inspection/characterization study and/or mitigation study. On-range studies conducted prior to or in conjunction with off-range investigations ensures appropriate on-range measures and corrective actions, if necessary, are identified and planned for to prevent further off-range releases. Any on-range actions taken, measures implemented, and MC migration should be monitored to ensure measures are effective at preventing future off-range contamination concerns.

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8.0 REPORTING REQUIREMENTS

Reports developed under the ORAP and any reports generated from subsequent efforts as a result of Qualitative or Quantitative Assessment findings will be kept on file at the MAJCOM. Final versions of ORA reports as well as associated follow-on effort reports shall be provided to AFCEE in electronic portable document format (PDF) for permanent record keeping purposes.

8.1 STATUS REPORTING

MAJCOMs will annually report the progress made in accomplishing ORAs as prescribed under the ORAP to HQ USAF/A7CAN in coordination with AFCEE. A data call shall be sent out prior to the end of each fiscal year, requesting an update on the MAJCOMs schedule for completion of required assessments. Status updates shall include date of completion or anticipated completion for all assessments and reassessments conducted under this program document in order to assess meeting established goals (refer to Section 3). Status reporting may include other pertinent data such as, but not limited to, program/project funding and assessment findings.

HQ USAF/A7CAN, in coordination with AFCEE, utilizes provided information to respond to end of fiscal year data calls as well as data requests throughout the following fiscal year on implementing the ORAP, completing ORAs, and reporting findings of release or substantial threat of release. Reported data includes, but is not limited to: inventory; overall program budget; status of meeting goals; schedule for completing ORAs; explanation for not meeting established goals and actions being taken to address challenges; budget forecasting; and assessment findings as well as any response actions. Additionally, HQ USAF/A7CAN will provide information on the overarching Operational Range Environmental Program which includes ORAs and/or submit data in coordination with HQ USAF/A3O-BR under the Air Force Range Sustainment Program in order to provide USAF information for the Sustainable Ranges Report to Congress.

8.1.1 Range Inventory

MAJCOMs, in coordination with installation and range contacts, shall review their ORA inventory at least annually in conjunction with submission of assessment status reporting. Eligible operational ranges/areas (refer to Section 3) should be identified, as well as any change in operational status which may indicate a range is excluded from the ORAP to HQ USAF/A7CAN and AFCEE/TD. Information generated under the MMRP regarding areas identified as operational and therefore not eligible for the MMRP may be utilized to confirm the ORA inventory and/or evaluate areas for ORAP eligibility. HQ USAF/A7CAN will coordinate, as appropriate, with HQ USAF/A3O-BR, HQ USAF/A7CX, and/or HQ USAF/A5RJ-FP to confirm changes in the inventory of operational ranges subject to the requirements of this program document.

8.2 ASSESSMENT REPORTS

Upon completion of the assessment or reassessment, a report summarizing the results will be provided to USAF decision-makers. A draft version of the assessment report will be submitted

to the appropriate range, installation, and MAJCOM personnel for review and concurrence on recommendations prior to finalization. Upon range, installation, and MAJCOM concurrence with reported data analysis and recommendations, a determination is made regarding findings and a final report issued.

The final assessment report will be kept on file at the MAJCOM. MAJCOMs or installations, if designated, shall provide final assessment reports in electronic portable document format (PDF) to AFCEE. AFCEE/TD has been designated as the permanent central repository for maintaining all assessments conducted under the ORAP.

8.2.1 Qualitative Assessment Report

A Qualitative Assessment Report shall be developed to provide all compiled data and present assessment findings. It will consist of information on current and past range activities; describe the physical and environmental setting; document data collection activities; present data analyses and discuss results of analyses in terms of potential source areas, migration routes, receptors, and source-receptor interactions; and present recommendations based on data analysis. A sample report format is provided in Appendix D.

The report will be submitted in electronic formats (Microsoft Word and Adobe Acrobat) and hardcopy, if requested. Report appendices shall include pertinent records and data files in electronic formats compatible with USAF systems.

8.2.2 Quantitative Assessment Report

A Quantitative Assessment Report shall be developed to provide all compiled data and present assessment findings. It will consist of information on project objectives and sampling approach; characterization data on source areas and migration routes; present data analyses, and will discuss results of analyses in terms of affected media, release, and risk; quality assurance/control measures; and recommendations based on data analysis. The report shall, to the maximum extent possible, utilize the Qualitative Assessment Report or update information in order to provide a summary of current and past range activities, and describe the physical and environmental setting. A sample report format is provided in Appendix D.

The report will be submitted in electronic formats (Microsoft Word and Adobe Acrobat) and hardcopy, if requested. Report appendices shall include pertinent records and data files in electronic formats compatible with USAF systems.

8.2.3 Operational Range Reassessment Report

Assessment updates are accomplished in the same manner as the previous ORA and shall, to the maximum extent possible, use any prior ORA report format/content. If the ORA process was completed at the qualitative phase, then the reassessment report shall include all elements of the Qualitative Assessment Report. The reassessment report shall incorporate updated information and new records documenting changes in conditions at the range and surrounding area over the previous five years, document analysis of existing, updated, and/or new records, discuss confirmation of prior assessment findings or revision of findings; and present recommendations based on data analysis.

If the ORA process was completed at the quantitative phase, no matter the finding, then the reassessment report shall include all elements of the Quantitative Assessment Report. The reassessment report shall incorporate updated information and new records obtained during the qualitative phase, and new sampling data obtained during the quantitative phase. This report shall document changes over the previous five years; discuss analysis of existing, updated, and/or new records and sampling data; compare new sampling data to that collected during all previous assessments or investigations; discuss effectiveness of any implemented mitigation measures; and present analysis findings and recommendations.

8.3 RELEASE / RISK REPORTING

If assessment findings indicate and USAF decision-makers concur to determine there has been a release or substantial threat of release of MCs to an off-range area that could potentially pose an unacceptable risk to human health or the environment, an Operational Range Release or Threat of Release Assessment Memorandum is required (refer to Appendix D). The assessment team (i.e., contractor) shall not independently declare a release or threat of release.

8.3.1 Internal Air Force Notification

MAJCOMs will notify HQ USAF/A7CAN, in coordination with the AFCEE (TD, and ER), immediately if results of an ORA indicate a release or substantial threat of a release to off-range areas that poses a potential risk to off-range human health or the environment. The release or threat of release notification will include, but not be limited to, the following information:

- Name of the installation and POC;
- Name of range, range type, and POC;
- Specific location of the off-range release or substantial threat of release;
- Name of the MC(s) detected and applicable screening levels;
- Suspected or confirmed source of the release (impact area, burial pit, etc.);
- Suspected or confirmed MC migration route and affected media; and
- Potentially affected (at risk) human or ecological receptors.

Within 15 calendar days of notification the MAJCOM, in coordination with the range and installation POCs and AFCEE (TD and ER), shall submit to HQ USAF/A7CAN and AFCEE/TD a complete Operational Range Release or Threat of Release Assessment Memorandum (refer to Appendix D) to include but not be limited to the following additional information:

- Description of current efforts to address release and/or risk;
- Description of proposed and future actions to address release and/or risk; and
- Agencies to be notified or notified of release or substantial threat of release that potentially poses a risk.

HQ USAF/A7CAN will provide information and coordinate with HQ USAF/A3O-BR or other appropriate Air Staff office on any release or threat of release notification and completed Operational Range Release or Threat of Release Assessment Memorandum.

8.3.2 External Air Force Reporting

After internal USAF notification and concurrence with planned actions, the installation will notify the state or federal regulatory agency regarding ORA findings. Within 15 calendar days of concurrence of planned action on the complete Operational Range Release or Threat of Release Assessment Memorandum, the information and any additional information, as required, shall be submitted to the appropriate regulatory agencies. The MAJCOM and AFCEE/TD will provide support, as necessary, regarding external reporting of a release or substantial threat of release of MCs from an operational range that potentially poses an unacceptable risk to off-range human health or the environment.

According to 40 Code of Federal Regulations (CFR) Part 302 and 33 CFR 153, a telephone call to the National Response Center (NRC) fulfills the requirement to report releases under CERCLA and several other regulatory programs, including those under the Clean Water Act Section 311, RCRA, and the U.S. Department of Transportation's Hazardous Materials Transportation Act. If direct reporting to the NRC is not practicable, reports may be made to the EPA pre-designated On-scene Coordinator (OSC) for the geographic area where the release occurred. All such reports must be relayed promptly to the NRC. If it is not possible to notify the NRC or the OSC immediately, reports may be made immediately to the nearest U.S. Coast Guard unit, provided the person in charge notifies the NRC as soon as possible.

8.4 RESPONSE REPORTING

Implementation of follow-on response efforts will depend on the findings, recommendations, and USAF determinations at the conclusion of the Quantitative Assessment phase. Any further evaluation determination will result in follow-on investigations and/or studies to conduct additional or supplemental analysis of a release or substantial threat of release and potential risk. These follow-on efforts and associated determinations will be appropriately documented as required in the project's statement of work. Additionally, any subsequent corrective and/or mitigation actions implemented to address a release, substantial threat of release, and/or unacceptable risk, as well as monitoring to ensure effectiveness of actions will be appropriately documented as required in the project's statement of work.

Any reports generated from follow-on ORA efforts shall be kept on file at the MAJCOM. MAJCOMs or installations, if designated, shall provide final reports to AFCEE/TD for permanent record keeping purposes and as necessary, for assisting in responding to data calls to address actions and findings from follow-on efforts initiated due to ORAs conducted under the ORAP.

9.0 STAKEHOLDER INVOVLEMENT

A multidisciplinary team of USAF personnel and contract technical staff shall work together to successfully implement and execute the ORAP methodology. The assessment team shall consist of personnel that gather/generate the data (e.g., contractors), the organizations that approve and use the data to make decisions (e.g., range, installation, and MAJCOM), those potentially affected by the decisions made based on the data (e.g., stakeholders), and the entities that approve precedent setting recommendations, findings and/or actions (e.g., HQ USAF). USAF as well as assessment team roles and responsibilities are outlined in Section 2.

9.1 AIR FORCE ORGANIZATIONS

Air Force stakeholders may include, but are not limited to ROAA/RMO, civil engineering, environmental, safety, EOD, bioenvironmental, planning, and real property organizations. The assessment team's early identification and regular involvement of stakeholders in the ORAP methodology will facilitate data collection and acceptance of recommendations. Review of the draft assessment report provides a final opportunity for stakeholders to evaluate ORA findings and recommendations.

9.2 REGULATORY AGENCY INTERACTION

Operational range management and conducting ORAs are a DoD function. Regulatory agency interaction shall occur within Office of the Secretary of Defense (OSD) directed guidelines which may include notification of plans, schedules, and progress on range assessments. Regulatory agency interaction and data dissemination to regulatory agencies will be directly controlled by the subject range or host installation, as directed by the MAJCOM, in coordination with AFCEE personnel, as appropriate. Personnel at the subject range, installation, MAJCOM, and AFCEE have an understanding of unique local and state concerns as well as regulations, and have established contacts with appropriate regulatory agency personnel. AFCEE will provide support to range personnel, as appropriate, and will provide compliance and regulatory guidance, as needed.

Base Commanders and their designated representatives have flexibility to interact with regulators as they deem necessary for the situation, within an established framework. DoDI 4715.14 provides the "floor" for regulatory interaction. At a minimum, findings of a release or substantial threat of a release of MCs to an off-range area that creates an unacceptable risk to human health or the environment shall be reported to the appropriate regulatory authorities (refer to Section 8). A 2006 memorandum from OSD provided the "ceiling" on regulator interaction for ORAs. The following is a summary of elements on the maximum level of interaction for Base Commanders or their designated representatives:

- Periodically brief regulators on the plans and progress of range assessments, as needed;
- Determine the level of detail and data provided during progress briefings based on site specific circumstances;

- May provide assessment information to regulators for informational purposes only (e.g., will not negotiate plans nor provide plans or reports for comment);
- May use feedback from regulators (on documents provided for informational purposes), as appropriate; and
- May provide, after quality assurance/quality control, sampling data and draft assessment reports for information.

9.3 PUBLIC INVOLVEMENT

Public involvement will be performed in accordance with DoDD 4715.11, DoDI 4715.14, AFI 13-212, and applicable USAF guidance. OSD guidance (see Appendix E) indicates that ORA reports or findings shall be made available to the public upon finalization. The DoD Environmental, Safety and Occupational Health Network and Information Exchange (DENIX) includes an area for military services to post finalized ORA reports and/or assessment findings (e.g., executive summary of finalized reports).

The installation ORA contact should coordinate with their local Public Affairs office to identify appropriate public participation forums available to accommodate dissemination of ORA data and/or findings. A public participation forum provides an opportunity for the public to voice concerns, allowing installation ORA contacts to obtain an understanding of public opinion on operational range management and identify potential encroachment issues which may impact range sustainability. All public involvement and ORA data dissemination shall be conducted with concurrence of installation/wing public affairs personnel. The need for public meetings or press releases regarding ORAP activities and/or ORA findings shall be determined by installation/wing staff.

HQ USAF/A7CAN, in coordination with AFCEE, may request information from MAJCOMs and/or installation contacts to provide data on ORA public participation initiatives in order to evaluate and ensure the Air Force is meeting stakeholder involvement requirements.

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GLOSSARY

Conceptual Site Model (CSM): A description of an environment based on an understanding of the physical nature of that environment. For an operational range assessment, the CSM describes potential sources of MCs, transport pathways, and routes of exposure to receptors.

Data Quality Objectives (DQOs): Statements that define the type, quality, and quantity of data needed to answer specific questions and to support assessment decisions. The DQO process involves a logical, step-by-step procedure for determining which of the complex issues affecting a site are the most relevant to planning a site investigation before any data are collected (EPA 2006).

Exposure Pathway: An exposure pathway refers to the way in which a person may come into contact with MCs. There are three basic exposure pathways: inhalation, ingestion, and direct contact.

Indoor Ranges: A range that is completely enclosed within a building or structure (ETL 11-18).

Military Range: A designated land or water area that is set aside, managed, and used for range activities by the Department of Defense. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration munitions [10 USC 101(e)(1)].

Munitions Constituents (MCs): Any materials originating from UXO, discarded military munitions (DMM), or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions [10 USC 2710(e)(3)].

MC of interest: MCs having the potential to migrate from a source area to a receptor (human or ecological) in sufficient quantity to cause an unacceptable risk to human health or the environment (DoD 2005).

Munitions Manufacturing Facilities: Facilities that make ammunition products and components produced or used by or for DoD or the U.S. Armed Forces for national defense.

Off-installation: Land, water, and air beyond the installation boundary (i.e., property not owned, leased, and otherwise possessed or controlled by the Department of Defense).

Off-range: Land, water, and air beyond the lateral boundary of a range (refer to Range).

On-range: Land, water, and air within the lateral boundary of a range (refer to Range).

Open Burning (OB): An open-air combustion process by which excess, unserviceable, or obsolete munitions are destroyed to eliminate their inherent explosive hazards (DoD 2008).

Open Detonation (OD): An open-air process used for the treatment of excess, unserviceable, or obsolete munitions, whereby an explosive donor charge initiates the munitions being treated (DoD 2008).

Operating Area: Included in the definition of operational range, are specifically bounded geographic areas that may encompass a landmass, body of water (above or below the surface), and/or airspace used to conduct operations, training, research and development, and test and evaluation of military hardware, personnel, tactics, munitions, explosives, or electronic combat systems (DoD 2003a).

Operational Range: An operational range is a military range that is under the jurisdiction, custody, or control of the Secretary of Defense and is (1) used for range activities (i.e., active) or (2) although not currently being used for range activities (i.e., inactive), is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities (DoD 2004a).

Other-Than-Operational Range: Any military range (i.e., closed, transferred, transferring) that does not fall under the definition of operational range.

Pulverization: As applied to small arms rounds fired, the action of reducing to dust or powder as by crushing, beating, or grinding to very small particles.

Range: A designated land or water area that is set aside, managed, and used for DoD range activities. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration [10 USC 101(e)(1)].

Range Activities: Research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems; and the training of members of the armed forces in the use and handling of military munitions, other ordnance, and weapons systems [10 USC 101(e)(2)].

Range Complex: An area which consists of multiple ranges and/or areas to include all facilities, impact or maneuver areas, and safety zones located within a single boundary or located in close proximity to each other and have similar environmental conditions (USAF 2009).

Receptor: The biological or ecological entity that is exposed to an environmental or man-made stressor.

Release: When MCs escape into the environment beyond the defined range boundary. May be identified when MCs of concern are detected above screening levels at the range boundary or when off-range sampling detects MCs beyond the range boundary.

Sensitive Environmental Area: A terrestrial or aquatic resource, fragile natural setting, or other area with unique or highly-valued environmental or cultural features. Typically, areas that are established and/or protected by State or Federal law (e.g., National Parks, National Monuments, habitats of threatened or endangered species, wildlife refuges, etc) (EPA 1997).

Sentry Areas: Defined on-range locations utilized to indicate the presence of MCs and evaluate migration from suspected source areas through the environment towards the range boundary.

Small Arms Ammunition: Ammunition, without projectiles that contain explosives (other than tracers), that is .50 caliber or smaller, or for shotguns (DoD 2008).

Small Arms Ranges: A range where small arms ammunition is fired. In the context of the ORAP, small arms range means a range on which **only** small arms ammunition is fired.

Substantial Threat of Release: When MCs deposited into the on-range environment are migrating (unconstrained) towards the defined range boundary and/or are detected, below screening levels, at or in close proximity to the range boundary.

Water Ranges: A range that is significantly comprised of a surface water body and used to conduct training, research, development, testing, or evaluation of military munitions or

explosives. Water ranges do not include ranges that are primarily comprised of land and contain a water body.

Unacceptable Risk: When MCs are detected above identified screening levels, or when risk characterization studies verify exposure in sufficient frequency and duration.

Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and that have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, or material and remains unexploded either by malfunction, design, or any other cause [10 USC 101(e)(5)].

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LIST OF ACRONYMS

ACES-PM	Automated Civil Engineering System-Program Management
ADNT	Amino dinitrotoluene
AFCEE	Air Force Center for Engineering and the Environment
AFCESA	Air Force Civil Engineer Support Agency
AFDW	Air Force District of Washington
AFI	Air Force Instruction
ANG	Air National Guard
ASR	Archives Search Report
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRREL	Cold Regions Research and Engineering Laboratory
CRP	Compliance Restoration Program
CSM	Conceptual Site Model
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DMM	Discarded Military Munitions
DNB	Dinitrobenzene
DNT	Dinitrotoluene
DQO	Data Quality Objective
EE/CA	Engineering Evaluation/Cost Analysis
EESOH-MIS	Enterprise, Environmental, Safety & Occupational Health Management Information System
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERDC	Engineer Research and Development Center
ERPIMS	Environmental Resources Program information management System
ESOHCAMP	Environmental Safety and Occupational Health Compliance Assessment and Management Program
FGS	Final Governing Standards
GIS	Geographic Information System
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine, also called Octogen
HQ	Headquarters
HRR	Historical Records Review
IC	Installation/Wing Commander
ICRMP	Integrated Cultural Resources Management Plan

INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
MAJCOM	Major Command
MC	Munitions Constituent
MIDAS	Munitions Item Disposition Action System
MMRP	Military Munitions Response Program
NB	Nitrobenzene
NC	Nitrocellulose
NEPA	National Environmental Policy Act
NG	Nitroglycerine
NOAA	National Oceanic and Atmospheric Administration
NQ	Nitroguanidine
NRC	National Response Center
OB/OD	Open Burn/Open Detonation
OEBGD	Operations Environmental Baseline Guidance Document
ORA	Operational Range Assessment
ORAP	Operational Range Assessment Program
OSD	Office of the Secretary of Defense
OSC	On-scene Coordinator
PA/SI	Preliminary Assessment/Site Inspection
PETN	Pentaerythritol tetranitrate
POC	Point of Contact
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBC	Risk-based Concentration
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine, also called Cyclonite
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RMO	Range Management Office
RMUS	Range and Munitions Use Subcommittee
ROA	Range Operating Agency
RSL	Regional Screening Level
SAF/IE	Secretary of the Air Force, Installations, Environment, and Logistics
SAP	Sampling and Analysis Plan
SAR	Small Arms Range
SERDP	Strategic Environmental Research and Development Program
SOFA	Status of Forces Agreement
Tetryl	Methlyl-2,4,6-trinitorphenylnitramine
TNB	1,3,5-Trinitrobenzene

TNT	Trinitrotoluene
TRI-DDS	Toxics Release Inventory-Data Delivery System
UFP	Uniform Federal Policy
USAEC	U.S. Army Environmental Command
USAF	U.S. Air Force
USAF/A7CAN	U.S. Air Force, Office of the Civil Engineer, Asset Management and Operations Division, Environmental Branch
USAF/A7CX	U.S. Air Force, Office of the Civil Engineer, Readiness and Installation Support Division
USAF/A3O-BR	U.S. Air Force, Associate Directorate for Airspace, Ranges and Airfield Operations, Ranges and Airspace Division
USAF/A5RJ-FP	U.S. Air Force, Associate Directorate for Airspace, Force Protection and Operations Division
USC	United States Code
USD AT&L	Under Secretary of Defense for Acquisition, Technology, and Logistics
USD P&R	Under Secretary of Defense for Personnel and Readiness
USGS	U.S. Geological Survey
UXO	Unexploded Ordnance
XRF	X-Ray Fluorescence

APPENDIX A

RANGE ASSESSMENT SURVEY CHECKLIST

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APPENDIX A: APPLICABLE REQUIREMENTS SURVEY CHECKLIST

A survey checklist shall be completed for each operational range, training area, or complex and included as an appendix in the Final ORAP Report. Information obtained on the overall condition of a subject range's natural and built infrastructure; existing environmental compliance requirements, standards, laws, and regulations; and associated historic and current environmental, maintenance, and/or safety compliance efforts shall aid in establishing the "health" of the on-range environment and facilities. Information shall be used to identify any non-munitions related concerns as well as to recommend an independent environmental, health, and/or safety compliance study.

Checklist Preparer: _____
(Name/Title)

_____
(Company)

_____
(Date)

Site Location: _____
(Complex, Range, Training Area Name)

_____
(Installation/MAJCOM)

_____
(Location if not on the Installation)

Complete the following checklist. As appropriate, please explain responses under "Comments" or separate page.	**YES**	**NO**	**N/A**	**Comments**
ORAP Inventory POC: *Insert Personnel Contacted*				
1. Is the range/area listed in the ORAP Inventory?				
2. Is the range/area not listed in the ORAP Inventory but eligible for assessment under the ORAP?				
3. Was any operational range/training area identified that is not eligible for assessment under the ORAP?				
Air Quality POC: *Insert Personnel Contacted*				
4. Is the range/area in a National Ambient Air Quality Standards (NAAQS) non-attainment area?				
5. Does the National Emission Standards for Hazardous Air Pollutants (NESHAPs) apply at the range/area?				
6. Does the range/area have an air permit OR does the installation have an air permit which includes the range/area?				
7. Has management activities (e.g., dust control, etc.) been implemented or altered (e.g., controlled burns, etc.) due to air quality requirements?				
a. Are air quality management activities documented (e.g., operating standards, best management practices, plans, etc.)				
8. Has any air quality concerns (e.g., regional haze, conformity, etc.) negatively impacted the mission?				

Complete the following checklist. As appropriate, please explain responses under "Comments" or separate page.	**YES**	**NO**	**N/A**	**Comments**
Cultural Resources POC: *Insert Personnel Contacted*				
9. Is the range/area covered in the Integrated Cultural Resource Management Plan (ICRMP)?				
10. Has a cultural resource survey been conducted to include the range/area?				
a. Are there any known or suspected cultural sites on the range/area?				
11. Has any management activities been implemented or altered due to cultural resources?				
a. Are processes for managing cultural resource documented (e.g., operating standards, best management practices, plans, etc.)				
12. Has any cultural resource concerns negatively impacted the mission?				
Natural Resources POC: *Insert Personnel Contacted*				
13. Is the range/area covered in the Integrated Natural Resource Management Plan (INRMP)?				
14. Has a natural resource survey been conducted to include the range/area?				
a. Are there any known or suspected listed species, critical habitat, and/or species of concern on the range/area?				
15. Are there other pertinent natural resources (e.g., wetlands, floodplains, etc.) on the range/area?				
16. Has management activities been implemented (e.g., species or habitat protection, etc.) or altered (e.g., hunting/fishing, controlled burns, etc.) due to identified species or designated habitat?				
a. Are processes for managing natural resource documented (e.g., operating standards, best management practices, plans, etc.)				
17. Has any natural resource concerns negatively impacted the mission?				
Environmental Planning POC: *Insert Personnel Contacted*				
18. Has any National Environmental Policy Act (NEPA) studies (i.e., Environmental Assessment [EA] or Environmental Impact Statement [EIS]) been conducted to assess impacts from operations at the range/area?				
19. Has an Air Installations Compatible Use Zones (AICUZ) or Range Air Installations Compatible Use Zones (RAICUZ) study been performed at the range/area?				
20. Has information on the range boundary and associated safety zone been provided to installation and/or local planning organizations to assist in compatible use planning?				
21. Has any mitigation measures, resulting from any impact studies, been implemented at the range/area?				
22. Is a process in place to address new or modified activities at the range/area for compliance with NEPA?				

Complete the following checklist. As appropriate, please explain responses under "Comments" or separate page.	**YES**	**NO**	**N/A**	**Comments**
a. Are the results of any the environmental impact analysis processes documented?				
23. Has any NEPA compliance requirements negatively impacted the mission?				
Environmental Reporting POC: *Insert Personnel Contacted*				
24. Does the range/area submit Toxic Chemical Release Inventory (TRI) data OR is the data included with the installation TRI data?				
a. Was TRI data associated with munitions related activities?				
25. Has there been a release of hazardous substances, as defined by CERCLA that required reporting to the National Response Center?				
a. Was NRC reporting associated with munitions-related activities?				
Environmental Restoration POC: *Insert Personnel Contacted*				
26. Are processes in place and documented (e.g., operating standards, best management practices, management plans, etc.) regarding spill prevention, response action, and internal Air Force reporting?				
27. Has any non-munitions related areas of concern (e.g., leaking tanks, oil-water separator, etc.) been identified at the range/area?				
a. Has identified non-munitions related area of concern been investigated and/or being remediated?				
b. Has non-munitions related restoration activities negatively impacted the mission?				
28. Are there any historic munitions related areas of interest at the range/area?				
a. Has identified historic munitions related area of interest been investigated and/or being remediated?				
b. Has historic munitions related clean-up activities negatively impacted the mission?				
Range Management POC: *Insert Personnel Contacted*				
29. Is the range/area appropriately designated on real property records?				
30. Is the range/area appropriately documented in the Base Comprehensive Plan?				
31. Is the range/area location and size appropriately depicted in the installation geographical information system?				
a. Does the identified range/area boundary include the associated safety buffer zone?				
32. Does the range conduct munitions related maintenance activities (e.g., munitions debris collection, UXO clearances, etc.)?				
a. Are management, procedure, and schedule of such activities documented (e.g., operating standards, best management practices, plans, etc.)?				

Complete the following checklist. As appropriate, please explain responses under "Comments" or separate page.	**YES**	**NO**	**N/A**	**Comments**
33. Does the range conduct non-munitions related range/area maintenance activities (e.g., berm replacement, target refurbishment, filter replacement, etc.)?				
a. Are management, procedures, and schedule of such activities documented (e.g., operating standards, best management practices, plans, etc.)?				
34. Does the range/area have a process in place to address off-range munitions items as a result of current range/area activities?				
a. Are procedures documented and copy provided to appropriate authorities?				
Range Sustainment/Encroachment POC: *Insert Personnel Contacted*				
35. Is civilian and/or military development (e.g., land use, visibility, etc.) encroaching on the range/area?				
36. Is there any adverse impact on the surrounding area due to range/area activities (e.g., noise, etc.)?				
a. Has any mitigation measures been implemented?				
37. Does the range/area have a program or process in place to address public concerns related to activities?				
a. Are there any conflicts between the community and range operations?				
38. Are environmental, safety, and/or health compliance activities documented (e.g., operating standards, best management practices, management plans, etc.)				
a. Has the range/area received an environmental, compliance inspection?				
b. Has the range/area received safety and health compliance inspection?				
c. Did the range/area receive any notice of deficiencies?				
39. Are sustainment activities/efforts documented (e.g., operating standards, best management practices, management plans, etc.)				
40. Are you aware of any issues or negative public perception associated with similar types of ranges/areas?				
Waste Management POC: *Insert Personnel Contacted*				
41. Does the range/area generate solid waste, as defined by RCRA?				
a. Is solid waste disposed of on-range (e.g., historic or current landfill, etc.)				
42. Does the range/area generate hazardous waste, as defined by RCRA (e.g., paints, solvents, lubricants, etc.)?				
a. Is hazardous waste stored at the range/area?				
b. Is hazardous waste disposed of on-range?				
43. Does the range/area have any waste management permits (e.g., RCRA Subpart X, Emergency Treatment/Storage, etc.) for any treatment, storage, and disposal activities occurring on-range?				
44. Is range residue (e.g., fragments, casings, target debris, etc.) collected for recycling?				

Complete the following checklist. As appropriate, please explain responses under "Comments" or separate page.	**YES**	**NO**	**N/A**	**Comments**
a. Is the material turned over to the installation's Qualified Recycling Program (QRP)?				
b. Is the material turned over to a Defense Reutilization and Marketing Office (DRMO)?				
45. Has management activities been implemented or altered (e.g., selection of non-hazardous products, etc.) due to waste management concerns?				
a. Are waste management activities documented (e.g., operating standards, best management practices, management plans, etc.)				
46. Has any waste management concerns negatively impacted the mission?				
Water Quality POC: *Insert Personnel Contacted*				
47. Is the range/area situated over an aquifer?				
a. Is the aquifer utilized as a drinking water source?				
48. Is the range/area located within a designated aquifer (groundwater) recharge zone?				
49. Is there natural surface water bodies (e.g., lakes, ponds, stream, etc.) present on the range/area?				
a. Do water bodies have a designated use (e.g., recreational, migratory bird management, etc.)?				
b. Are wetlands present on or near the range/area?				
50. Is there non-natural surface water features (e.g., retention ponds, drainage ditches, etc.) present on the range/area?				
51. Does the range/area have a water discharge permit (e.g., NPDES, storm water, etc.) OR does the installation have a permit which includes the range/area?				
a. Are outfalls monitored or sampled for MC?				
52. Are any drinking water wells located on the range/area?				
a. Is water quality testing performed?				
53. Are any non-potable water wells located on the range/area?				
a. Are the wells being monitored or sampled for MC?				
54. Has management activities been implemented or altered (e.g., storm water drainage, erosion control, sediment collection, etc.) due to water quality concerns?				
a. Are water quality management activities documented (e.g., operating standards, best management practices, plans, etc.)				
55. Has any water quality concerns (e.g., run-off, drinking water sources, wetlands, floodplains, etc.) negatively impacted the mission?				

Provide a brief explanation of responses shown above (attach additional sheets as needed):

_____

_____

_____

_____

_____

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APPENDIX B

DATA QUALITY ASSURANCE

B.1 Data Quality Objectives

B.2 Programmatic Quality Assurance Project Plan

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APPENDIX B.1: DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are statements that: clarify the study objectives, define the appropriate type of data to be collected, determine the appropriate conditions for data collection, and specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the decision.

DQOs are developed before data collection. The process for identifying DQOs was developed by the U.S. Environmental Protection Agency (EPA) as outlined in the *Data Quality Objectives Process for Superfund Interim Final Guidance* (EPA 1993) and in the *Guidance for the Data Quality Objective Process* (EPA 2000). The DQO process outlined in the EPA guidance document will be used when it is necessary to develop specific DQOs and consists of the following seven steps that are sequential and reiterative:

1. **State the Problem:** Summarize the problem that will require resolution and identify the resources available to resolve the problem.

2. **Identify the Decision:** Identify the decision that needs to be made.

3. **Identify Inputs to the Decision:** Identify the information needed to support the decision and specify which inputs require new measurements.

4. **Define the Study Boundaries:** Specify the spatial and temporal aspects of the media that the data must represent to support the decision.

5. **Develop a Decision Rule:** Develop a logical "if…then…" statement that defines the conditions that would cause the decision-maker to choose among alternative actions.

6. **Specify Limits on Decision Errors:** Specify the decision-maker's acceptable limits on decision errors that are used to establish performance goals for limiting uncertainty in the data.

7. **Optimize Design for Obtaining Data:** Identify the most resource-effective design for generating data that are expected to satisfy the DQOs.

ORAP Programmatic DQOs

Range-specific DQOs shall be developed to ensure Quantitative Assessment goals and data needs will be met and identified CSM data gaps addressed. The ORAP programmatic DQOs, discussed below, may assist in understanding overall assessment goals and data needs:

1) State the Problem:

Assess operational ranges in order to determine whether there has been a release or a substantial threat of a release of MCs of concern from an operational range or range complex to off-range areas; and whether the release or substantial threat of a release of MCs of concern from an operational range or range complex to an off-range area creates an unacceptable risk to human health or the environment.

2) *Identify the Decision:*
Decide whether there is a release or substantial threat of release of MCs beyond the range boundary; and if a release or substantial threat of release is at sufficient concentrations and exposure frequencies/durations to pose a potentially unacceptable risk to human health or the environment. Assessment results may include no further evaluation, or further evaluation.

3) *Identify Inputs to the Decision:*
Inputs to the decision are operational range data obtained during the qualitative and quantitative, if conducted, assessment. The qualitative effort obtains existing environmental compliance, facility management, and operational activity information, adjacent/regional land use, and other background information obtained through personnel interviews and range survey to develop a CSM. The quantitative effort consists of collecting and analyzing MC sampling data where the developed CSM indicates a potentially complete or complete exposure pathway (source/receptor interaction) in order to confirm an off-range release, threat of release, and potential risk.

4) *Define the Study Boundaries:*
The initial study boundary is the entire range or range complex area, and all possible MC transportation routes to off-range areas. Refinement of study boundaries (e.g., source area) and MC sampling area (e.g., along a specific drainage) will be defined by the range-specific CSM. In general, a range's built infrastructure, environmental parameters, range constraints as well as location and sensitivity of off-range receptors will be evaluated during development of the CSM, to identify the sources, migration routes, and media to analyze.

5) *Develop a Decision Rule:*
The approach to the USAF ORA includes a two-phase process: a qualitative effort and a quantitative effort (conducted if necessary).

- Qualitative Decision. If the Qualitative Assessment findings indicate no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors, the ORA process is concluded. However, if findings indicating a potential exists for a viable transport mechanism between suspected MC source areas and off-range areas; a suspected, possible, or probable off-range release; or there is not enough information available to evaluate potential source-receptor interactions, further evaluation is required in the form of a Quantitative Assessment.

- Quantitative Decision. If the Quantitative Assessment findings indicate no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors the ORA process is concluded. However, if findings confirm MC migration or threat of release, an off-range release, and/or a potential risk to off-range receptors, then further evaluation is identified. Further evaluation efforts upon the conclusion of the Quantitative Assessment shall be addressed under an appropriate existing environmental quality program and/or environmental restoration program (refer to Section 7.2).

6) *Specify Limits on Decision Errors:*
   No specific decision error limits apply to this DQO, as the decision is either no further evaluation due to no off-range MC release, no substantial threat of an off-range MC release, and no potential risk to off-range receptors based on MCs of concern not being detected or detected at concentrations below applicable environmental and risk-based screening levels; or further evaluation based on comparison of maximum detected MC concentrations against appropriate environmental and risk-based screening levels. In general, a 95% upper confidence limit will be applied, as appropriate to address uncertainty and indicate acceptable sampling criteria.

7) *Optimize Design for Obtaining Data:*
   Elements presented in this ORAP provide the design for obtaining the data needed to complete the ORA and report any release or substantial threat of release, and associated risks to off-range human health or the environment.

Additional DQOs shall be developed, as appropriate, to specify operational range assessment data needs that will be met by data evaluation and sampling activities. Formal DQOs will not necessarily be produced for each step of the data collection and evaluation process. The DQO process should be applied in a practical manner to prevent the use of resources in applying the process to situations that do not merit analysis in great detail.

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APPENDIX B.2: PROGRAMMATIC QUALITY ASSURANCE PROJECT PLAN

USAF ORAP
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APPENDIX C

CONCEPTUAL SITE MODEL TEMPLATE

C.1 Graphical CSM Template

C.2 Pictorial CSM Template

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APPENDIX C.1: GRAPHICAL CSM TEMPLATE

SOURCE				INTERACTION			RECEPTORS			
Range Activity MC Residue	**MC Deposition Mechanism**	**Primary Source (Range Area)**	**Secondary Source (Media)**	**Migration Mechanism**	**Exposure Media**	**Exposure Route[1]**	**Human[2]**		**Ecological[3]**	
							CURRENT	FUTURE	TERRESTRIAL	AQUATIC
Weapons/Maneuver Training	Firing Munitions (MC Residue)	Firing Point/Line	Air (Free MC particulates)	Air/Wind	Air	Inhalation	○	○	○	○
	Deploying Munitions (MC Residue)	Static Test Point								
Weapons Testing	Complete Detonation (High-Order, Frag)	Target/Impact Areas		Wind Entrainment (Dust)						
	Function as Designed (Frag, High-Order)	Berms/Bullet Traps	Surface Soil	Run-Off/Erosion	Air	Inhalation	○	○	○	○
Munitions Disposal (Proficiency Training)	Non-Functioning Munitions (UXO, Duds, Frag, MPPEH)	Safety Fans/Buffer Zones		Chemical Weathering	Surface Water Sediments	Dermal Contact	○	○	○	○
	Incomplete Detonation (Low-Order, Kick-Out, MPPEH)	Open Detonation Points				Ingestion	○	○	○	○
Munitions Disposal/Treatment	Unfired Munitions (Loss, Mishandling, Abandonment)	Open Burn Pits	Subsurface Soil	Human Activities	Surface Soil	Dermal Contact	○	○	○	○
	Burning/Treatment (MPPEH, MC Residue)	Burial Pits		Leaching		Ingestion	○	○	○	○
	Incomplete Burning/Treatment (MPPEH, MC Residue)				Subsurface Soil	Dermal Contact	○	○	○	○
						Ingestion	○	○	○	○
					Groundwater	Dermal Contact	○	○	○	○
						Ingestion	○	○	○	○

Key	
● Complete Pathway	◑ Potentially Complete Pathway
○ Incomplete Pathway	┈┈ Receptor Not Present

[1] Indirect exposure routes (movement through the food chain, bioaccumulation, or bioconcentration) are not presently considered pathways.

[2] Human Health Receptors may include one of the following: Community/Industry worker, nearby residents, etc. For each human receptor, identify if it is current or future.

[3] Ecological Receptors include sensitive environmental areas (terrestrial and aquatic ecosystems) that provide a unique and protected habitat, and contains species of local significance.

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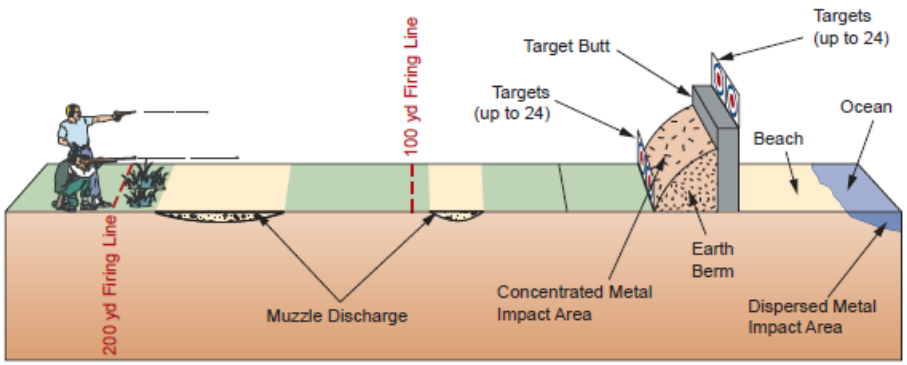
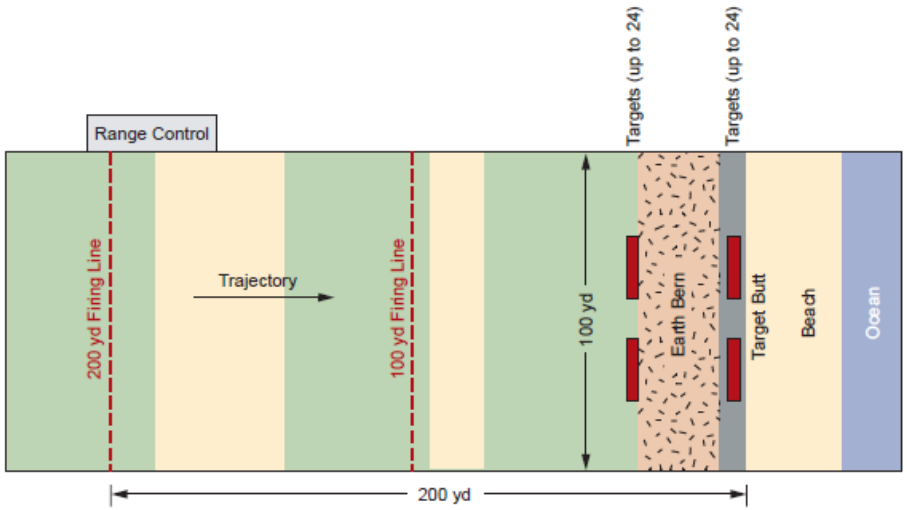
APPENDIX C.2: PICTORIAL CSM TEMPLATE



Schematic Cross Section View



Plan View

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APPENDIX D

OPERATIONAL RANGE ASSESSMENT REPORT FORMATS

D.1 Sample Qualitative Assessment Report Format

D.2 Sample Quantitative Assessment Report Format

D.3 Operational Range Assessment–Release or Threat of Release Notification

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APPENDIX D.1: Sample Qualitative Assessment Report Format

Executive Summary

- Purpose of Effort
- Overview of Range(s)
- Assessment Findings
- Recommendations

Report Body

1. Introduction
   - 1.1. Purpose of ORAP
   - 1.2. Project Scope/Objectives
   - 1.3. Project Management
   - 1.4. Report Organization

2. Installation Information
   - 2.1. Location/Setting
     - 2.1.1. Surrounding Land Use / Anticipated Changes in Use
     - 2.1.2. Surrounding Water Use / Anticipated Changes in Use
   - 2.2. Mission/Operational History
   - 2.3. Operational Ranges/Training Areas
     - 2.3.1. ORAP Eligible Ranges/Areas
     - 2.3.2. ORAP Non-Eligible Areas
     - 2.3.3. Governing Standards
   - 2.4. Range Related Studies/Investigations
     - 2.4.1. Environmental Program
     - 2.4.2. Restoration Program

3. Environmental/Physical Characteristics
   - 3.1. Climate/Meteorology
   - 3.2. Vegetation
   - 3.3. Topography
   - 3.4. Hydrology
   - 3.5. Soils
   - 3.6. Geology
   - 3.7. Hydrogeology
   - 3.8. Natural/Cultural Resources
     - 3.8.1. Archaeological Sites
     - 3.8.2. Sensitive Habitats
     - 3.8.3. Species of Concern

4. Summary of Project Activities
   - 4.1. Records Review
   - 4.2. Personnel Interviews
   - 4.3. Range Survey(s)

5. Operational Range/Area Information
   - 5.1. Summary of Ranges/Areas
   - 5.2. Range [A] Specific Characteristics
     - 5.2.1. Site Description/Boundary
     - 5.2.2. Operations/Historic Land Use
     - 5.2.3. Weapons/Munitions Use
     - 5.2.4. Built Infrastructure/Layout
       - 5.2.4.1. Surrounding Land Use
       - 5.2.4.2. Encroachment Concerns
     - 5.2.5. Environmental Setting
       - 5.2.5.1. Surface Water Flow
       - 5.2.5.2. Groundwater Flow
       - 5.2.5.3. Natural/Cultural Areas
       - 5.2.5.4. Environmental Concerns
     - 5.2.6. Operating Standards
       - 5.2.6.1. Maintenance Activities
       - 5.2.6.2. Sustainment Concerns

6. MC of Potential Concern
   - 6.1. USAF Master List
   - 6.2. Range [A] Specific Evaluation
     - 6.2.1. Munitions Composition Data
     - 6.2.2. Known/Suspected MC

7. MC Deposition and Transport
   - 7.1. MC Deposition Mechanisms
   - 7.2. MC Transport Mechanisms
     - 7.2.1. Air Migration
     - 7.2.2. Soil Migration
     - 7.2.3. Surface Water Migration
     - 7.2.4. Groundwater Migration
   - 7.3. MC Migration Evaluation

8. CSM Development
   - 8.1. Source Area(s)
   - 8.2. Receptors
     - 8.2.1. Off-Range Humans
     - 8.2.2. Off-Range Ecological
   - 8.3. Source-Receptor Interaction
     - 8.3.1. Exposure Media
     - 8.3.2. Exposure Routes
   - 8.4. Exposure Pathway Analysis

9. Conclusions & Recommendations
    - 9.1. MC Deposition & Transport
        - 9.1.1. Substantial Threat of Release
        - 9.1.2. Off-Range MC Release
    - 9.2. MC Exposure Pathway(s)
        - 9.2.1. Human Health Risks
        - 9.2.2. Environmental Risks
    - 9.3. Recommendations

References

Appendices

- Project Data Source List
- Records Compilation File
- Interview Records
- Survey Checklist
- Photo Documentation
- Positional Data
- Munitions Use Data
- Compliance/Management Initiatives

Figures/Tables

- Composition of Munitions Used
- MCs of Potential Concern
- CSM – Graphical/Pictorial

Maps

- Installation Location – Regional
- Installation Location – Detailed
- Operational Range/Area Inventory Map
- Surrounding Land Use(s) – Industrial, Residential, Parks, Preserves, etc.
- Environmental Setting – Critical Habitat, Species, Recharge Area, etc.
- Range Boundary/Layout – Buildings, Utilities, Firing Line, Targets, etc.
- Range Environmental Features – Soil, Vegetation, Surface Water, etc.

APPENDIX D.2: Sample Quantitative Assessment Report Format

Executive Summary
- Purpose of Effort
- Overview of Range(s)
- Assessment Findings
- Recommendations

Report Body

1.0 Introduction
- 1.1. Purpose of ORAP
- 1.2. Project Scope/Objectives
- 1.3. Project Management
- 1.4. Report Organization

2.0 Installation Information
- 2.1. Location/Setting
- 2.2. Mission/Operational History
- 2.3. Operational Ranges/Training Areas
- 2.4. Qualitative Assessment Summary

3.0 Environmental/Physical Characteristics
- 3.1. Vegetation and Soil Type
- 3.2. Topography and Hydrology
- 3.3. Geology and Hydrogeology
- 3.4. Natural/Cultural Resources

4.0 Summary of Project Activities
- 4.1. Sampling Methodology
  - 4.1.1. Data Quality Objectives
  - 4.1.2. Design and Approach

5.0 Operational Range/Area Information
- 5.1. Summary of Ranges/Areas
- 5.2. Range [A] Specific Characteristics
  - 5.2.1. Site Description Summary
  - 5.2.2. CSM Overview
  - 5.2.3. MC of Potential Concern
    - 5.2.3.1. Screening Values
  - 5.2.4. Sample Approach/Location
    - 5.2.4.1. Media Sampling
    - 5.2.4.2. Analytical Methods
  - 5.2.5. Sampling Results Summary

6.0 MC Availability and Transport
- 6.1. MC of Concern Determination
- 6.2. Media Migration Conclusions
- 6.3. MC Off-Range Release Evaluation

7.0 CSM Revision
- 7.1. Source Area(s)
- 7.2. Receptors
  - 7.2.1. Off-Range Humans
  - 7.2.2. Off-Range Ecological
- 7.3. Interaction
  - 7.3.1. Exposure Media
  - 7.3.2. Exposure Routes
- 7.4. Exposure Pathway Conclusions
- 7.5. Human/Ecological Risk Analysis

8.0 Conclusions & Recommendations
- 8.1. MC Availability & Transport
  - 8.1.1. Substantial Threat of Release
  - 8.1.2. Off-Range MC Release
- 8.2. MC Exposure Pathway(s)
  - 8.2.1. Human Health Risks
  - 8.2.2. Environmental Risks
- 8.3. Recommendations

References

Appendices
- Photo Documentation
- Positional Data
- Sampling/Laboratory Data
- Compliance/Management Initiatives

Figures/Tables
- MCs of Concern
- CSM – Graphical/Pictorial

Maps
- Installation Location
- Operational Range/Area Location
- Range Features – Boundary, Source Area(s), Transport Route(s), etc.
- Range Sampling Location(s)
- Off-Range Human Receptors
- Off-Range Ecological Receptors

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APPENDIX D.3: Operational Range Assessment–Release or Threat of Release Notification

MEMORANDUM FOR USAF/A7CAN

FROM: *[Insert Name, Organization]*

SUBJECT: Operational Range MC Off-Range Release or Substantial Threat of Release

1. The results of the operational range assessment at *[insert name of range and installation]* indicate munitions constituent (MC) release or threat of release to an off-range area which could potentially pose an unacceptable risk to human health and/or the environment as defined by the Operational Range Assessment Program.

2. The following MC were found above screening levels resulting in an off-range release or threat of release conclusion. A potentially complete exposure pathway exists for off-range receptors (human and/or ecological) which may pose an unacceptable risk.

MC of Concern	Detection Level (mg/kg)	Screening Value (mg/kg)	Sample Location	Source Area	Transport Media	Affected Media	At Risk Receptors
Lead	*1200*	*400*	*Boundary*	*Berm*	*Surface Water*	*Soil; Sediment*	*Children (Day Care Facility)*

3. The following actions were taken as a result of the discovery of the release/threat of release and potential unacceptable risks:

   [Brief description of actions taken to include agencies notified, response to release, public involvement, etc.]

4. The following actions will be taken as a result of the discovery of the release/threat of release and potential unacceptable risks:

   [Insert brief description of future activities including additional agencies that will be notified.]

5. The POC for additional information is *[insert name, organization, phone number, email]*.

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APPENDIX E

OSD OPERATIONAL RANGE ASSESSMENT SUPPLEMENTAL GUIDANCE

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APPENDIX E: OPERATIONAL RANGE SUPPLEMENTAL GUIDANCE

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

DEC 1 8 2007

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY
(INSTALLATIONS & ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY
(INSTALLATIONS & ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE
(INSTALLATIONS, ENVIRONMENT & LOGISTICS)

SUBJECT: Operational Range Assessments – Supplemental Guidance

To ensure that the operational range assessments required under DoDI 4715.14 "Operational Range Assessments" are conducted and managed similarly across the Services the following guidance is provided for immediate implementation.

- Operational Range Assessment Schedules. Schedules for the performance of operational range assessments shall be made available to environmental regulators and other stakeholders. Operational range assessment schedules will be forwarded through the chain of command to ODUSD(I&E) no later than September 30 of each fiscal year for posting on the Defense Environmental Network Information Exchange (DENIX).

- Operational Range Assessment Release to the Public. Immediately upon finalization, individual operational range assessments (or a documentation of findings) shall be made available to the public. Individual operational range assessments shall not be held for bundling or otherwise released to the public in bulk.

- Reevaluation. Services shall reevaluate each operational range or range complex at least every five years from the completion of the previous assessment. Reevaluation shall occur sooner if a significant change occurs that affects determinations made during the previous assessment.

- Reporting. By September 30 of each year the Services shall report the following information to DUSD(I&E) and DUSD(R):
  - An accounting of the differences between the 366 report (PL 107-314 section 366) inventory and the operational range assessment inventory
  - Latest operational range assessment schedule
  - Listing of operational range assessments (or summary documentation) provided to the public and when they were released
  - Listing of reevaluations underway and proposed for the next fiscal year.

- Unacceptable Risk. The CERCLA risk assessment process will be used to determine whether a release of munitions constituents of concern from an operational range to an off-range area creates an unacceptable risk to human health and the environment.

This guidance shall be incorporated into individual service guidance as appropriate. If there are questions or additional information is required please contact Mr. Vic Wieszek, available at (703) 571-9061 or victor.wieszek@osd.mil.

Alex A. Beehler

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Acting, Deputy Under Secretary of Defense
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cc:
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REVISED APPENDIX F

HUMAN HEALTH AND ECOLOGICAL RISK SCREENING VALUES

RMUS Operational Range Assessment Screening Values, Updated 21 May 2012

Operational Range Assessment Screening Values

Background

Department of Defense Directive 4715.11 and Department of Defense Instruction (DODI) 4715.14 require each service to assess its operational ranges within the continental United States (CONUS). Each service has developed their own Operational Range Assessment Program and provides their own direction and guidance for conducting its range assessments. The operational range assessment programs determine whether there has been a release or substantial threat of release of munitions constituents (MC) from an operational range to off-range areas which creates an unacceptable risk to human health and/or the environment. This document provides screening level values to assist the operational range assessment programs in determining if there may be an unacceptable risk to human health and/or the environment. As provided in the individual Services' range assessment programs and guidance, sampling may be warranted during the range assessment process.

To promote consistency across the services' range assessment programs, the DoD Range and Munitions Use Subcommittee (RMUS), has developed screening values presented in this document to which all services will compare their surface water, groundwater and sediment sampling data. The RMUS involved toxicologists and the Tri-Service Environmental Risk Assessment Work Group (TSERAWG) in the development and review of these procedures and screening values. Screening values have been selected from a hierarchy of sources with recognized authority, acceptance and applicability. This list of screening values has been developed as a general list of commonly found MC used in various range training activities. This list is not intended to be inclusive of all munitions types nor is it intended that the entire list be monitored for all ranges to be investigated. The specific list of MC to be evaluated will be determined on a site-by-site basis during the range assessment process, based on the munitions used and, source, pathway, and receptor characteristics.

To promote defensibility, the methodology and scientific basis of collecting and analyzing samples should be as rigorous as the process used to comply with standards associated with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) risk screening and analysis as provided in the individual services' program direction and guidance.

Sampling data will be compared to the appropriate media screening values presented here to determine if further assessment is appropriate. MC concentrations less than these conservative screening values will be considered to have no adverse impacts on human health and/or the environment, and therefore, would not require any further action.

Sampling data with MC concentrations exceeding these screening values do not necessarily indicate the presence of an unacceptable risk, or that cleanup or other mitigation measures will be necessary. Results above these conservative screening values indicate that a more detailed evaluation of the existing data is required. An initial assessment of data exceeding screening values would consider such things as review and update of the conceptual site model (CSM), additional data collection, site-specific screening evaluations, and potential cumulative health risk effects from multiple parameters.

Supplemental actions and/or investigations may be conducted as part of the data assessment. These additional actions may include, but are not limited to: more sophisticated modeling (3-Dimensional modeling), data refinement, weight of evidence determination and additional sampling and analysis. If indicated by this initial screening, a site-specific risk assessment may be conducted as well. Any site-specific risk assessments conducted should comply with regulations and guidance associated with CERCLA. Since the range assessments are internal DoD and are not a regulatory requirement, involvement with regulators is not part of the data assessment process. Regulatory involvement in the range assessment process is described in the DODI 4715.14 – Operational Range Assessments (30 November 2005) and in the Department of Defense Memorandum “DoD-Regulator Interactions for Operational Range Assessments” (15 August 2006).

If the conclusion of the range assessment is, or most likely is, that an off-range release has occurred or is likely to occur, creating an unacceptable risk, the assessor should follow the appropriate services’ program direction and guidance.

Approach

The services will only use these screening values for the appropriate exposure scenarios identified for the site location. To facilitate development of uniform values, the most prevalent and significant exposure scenarios were selected. These scenarios include groundwater, surface water and sediment migration pathways from on-range to off-range areas occupied by human and/or ecological receptors. For human health, the most significant exposure scenario is consumption of either surface water or groundwater. For ecological receptors, direct contact with surface water and sediment by aquatic organisms (e.g. fish, algae) was selected as the most significant exposure scenario. Generally, aquatic organisms are considered a conservative representative for other ecological receptors because they will have continuous exposure to the water and sediment through their entire lifecycle. Ecological screening values are provided for both fresh and marine surface water and sediments. The ecological values are not appropriate for determining human exposure from consumption of ecological receptors exposed to potentially impacted water and/or sediments.

Multiple agencies have developed drinking water, surface water and sediment values indicting levels that should not cause adverse effects to consumers and aquatic organisms using a variety of processes and assumptions. The RMUS developed a hierarchy of sources for each of the identified exposure scenarios to guide the selection of screening values for this protocol. The hierarchies are prioritized lists of screening value sources in order of recognized authority and applicability, and are described in the Drinking Water and Surface Water Systems sections. From the prioritized list, the first, and most appropriate screening value found for each MC was selected for use in this protocol. Where there were multiple values for the same MC from the same hierarchy source, the RMUS selected the most conservative value.

Other Considerations

- The screening values presented here are the default values. If there are appropriate State or local regulatory standards that are more stringent, they take precedence and will be used on a site-specific basis. Assessors will investigate state and local regulations to determine if they are appropriate.

- The screening values were selected assuming a chronic exposure to the receptors. The assessor should verify that a specific species/MC acute value is not lower than the identified chronic value.

- These screening values are based on current existing information. The range assessments will be based upon the information available at the time of the assessment. As EPA or other federal agencies develop new standards, regulations or guidance, or new information affecting MC tables is published, the screening values will be re-evaluated, and where appropriate, updated. A designated RMUS member will be responsible for reviewing screening values and sources at least biennially. The RMUS and TSERAWG will be involved with any updates to the screening values.

- Sampling results for metals and perchlorate will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

- The statistical analyses used by each service to compare sampling data to screening values and/or background values will be described in individual sampling plans and are not discussed further in this document.

- In exposure scenarios where surface water has potential to impact human health and ecological receptors, both drinking water and ecological surface water screening values need to be considered. The more

conservative value should be selected for comparison with analytical results.

Drinking Water

Drinking Water values are usually appropriate for an exposure scenario where humans are using the water (surface water or groundwater) as a drinking water source. These screening values may not be appropriate if humans are both drinking the water and consuming aquatic organisms from that source. The RMUS recognized the samples may be collected from raw sources such as wells or other sampling locations and not necessarily from finished drinking water supply wells or surface water intakes to which most screening values are applicable. Therefore, while it is appropriate to use the drinking water standards as screening values only, note they are not directly enforceable regulatory standards. When collecting samples from these raw sources, these values will be technically evaluated on a case-by-case basis to determine the appropriateness of the drinking water values. Table 1 presents the human health drinking water screening values.

The hierarchy for human health drinking water screening values:

1. Applicable standards or benchmarks that have been recognized or released by the U.S. Environmental Protection Agency (EPA).
    a. Regional Screening Levels (RSL) - The values from the RSL table were used as the default EPA value for drinking water.
    b. Other EPA drinking water values (MCLs)
2. When no EPA values are available, values from other government agencies will be considered (e.g. National Oceanic and Atmospheric Administration (NOAA), Department of Energy).
3. If none of those are available, scientifically peer reviewed published literature will be researched.

Other Considerations

- The DoD Memo “Policy on DoD Required Actions Related to Perchlorate” (26 January 2006) identifies a level of concern for managing perchlorate at 24 ppb. That value will be used for drinking water in the absence of more stringent state or local standards.

- Toxicity studies have indicated that 2,4-DNT and 2,6-DNT may be carcinogenic when present together. When both compounds are detected at a site, the screening level for the 2,4-DNT, 2,6-DNT mixture should be used instead of the individual screening levels.

Surface Water Systems; Fresh and Marine

For surface water systems, the RMUS considered the scenarios of ecological receptors being exposed to surface water and sediment from either fresh or marine waters. For brackish waters, state guidance on the use of fresh or marine screening levels for the specific water bodies (bays, estuaries, rivers, etc.) should be followed. Due to the sensitivity of some of the ecological receptors, these values are not intended to be applicable for every possible type of species. These values were selected as a conservative screening tool protective of a majority of species. Therefore, when sampling, the specific species type should be taken into consideration when comparing screening values and evaluating whether there is a potential unacceptable risk.

The overall hierarchy of sources for determining surface water system impacts on the ecological receptor is the same whether the focus is on fresh water or marine water. The appropriate sections and values must be selected for the exposure scenario being assessed. Ecological screening values are presented in Table 2 for Freshwater Surface Water Systems and Table 3 for Marine Surface Water Systems.

The hierarchy for ecological surface water and sediment for both fresh and marine environments is listed below:

1. Applicable standards or benchmarks recognized or released by the U.S. EPA.
    a. National Recommended Ambient Water Quality Criteria developed by the EPA Office of Water.
    b. Ecotox Thresholds developed by EPA Office of Solid Waste and Emergency Response.
    c. Ecological Screening Values developed by EPA Regions.
2. When no EPA values are available, values developed by other government agencies will be considered.
3. If none of those are available, scientifically peer reviewed published literature will be researched.

Other Considerations

- These values are not relevant for recreational contact with surface water by human receptors. This scenario can be evaluated if appropriate for a site-specific circumstance.

Operational Range Assessment Screening Value Tables

Table 1 - Human Drinking Water Values

MC	CAS #	Screening Value	
		Value (µg/L)	Source
Antimony	7440-36-0	6	EPA RSL Table[a]
Arsenic	7440-38-2	0.045	EPA RSL Table[a]
Barium	7440-39-3	2000	EPA RSL Table[a]
Cadmium	7440-43-9	5	EPA RSL Table[a]
Chromium[1]	7440-47-3	100	EPA RSL Table[a]
Copper	7440-50-8	620	EPA RSL Table[a]
Lead	7439-92-1	15	Region 6[b]
Manganese	7439-96-5	320	EPA RSL Table[a]
Mercury[2]	7487-94-7	0.63	EPA RSL Table[a]
Molybdenum	7439-98-7	78	EPA RSL Table[a]
Nickel	7440-02-0	300	EPA RSL Table[a]
Silver	7440-22-4	71	EPA RSL Table[a]
Vanadium	7440-62-2	78	EPA RSL Table[a]
Zinc	7440-66-6	4700	EPA RSL Table[a]
HMX	2691-41-0	780	EPA RSL Table[a]
RDX	121-82-4	0.61	EPA RSL Table[a]
TNT	118-96-7	2.2	EPA RSL Table[a]
1,3,5-TNB	99-35-4	460	EPA RSL Table[a]
1,3-DNB	99-65-0	1.5	EPA RSL Table[a]
tetryl	479-45-8	63	EPA RSL Table[a]
NB	98-95-3	0.12	EPA RSL Table[a]
2A-4,6-DNT	35572-78-2	30	EPA RSL Table[a]
4A-2,6-DNT	1946-51-0	30	EPA RSL Table[a]
DNT-mixture 2,4/2,6	25321-14-6	0.092	EPA RSL Table[a]
2,6-DNT	606-20-2	15	EPA RSL Table[a]
2,4-DNT	121-14-2	0.20	EPA RSL Table[a]
2-NT (o-)	88-72-2	0.27	EPA RSL Table[a]
3-NT (m-)	99-08-1	1.3	Region 6[b]
4-NT (p-)	99-99-0	3.7	EPA RSL Table[a]
Nitroglycerin	55-63-0	1.5	EPA RSL Table[a]
PETN	78-11-5	16	
Perchlorate	14797-73-0	15	DoD[c]

Notes:
These values are "default" values. Local standards may be more stringent and take precedence.
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
1 - Screening value is for Total Chromium
2 - Screening value is for Elemental Mercury
Sources:
a - EPA Regional Screening Levels (RSL) table – From "Regional Screening Levels for Chemical Contaminants at Superfund Sites" which is an update for Region 3 RBCs, Region 6 MSSLs, and Region 9 PRGs. From: http://epa-prgs.ornl.gov/chemicals/index.shtml (23 June 2008)
b - Region 6 – Region 6 MSSL Values
c - DoD – The Department of Defense has established a screening value for perchlorate of 24 ppb.

Table 2 – Ecological Freshwater Surface Water System Values

		Freshwater Surface Water		Freshwater Sediment	
MC	**CAS #**	**Value (µg/L)**	**Source**	**Value (mg/kg)**	**Source**
Antimony	7440-36-0	30	EPA Region 3[a]	12	EPA Region 4[d]
Arsenic	7440-38-2	150	EPA NRWQC[2,b]	8.2	EPA OSWER*[,c]
Barium	7440-39-3	3.9	EPA OSWER[c]	20	EPA Region 6[f]
Cadmium	7440-43-9	0.25	EPA NRWQC[2,3,b]	1.2	EPA OSWER[c]
Chromium (VI)	7440-47-3	11	EPA NRWQC[2,b]	81	EPA OSWER[c]
Copper	7440-50-8	9	EPA NRWQC[2,3,b]	34	EPA OSWER[c]
Lead	7439-92-1	2.5	EPA NRWQC[2,3,b]	47	EPA OSWER[c]
Manganese	7439-96-5	80	EPA OSWER[c]	460	Ontario Guidelines[i]
Mercury	22967-92-6	0.77	EPA NRWQC[2,b]	0.15	EPA OSWER[c]
Molybdenum	7439-98-7	240	EPA OSWER[c]	4	D.D.MacDonald et al., 1994[g]
Nickel	7440-02-0	52	EPA NRWQC[2,3,b]	21	EPA OSWER[c]
Silver	7440-22-4	3.2	EPA NRWQC[2,3,b]	2	EPA Region 4[d]
Vanadium	7440-62-2	19	EPA OSWER[c]	50	NOAA Screening Tables[h]
Zinc	7440-66-6	120	EPA NRWQC[2,3,b]	150	EPA OSWER[c]
HMX	2691-41-0	150	EPA Region 3[a]	.0047-.47	EPA Region 4[1,d]
RDX	121-82-4	190	EPA Region 4[d]	.013-1.3	EPA Region 4[1,d]
TNT	118-96-7	90	EPA Region 4[d]	.092-9.2	EPA Region 4[1,d]
1,3,5-TNB	99-35-4	11	EPA Region 4[d]	.0024-.24	EPA Region 4[1,d]
1,3-DNB	99-65-0	20	EPA Region 4[d]	.0067-.67	EPA Region 4[1,d]
tetryl	479-45-8	NA		53.4	Nipper et al., 2002[j] (fine grain sediment)
NB	98-95-3	270	EPA Region 4[d]	0.488	EPA Region 4[d]
2A-4,6-DNT	35572-78-2	20	EPA Region 4[d]	NA	
4A-2,6-DNT	1946-51-0	NA		NA	
2,6-DNT	606-20-2	42	EPA Region 4[d]	0.0206	EPA Region 4[d]
2,4-DNT	121-14-2	44	EPA Region 3[a]	0.0751	EPA Region 4[d]
2-NT (o-)	88-72-2	NA		NA	
3-NT (m-)	99-08-1	750	EPA Region 3[a]	NA	
4-NT (p-)	99-99-0	1900	EPA Region 3[a]	NA	
Nitroglycerin	55-63-0	138	EPA Region 3[a]	NA	
PETN	78-11-5	85000	EPA Region 3[4,a]	NA	
Perchlorate	14797-73-0	9300	Dean et al.[e]	NA	

Notes:
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. E.g. for TNT in sediment w/ 5% TOC it would be: 0.46 (5*0.092=0.46)
2 - Value applies to dissolved metals
3 - The value is dependent on the hardness of the water, provided value is for a water hardness of 100 mg/L as CaCO3.
4 – For PETN, EPA Region III values came from TNRCC 2001 & 2000, which are documented sources k & l below.

Sources:
a - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
b - EPA, Office of Water, Office of Science and Technology (4304T), National Recommended Water Quality Criteria, 2006.

c - EPA Office of Solid Waste and Emergency Response Ecotox Thresholds, January 1996
d - EPA Region 4, Ecological Risk Assessment Bulletins – Supplement to RAGS (EPA 2001)
e - Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
f - EPA Region 6, Screening Level Ecological Risk Assessment Protocol, Aug 1999.
g – A Review of Environmental Quality Criteria and Guidelines for Priority substances in the Fraser River Basin, Prepared by D.D. MacDonald, MacDonald Environmental Sciences Limited, March 1994
h - NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages. Buchman, M.F., 1999.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
j - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
k - TNRCC 2001 Guidance for Conducting Ecological Risk Assessment and Remediation Sites in Texas, Toxicology and Risk Assessment Section, December.
l - TNRCC 2000 Texas Surface water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Effective 17, 2000.

Table 3 – Ecological Marine Surface Water System Values

		Marine Surface Water		Marine Sediment	
MC	**CAS #**	**Value (µg/L)**	**Source**	**Value (mg/kg)**	**Source**
Antimony	7440-36-0	30	Suter and Tsao, 1996[e]	2	NOAA 1990[g]
Arsenic	7440-38-2	36	USEPA, 2004[b]	7.24	MacDonald et al., 2000*[,h]
Barium	7440-39-3	4	Suter and Tsao, 1996[e]	NA	
Cadmium	7440-43-9	8.8	USEPA, 2004[b]	0.68	MacDonald et al., 2000[h]
Chromium (VI)	7440-47-3	50	USEPA, 2004[b]	52.3	MacDonald et al., 2000[h]
Copper	7440-50-8	3.1	USEPA, 2004[b]	18.7	MacDonald et al., 2000[h]
Lead	7439-92-1	8.1	USEPA, 2004[b]	30.2	MacDonald et al., 2000[h]
Manganese	7439-96-5	120	Suter and Tsao, 1996[e]	460	Ontario Guidelines[i]
Mercury	22967-92-6	0.94	USEPA, 2004[b]	0.14	
Molybdenum	7439-98-7	370	Suter and Tsao, 1996[e]	NA	
Nickel	7440-02-0	8.2	USEPA, 2004[b]	15.9	MacDonald et al., 2000[h]
Silver	7440-22-4	1.9	USEPA, 2004[b]	0.73	MacDonald et al., 2000[h]
Vanadium	7440-62-2	20	Suter and Tsao, 1996[e]	NA	
Zinc	7440-66-6	81	USEPA, 2004[b]	124	MacDonald et al., 2000[h]
HMX	2691-41-0	330	Talmage et al., 1999[o]	.0047-.47	EPA Region 4[1,a]
RDX	121-82-4	5000	Nipper et al., 2001[k]	.013-1.3	EPA Region 4[1,a]
TNT	118-96-7	180	Nipper et al., 2001[k]	.092-9.2	EPA Region 4[1,a]
1,3,5-TNB	99-35-4	25	Nipper et al., 2001[k]	.0024-.24	EPA Region 4[1,a]
1,3-DNB	99-65-0	180	Nipper et al., 2001[k]	.0067-.67	EPA Region 4[1,a]
tetryl	479-45-8			53.4	Nipper et al., 2002[l] (fine grain sediment)
NB	98-95-3	66.8	USEPA, 2002[c]	27	Talmage and Opresko, 1995[j]
2A-4,6-DNT	35572-78-2	1480	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
4A-2,6-DNT	1946-51-0	NA	NA	NA	
2,6-DNT	606-20-2	1000	Nipper et al., 2001[k]	0.55	Nipper et al., 2002[l]
2,4-DNT	121-14-2	480	Nipper et al., 2001[k]	0.23	Talmage and Opresko, 1995[j]
2-NT (o-)	88-72-2	NA	NA	NA	
3-NT (m-)	99-08-1	NA	NA	NA	
4-NT (p-)	99-99-0	NA	NA	NA	
Nitroglycerin	55-63-0	138	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
PETN	78-11-5	85000	EPA Region 3[2,d]	NA	
Perchlorate	14797-73-0	9300	Dean et al., 2004[f]	NA	

Notes:

NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. (e.g. for TNT in sediment w/ 5% TOC it would be: 0.46)(5*0.092=0.46)
2 - EPA Region III for PETN marine water refers to US EPA Region 3's Freshwater Screening Benchmark table for a value. These values came from TNRCC 2001 & 2000, which are documented sources m & n below.

Sources:
a - EPA Region 4, Ecological Risk Assessment Bulletins - Supplement to RAGS (EPA 2001)
b – EPA – USEPA 2004 National Recommended Water Quality Criteria Office of Water and Office of Science and Technology.
c – EPA – USEPA 2002 Ecological Risk Assessment Bulletin 2/11/2002. Waste Management Division, Freshwater Surface Screening Values for Hazardous Waste Sites, February.
d - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
e – Suter and Tsao, 1996 Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 196 Revision. ES/ER/Tm-96/R2.
f – Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
g - The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52. Long, E.R. and L.G. Morgan. 1990.
h - MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology, 39: 20-31.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
j - Talmage, S.S., and D.M. Opresko. 1995. Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
k – Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, K. Miller, and S. Saepoff, 2001. Development of Marine Toxicity Data for Ordnance Compounds, Archives of Environmental Contamination and Toxicology, 41:308-31.
l - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
m – TNRCC 2001 Guidance for Conducting Ecological Risk Assessment and Remediation Sites in Texas, Toxicology and Risk Assessment Section, December.
n – TNRCC 2000 Texas Surface water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Effective 17, 2000.
o – Talmage, S.S., D.M. Opresko, C.J. Maxwell, J.E. Welsh, M. Cretelia, P.H. Reno, and F.B. Daniel. 1999. Nitroaromatic munition compounds: Environmental effects and screening values. Reviews in Environmental Contamination and Toxicology, 161: 1-156.

APPENDIX F

HUMAN HEALTH AND ECOLOGICAL RISK SCREENING VALUES

F.1 USAF Identified Soil Screening Levels

F.2 RMUS Identified Human Drinking Water Screening Levels

F.3 RMUS Identified Ecological Freshwater Surface Water Screening Levels

F.4 RMUS Identified Ecological Marine Surface Water Screening Levels

F.5 RMUS, "Operational Range Assessment Screening Values," January 2009

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APPENDIX F.1: USAF Identified Soil Screening Levels

Munitions Constituent	CAS Number	SCREENING VALUES			
		Residential Soil	Industrial Soil	Protection of Groundwater[b]	Source
		mg/kg	mg/kg	mk/kg	
METALS					
Antimony	7440-36-0	31	410	0.27	EPA RSL Table[a]
Arsenic	7440-38-2	0.39	1.6	0.0013	EPA RSL Table[a]
Barium	7440-39-3	15,000	190,000	82	EPA RSL Table[a]
Cadmium	7440-43-9	70	80	0.38	EPA RSL Table[a]
Chromium (total)	7440-47-3	280	1,400	180,000	EPA RSL Table[a]
Copper	7440-50-8	3,100	41,000	46	EPA RSL Table[a]
Iron	7439-89-6	55,000	720,000	640	EPA RSL Table[a]
Lead	7439-92-1	400	800	NA	EPA RSL Table[a]
Manganese	7439-96-5	1,800	23,000	57	EPA RSL Table[a]
Mercury (elemental)	7439-97-6	4.3	24	0.03	EPA RSL Table[a]
Molybdenum	7439-98-7	390	5,100	3.7	EPA RSL Table[a]
Nickel	7440-02-0	1,500	20,000	48	EPA RSL Table[a]
Silver	7440-22-4	390	5,100	1.6	EPA RSL Table[a]
Vanadium	7440-62-2	550	7,200	260	EPA RSL Table[a]
Zinc	7440-66-6	23,000	310,000	680	EPA RSL Table[a]
EXPLOSIVE COMPOUNDS					
2-Amino-4,6-dinitrotoluene	355-72-78-2	150	2,000	0.029	EPA RSL Table[a]
4-Amino-2,6-dinitrotoluene	1946-51-0	150	1,900	0.029	EPA RSL Table[a]
2,6-Diamino-4-nitrotoluene	59229-75-3	NA	NA	NA	
2,4-Diamino-6-nitrotoluene	6629-29-4	NA	NA	NA	
1,3-Dinitrobenzene (1,3-DNB)	99-65-0	6.1	62	0.0023	EPA RSL Table[a]
2,4-Dinitrotoluene (2,4-DNT)	121-14-2	1.6	5.5	0.0002	EPA RSL Table[a]
2,6-Dinitrotoluene (2,6-DNT)	606-20-2	61	620	0.034	EPA RSL Table[a]
DNT-mixture 2,4/2,6	25321-14-6	0.71	2.5	0.000093	EPA RSL Table[a]
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	5.5	24	0.00036	EPA RSL Table[a]
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	240	2500	0.65	EPA RSL Table[a]
Nitrobenzene (NB)	98-95-3	4.4	22	0.000071	EPA RSL Table[a]
Nitrocellulose (NC)	9004-70-0	NA	NA	NA	
Nitroglycerin (NG)	55-63-0	6.1	62	0.0017	EPA RSL Table[a]
Nitroguanidine (NQ)	556-88-7	6,100	62,000	0.92	EPA RSL Table[a]
2-Nitrotoluene (o-Nitrotoluene)	88-72-2	2.9	13	0.00025	EPA RSL Table[a]
3-Nitrotoluene (m-Nitrotoluene)	99-08-1	1,200	12,000	0.6	EPA RSL Table[a]
4-Nitrotoluene (p-Nitrotoluene)	99-99-0	30	110	0.0034	EPA RSL Table[a]
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	3,800	49,000	7.1	EPA RSL Table[a]
Pentaerythritol tetranitrate (PETN)	78-11-5	NA	NA	NA	
1,3,5-Trinitrobenzene (TNB)	99-35-4	2,200	27,000	2.6	EPA RSL Table[a]
2,4,6-Trinitrotoluene (TNT)	118-96-7	19	79	0.0087	EPA RSL Table[a]
White Phosphorus	7723-14-0	1.6	20	0.0027	EPA RSL Table[a]
Perchlorate	14797-73-0	55	720	NA	EPA RSL Table[a]

Notes:
These values are "default" values. Local standards may be more stringent and take precedence.
NA – Not Available (Screening levels not available due to the lack of scientific data on the specific constituents)

Sources:
[a] EPA Regional Screening Level (RSL) Table, April 2009 (update of the EPA Region 3 RBC Table, Region 6 HHMSSL Table and the Region 9 PRG Table)
[b] More protective of Risk-Based or MCL-Based Soil Screening Level

APPENDIX F.2: RMUS Identified Human Drinking Water Screening Levels

Munitions Constituent	CAS Number	SCREENING VALUE	
		Human Drinking Water µg/L	Source
METALS			
Antimony	7440-36-0	15	EPA RSL Table[a]
Arsenic	7440-38-2	0.045	EPA RSL Table[a]
Barium	7440-39-3	7300	EPA RSL Table[a]
Cadmium	7440-43-9	18	EPA RSL Table[a]
Chromium (total)	7440-47-3	100[b]	EPA RSL Table[a]
Copper	7440-50-8	1500	EPA RSL Table[a]
Iron	7439-89-6	26,000	EPA RSL Table[a]
Lead	7439-92-1	15 [b]	EPA RSL Table[a]
Manganese	7439-96-5	880	EPA RSL Table[a]
Mercury (elemental)	7439-97-6	0.57	EPA RSL Table[a]
Molybdenum	7439-98-7	180	EPA RSL Table[a]
Nickel	7440-02-0	730	EPA RSL Table[a]
Silver	7440-22-4	180	EPA RSL Table[a]
Vanadium	7440-62-2	260	EPA RSL Table[a]
Zinc	7440-66-6	11000	EPA RSL Table[a]
EXPLOSIVE COMPOUNDS			
HMX	2691-41-0	1800	EPA RSL Table[a]
RDX	121-82-4	0.61	EPA RSL Table[a]
TNT	118-96-7	2.2	EPA RSL Table[a]
1,3,5-TNB	99-35-4	1100	EPA RSL Table[a]
1,3-DNB	99-65-0	3.7	EPA RSL Table[a]
tetryl	479-45-8	150	EPA RSL Table[a]
NB	98-95-3	0.12	EPA RSL Table[a]
2A-4,6-DNT	355-72-78-2	73	EPA RSL Table[a]
4A-2,6-DNT	1946-51-0	73	EPA RSL Table[a]
DNT-mixture 2,4/2,6	25321-14-6	.099	EPA RSL Table[a]
2,6-DNT	606-20-2	37	EPA RSL Table[a]
2,4-DNT	121-14-2	0.22	EPA RSL Table[a]
2,6-Diamino-4-nitrotoluene	59229-75-3	NA	
2,4-Diamino-6-nitrotoluene	6629-29-4	NA	
2-NT (o-)	88-72-2	0.31	EPA RSL Table[a]
3-NT (m-)	99-08-1	0.37	EPA RSL Table[a]
4-NT (p-)	99-99-0	4.2	EPA RSL Table[a]
Nitrocellulose (NC)	9004-70-0	NA	
Nitroglycerin (NG)	55-63-0	3.7	EPA RSL Table[a]
Nitroguanidine (NQ)	556-88-7	3,700	EPA RSL Table[a]
PETN	78-11-5	NA	
White Phosphorus	7723-14-0	0.73	EPA RSL Table[a]
Perchlorate	14797-73-0	24	DoD[c]

Notes:
These values are "default" values. Local standards may be more stringent and take precedence.
NA – Not Available (Screening levels not available due to the lack of scientific data on the specific constituents)

Sources:
[a] EPA Regional Screening Levels (RSL), from "Regional Screening Levels for Chemical Contaminants at Superfund Sites" [an update of Region III Risk-Based Concentrations (RBCs), Region VI Medium Specific Screening Levels (MSSLs), and Region XI Preliminary Remediation Goals (PRGs)]
[b] MCL Screening Value
[c] DoD established a screening value for perchlorate of 24 ppb

APPENDIX F.3: RMUS Published Ecological Freshwater Surface Water Screening Levels

Munitions Constituent	CAS Number	SCREENING VALUES			
		Freshwater Surface Water		Freshwater Sediment	
		µg/L	Source	mg/kg	Source
METALS					
Antimony	7440-36-0	30	EPA Region 3[a]	12	EPA Region 4[d]
Arsenic	7440-38-2	150	EPA NRWQC[2,b]	8.2	EPA OSWER*[,c]
Barium	7440-39-3	3.9	EPA OSWER[c]	20	EPA Region 6[f]
Cadmium	7440-43-9	0.25	EPA NRWQC[2,3,b]	1.2	EPA OSWER[c]
Chromium (VI)	7440-47-3	11	EPA NRWQC[2,b]	81	EPA OSWER[c]
Copper	7440-50-8	9	EPA NRWQC[2,3,b]	34	EPA OSWER[c]
Lead	7439-92-1	2.5	EPA NRWQC[2,3,b]	47	EPA OSWER[c]
Manganese	7439-96-5	80	EPA OSWER[c]	460	Ontario Guidelines[i]
Mercury	22967-92-6	0.77	EPA NRWQC[2,b]	0.15	EPA OSWER[c]
Molybdenum	7439-98-7	240	EPA OSWER[c]	4	D.D.MacDonald et al., 1994[g]
Nickel	7440-02-0	52	EPA NRWQC[2,3,b]	21	EPA OSWER[c]
Silver	7440-22-4	3.2	EPA NRWQC[2,3,b]	2	EPA Region 4[d]
Vanadium	7440-62-2	19	EPA OSWER[c]	50	NOAA Screening Tables[h]
Zinc	7440-66-6	120	EPA NRWQC[2,3,b]	150	EPA OSWER[c]
EXPLOSIVE COMPOUNDS					
HMX	2691-41-0	150	EPA Region 3[a]	.0047-.47	EPA Region 4[1,d]
RDX	121-82-4	190	EPA Region 4[d]	.013-1.3	EPA Region 4[1,d]
TNT	118-96-7	90	EPA Region 4[d]	.092-9.2	EPA Region 4[1,d]
1,3,5-TNB	99-35-4	11	EPA Region 4[d]	.0024-.24	EPA Region 4[1,d]
1,3-DNB	99-65-0	20	EPA Region 4[d]	.0067-.67	EPA Region 4[1,d]
tetryl	479-45-8	NA		53.4	Nipper et al., 2002[j] (fine grain sediment)
NB	98-95-3	270	EPA Region 4[d]	0.488	EPA Region 4[d]
2A-4,6-DNT	35572-78-2	20	EPA Region 4[d]	NA	
4A-2,6-DNT	1946-51-0	NA		NA	
2,6-DNT	606-20-2	42	EPA Region 4[d]	0.0206	EPA Region 4[d]
2,4-DNT	121-14-2	44	EPA Region 3[a]	0.0751	EPA Region 4[d]
2-NT (o-)	88-72-2	NA		NA	
3-NT (m-)	99-08-1	750	EPA Region 3[a]	NA	
4-NT (p-)	99-99-0	1900	EPA Region 3[a]	NA	
Nitroglycerin	55-63-0	138	EPA Region 3[a]	NA	
PETN	78-11-5	85000	EPA Region 3[4,a]	NA	
Perchlorate	14797-73-0	9300	Dean et al.[e]	NA	

Notes:
NA – Not Available (Screening levels not available due to the lack of scientific data on the specific constituents)
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. E.g. for TNT in sediment w/ 5% TOC it would be: 0.46 (5*0.092=0.46)
2 - Value applies to dissolved metals
3 - The value is dependent on the hardness of the water, provided value is for a water hardness of 100 mg/L as

CaCO3.
4 – For PETN, EPA Region III values came from TNRCC 2001 & 2000, which are documented sources k & l below.

Sources:
a - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
b - EPA, Office of Water, Office of Science and Technology (4304T), National Recommended Water Quality Criteria, 2006.
c - EPA Office of Solid Waste and Emergency Response Ecotox Thresholds, January 1996
d - EPA Region 4, Ecological Risk Assessment Bulletins – Supplement to RAGS (EPA 2001)
e - Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
f - EPA Region 6, Screening Level Ecological Risk Assessment Protocol, Aug 1999.
g – A Review of Environmental Quality Criteria and Guidelines for Priority substances in the Fraser River Basin, Prepared by D.D. MacDonald, MacDonald Environmental Sciences Limited, March 1994
h - NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages. Buchman, M.F., 1999.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
j - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
k - TNRCC 2001 Guidance for Conducting Ecological Risk Assessment and Remediation Sites in Texas, Toxicology and Risk Assessment Section, December.
l - TNRCC 2000 Texas Surface water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Effective 17, 2000.

APPENDIX F.4: RMUS Identified Ecological Marine Surface Water Screening Levels

Munitions Constituent	CAS Number	SCREENING VALUES			
		Marine Surface Water		Marine Sediment	
		µg/L	Source	mg/kg	Source
METALS					
Antimony	7440-36-0	30	Suter and Tsao, 1996[e]	2	NOAA 1990[g]
Arsenic	7440-38-2	36	USEPA, 2004[b]	7.24	MacDonald et al., 2000*[,h]
Barium	7440-39-3	4	Suter and Tsao, 1996[e]	NA	
Cadmium	7440-43-9	8.8	USEPA, 2004[b]	0.68	MacDonald et al., 2000[h]
Chromium (VI)	7440-47-3	50	USEPA, 2004[b]	52.3	MacDonald et al., 2000[h]
Copper	7440-50-8	3.1	USEPA, 2004[b]	18.7	MacDonald et al., 2000[h]
Lead	7439-92-1	8.1	USEPA, 2004[b]	30.2	MacDonald et al., 2000[h]
Manganese	7439-96-5	120	Suter and Tsao, 1996[e]	460	Ontario Guidelines[i]
Mercury	22967-92-6	0.94	USEPA, 2004[b]	0.14	
Molybdenum	7439-98-7	370	Suter and Tsao, 1996[e]	NA	
Nickel	7440-02-0	8.2	USEPA, 2004[b]	15.9	MacDonald et al., 2000[h]
Silver	7440-22-4	1.9	USEPA, 2004[b]	0.73	MacDonald et al., 2000[h]
Vanadium	7440-62-2	20	Suter and Tsao, 1996[e]	NA	
Zinc	7440-66-6	81	USEPA, 2004[b]	124	MacDonald et al., 2000[h]
EXPLOSIVE COMPOUNDS					
HMX	2691-41-0	330	Talmage et al., 1999[o]	.0047-.47	EPA Region 4[1,a]
RDX	121-82-4	5000	Nipper et al., 2001[k]	.013-1.3	EPA Region 4[1,a]
TNT	118-96-7	180	Nipper et al., 2001[k]	.092-9.2	EPA Region 4[1,a]
1,3,5-TNB	99-35-4	25	Nipper et al., 2001[k]	.0024-.24	EPA Region 4[1,a]
1,3-DNB	99-65-0	180	Nipper et al., 2001[k]	.0067-.67	EPA Region 4[1,a]
tetryl	479-45-8			53.4	Nipper et al., 2002[l] (fine grain sediment)
NB	98-95-3	66.8	USEPA, 2002[c]	27	Talmage and Opresko, 1995[j]
2A-4,6-DNT	35572-78-2	1480	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
4A-2,6-DNT	1946-51-0	NA	NA	NA	
2,6-DNT	606-20-2	1000	Nipper et al., 2001[k]	0.55	Nipper et al., 2002[l]
2,4-DNT	121-14-2	480	Nipper et al., 2001[k]	0.23	Talmage and Opresko, 1995[j]
2-NT (o-)	88-72-2	NA	NA	NA	
3-NT (m-)	99-08-1	NA	NA	NA	
4-NT (p-)	99-99-0	NA	NA	NA	
Nitroglycerin	55-63-0	138	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
PETN	78-11-5	85000	EPA Region 3[2,d]	NA	
Perchlorate	14797-73-0	9300	Dean et al., 2004[f]	NA	

Notes:
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. (e.g. for TNT in sediment w/ 5% TOC it would be: 0.46)(5*0.092=0.46)
2 - EPA Region III for PETN marine water refers to US EPA Region 3's Freshwater Screening Benchmark table for a value. These values came from TNRCC 2001 & 2000, which are documented sources m & n below.

Sources:
a - EPA Region 4, Ecological Risk Assessment Bulletins - Supplement to RAGS (EPA 2001)
b – EPA – USEPA 2004 National Recommended Water Quality Criteria Office of Water and Office of Science and Technology.
c – EPA – USEPA 2002 Ecological Risk Assessment Bulletin 2/11/2002. Waste Management Division, Freshwater Surface Screening Values for Hazardous Waste Sites, February.
d - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
e – Suter and Tsao, 1996 Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 196 Revision. ES/ER/Tm-96/R2.
f – Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
g - The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52. Long, E.R. and L.G. Morgan. 1990.
h - MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology, 39: 20-31.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
j - Talmage, S.S., and D.M. Opresko. 1995. Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
k – Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, K. Miller, and S. Saepoff, 2001. Development of Marine Toxicity Data for Ordnance Compounds, Archives of Environmental Contamination and Toxicology, 41:308-31.
l - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
m – TNRCC 2001 Guidance for Conducting Ecological Risk Assessment and Remediation Sites in Texas, Toxicology and Risk Assessment Section, December.
n – TNRCC 2000 Texas Surface water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Effective 17, 2000.
o – Talmage, S.S., D.M. Opresko, C.J. Maxwell, J.E. Welsh, M. Cretelia, P.H. Reno, and F.B. Daniel. 1999. Nitroaromatic munition compounds: Environmental effects and screening values. Reviews in Environmental Contamination and Toxicology, 161: 1-156.

APPENDIX F.5: RMUS, Operational Range Assessment Screening Values, January 2009

Operational Range Assessment Screening Values

Background

Department of Defense Directive 4715.11 and Department of Defense Instruction (DODI) 4715.14 require each service to assess its operational ranges within the continental United States (CONUS). Each service has developed their own Operational Range Assessment Program and provides their own direction and guidance for conducting its range assessments. The operational range assessment programs determine whether there has been a release or substantial threat of release of munitions constituents (MC) from an operational range to off-range areas which creates an unacceptable risk to human health and/or the environment. This document provides screening level values to assist the operational range assessment programs in determining if there may be an unacceptable risk to human health and/or the environment. As provided in the individual Services' range assessment programs and guidance, sampling may be warranted during the range assessment process.

To promote consistency across the services' range assessment programs, the DoD Range and Munitions Use Subcommittee (RMUS), has developed screening values presented in this document to which all services will compare their surface water, groundwater and sediment sampling data. The RMUS involved toxicologists and the Tri-Service Environmental Risk Assessment Work Group (TSERAWG) in the development and review of these procedures and screening values. Screening values have been selected from a hierarchy of sources with recognized authority, acceptance and applicability. This list of screening values has been developed as a general list of commonly found MC used in various range training activities. This list is not intended to be inclusive of all munitions types nor is it intended that the entire list be monitored for all ranges to be investigated. The specific list of MC to be evaluated will be determined on a site-by-site basis during the range assessment process, based on the munitions used and, source, pathway, and receptor characteristics.

To promote defensibility, the methodology and scientific basis of collecting and analyzing samples should be as rigorous as the process used to comply with standards associated with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) risk screening and analysis as provided in the individual services' program direction and guidance.

Sampling data will be compared to the appropriate media screening values presented here to determine if further assessment is appropriate. MC concentrations less than these conservative screening values will be considered to have no adverse impacts on human health and/or the environment, and therefore, would not require any further action.

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Sampling data with MC concentrations exceeding these screening values do not necessarily indicate the presence of an unacceptable risk, or that cleanup or other mitigation measures will be necessary. Results above these conservative screening values indicate that a more detailed evaluation of the existing data is required. An initial assessment of data exceeding screening values would consider such things as review and update of the conceptual site model (CSM), additional data collection, site-specific screening evaluations, and potential cumulative health risk effects from multiple parameters.

Supplemental actions and/or investigations may be conducted as part of the data assessment. These additional actions may include, but are not limited to: more sophisticated modeling (3-Dimensional modeling), data refinement, weight of evidence determination and additional sampling and analysis. If indicated by this initial screening, a site-specific risk assessment may be conducted as well. Any site-specific risk assessments conducted should comply with regulations and guidance associated with CERCLA. Since the range assessments are internal DoD and are not a regulatory requirement, involvement with regulators is not part of the data assessment process. Regulatory involvement in the range assessment process is described in the DODI 4715.14 – Operational Range Assessments (30 November 2005) and in the Department of Defense Memorandum "DoD-Regulator Interactions for Operational Range Assessments" (15 August 2006).

If the conclusion of the range assessment is, or most likely is, that an off-range release has occurred or is likely to occur, creating an unacceptable risk, the assessor should follow the appropriate services' program direction and guidance.

Approach

The services will only use these screening values for the appropriate exposure scenarios identified for the site location. To facilitate development of uniform values, the most prevalent and significant exposure scenarios were selected. These scenarios include groundwater, surface water and sediment migration pathways from on-range to off-range areas occupied by human and/or ecological receptors. For human health, the most significant exposure scenario is consumption of either surface water or groundwater. For ecological receptors, direct contact with surface water and sediment by aquatic organisms (e.g. fish, algae) was selected as the most significant exposure scenario. Generally, aquatic organisms are considered a conservative representative for other ecological receptors because they will have continuous exposure to the water and sediment through their entire lifecycle. Ecological screening values are provided for both fresh and marine surface water and sediments. The ecological values are not appropriate for determining human exposure from consumption of ecological receptors exposed to potentially impacted water and/or sediments.

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Multiple agencies have developed drinking water, surface water and sediment values indicting levels that should not cause adverse effects to consumers and aquatic organisms using a variety of processes and assumptions. The RMUS developed a hierarchy of sources for each of the identified exposure scenarios to guide the selection of screening values for this protocol. The hierarchies are prioritized lists of screening value sources in order of recognized authority and applicability, and are described in the Drinking Water and Surface Water Systems sections. From the prioritized list, the first, and most appropriate screening value found for each MC was selected for use in this protocol. Where there were multiple values for the same MC from the same hierarchy source, the RMUS selected the most conservative value.

Other Considerations

- The screening values presented here are the default values. If there are appropriate State or local regulatory standards that are more stringent, they take precedence and will be used on a site-specific basis. Assessors will investigate state and local regulations to determine if they are appropriate.

- The screening values were selected assuming a chronic exposure to the receptors. The assessor should verify that a specific species/MC acute value is not lower than the identified chronic value.

- These screening values are based on current existing information. The range assessments will be based upon the information available at the time of the assessment. As EPA or other federal agencies develop new standards, regulations or guidance, or new information affecting MC tables is published, the screening values will be re-evaluated, and where appropriate, updated. A designated RMUS member will be responsible for reviewing screening values and sources at least biennially. The RMUS and TSERAWG will be involved with any updates to the screening values.

- Sampling results for metals and perchlorate will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

- The statistical analyses used by each service to compare sampling data to screening values and/or background values will be described in individual sampling plans and are not discussed further in this document.

- In exposure scenarios where surface water has potential to impact human health and ecological receptors, both drinking water and ecological surface water screening values need to be considered. The more

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conservative value should be selected for comparison with analytical results.

Drinking Water

Drinking Water values are usually appropriate for an exposure scenario where humans are using the water (surface water or groundwater) as a drinking water source. These screening values may not be appropriate if humans are both drinking the water and consuming aquatic organisms from that source. The RMUS recognized the samples may be collected from raw sources such as wells or other sampling locations and not necessarily from finished drinking water supply wells or surface water intakes to which most screening values are applicable. Therefore, while it is appropriate to use the drinking water standards as screening values only, note they are not directly enforceable regulatory standards. When collecting samples from these raw sources, these values will be technically evaluated on a case-by-case basis to determine the appropriateness of the drinking water values. Table 1 presents the human health drinking water screening values.

The hierarchy for human health drinking water screening values:

1. Applicable standards or benchmarks that have been recognized or released by the U.S. Environmental Protection Agency (EPA).
    a. Regional Screening Levels (RSL) - The values from the RSL table were used as the default EPA value for drinking water.
    b. Other EPA drinking water values (MCLs)
2. When no EPA values are available, values from other government agencies will be considered (e.g. National Oceanic and Atmospheric Administration (NOAA), Department of Energy).
3. If none of those are available, scientifically peer reviewed published literature will be researched.

Other Considerations

- The DoD Memo "Policy on DoD Required Actions Related to Perchlorate" (26 January 2006) identifies a level of concern for managing perchlorate at 24 ppb. That value will be used for drinking water in the absence of more stringent state or local standards.

- Toxicity studies have indicated that 2,4-DNT and 2,6-DNT may be carcinogenic when present together. When both compounds are detected at a site, the screening level for the 2,4-DNT, 2,6-DNT mixture should be used instead of the individual screening levels.

Surface Water Systems; Fresh and Marine

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For surface water systems, the RMUS considered the scenarios of ecological receptors being exposed to surface water and sediment from either fresh or marine waters. For brackish waters, state guidance on the use of fresh or marine screening levels for the specific water bodies (bays, estuaries, rivers, etc.) should be followed. Due to the sensitivity of some of the ecological receptors, these values are not intended to be applicable for every possible type of species. These values were selected as a conservative screening tool protective of a majority of species. Therefore, when sampling, the specific species type should be taken into consideration when comparing screening values and evaluating whether there is a potential unacceptable risk.

The overall hierarchy of sources for determining surface water system impacts on the ecological receptor is the same whether the focus is on fresh water or marine water. The appropriate sections and values must be selected for the exposure scenario being assessed. Ecological screening values are presented in Table 2 for Freshwater Surface Water Systems and Table 3 for Marine Surface Water Systems.

The hierarchy for ecological surface water and sediment for both fresh and marine environments is listed below:

1. Applicable standards or benchmarks recognized or released by the U.S. EPA.
    a. National Recommended Ambient Water Quality Criteria developed by the EPA Office of Water.
    b. Ecotox Thresholds developed by EPA Office of Solid Waste and Emergency Response.
    c. Ecological Screening Values developed by EPA Regions.
2. When no EPA values are available, values developed by other government agencies will be considered.
3. If none of those are available, scientifically peer reviewed published literature will be researched.

Other Considerations

- These values are not relevant for recreational contact with surface water by human receptors. This scenario can be evaluated if appropriate for a site-specific circumstance.

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Operational Range Assessment Screening Value Tables

Table 1 - Human Drinking Water Values

MC	CAS #	Screening Value	
		Value (µg/L)	Source
Antimony	7440-36-0	15	EPA RSL Table[a]
Arsenic	7440-38-2	0.045	EPA RSL Table[a]
Barium	7440-39-3	7300	EPA RSL Table[a]
Cadmium	7440-43-9	18	EPA RSL Table[a]
Chromium[1]	7440-47-3	110	EPA RSL Table[a]
Copper	7440-50-8	1500	EPA RSL Table[a]
Lead	7439-92-1	15	Region 6[b]
Manganese	7439-96-5	880	EPA RSL Table[a]
Mercury[2]	7487-94-7	0.63	EPA RSL Table[a]
Molybdenum	7439-98-7	180	EPA RSL Table[a]
Nickel	7440-02-0	730	EPA RSL Table[a]
Silver	7440-22-4	180	EPA RSL Table[a]
Vanadium	7440-62-2	180	EPA RSL Table[a]
Zinc	7440-66-6	11000	EPA RSL Table[a]
HMX	2691-41-0	1800	EPA RSL Table[a]
RDX	121-82-4	0.61	EPA RSL Table[a]
TNT	118-96-7	2.2	EPA RSL Table[a]
1,3,5-TNB	99-35-4	1100	EPA RSL Table[a]
1,3-DNB	99-65-0	3.7	EPA RSL Table[a]
tetryl	479-45-8	150	EPA RSL Table[a]
NB	98-95-3	3.4	EPA RSL Table[a]
2A-4,6-DNT	35572-78-2	73	EPA RSL Table[a]
4A-2,6-DNT	1946-51-0	73	EPA RSL Table[a]
DNT-mixture 2,4/2,6	25321-14-6	.099	EPA RSL Table[a]
2,6-DNT	606-20-2	37	EPA RSL Table[a]
2,4-DNT	121-14-2	73	EPA RSL Table[a]
2-NT (o-)	88-72-2	370	EPA RSL Table[a]
3-NT (m-)	99-08-1	122	Region 6[b]
4-NT (p-)	99-99-0	4.2	EPA RSL Table[a]
Nitroglycerin	55-63-0	3.7	EPA RSL Table[a]
PETN	78-11-5	NA	
Perchlorate	14797-73-0	24	DoD[c]

Notes:
These values are "default" values. Local standards may be more stringent and take precedence.
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
1 - Screening value is for Total Chromium
2 - Screening value is for Elemental Mercury
Sources:
a - EPA Regional Screening Levels (RSL) table – From "Regional Screening Levels for Chemical Contaminants at Superfund Sites" which is an update for Region 3 RBCs, Region 6 MSSLs, and Region 9 PRGs. From: http://epa-prgs.ornl.gov/chemicals/index.shtml (23 June 2008)
b - Region 6 – Region 6 MSSL Values
c - DoD – The Department of Defense has established a screening value for perchlorate of 24 ppb.

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Table 2 – Ecological Freshwater Surface Water System Values

		Freshwater Surface Water		Freshwater Sediment	
MC	**CAS #**	**Value (µg/L)**	**Source**	**Value (mg/kg)**	**Source**
Antimony	7440-36-0	30	EPA Region 3[a]	12	EPA Region 4[d]
Arsenic	7440-38-2	150	EPA NRWQC[2,b]	8.2	EPA OSWER*[,c]
Barium	7440-39-3	3.9	EPA OSWER[c]	20	EPA Region 6[f]
Cadmium	7440-43-9	0.25	EPA NRWQC[2,3,b]	1.2	EPA OSWER[c]
Chromium (VI)	7440-47-3	11	EPA NRWQC[2,b]	81	EPA OSWER[c]
Copper	7440-50-8	9	EPA NRWQC[2,3,b]	34	EPA OSWER[c]
Lead	7439-92-1	2.5	EPA NRWQC[2,3,b]	47	EPA OSWER[c]
Manganese	7439-96-5	80	EPA OSWER[c]	460	Ontario Guidelines[i]
Mercury	22967-92-6	0.77	EPA NRWQC[2,b]	0.15	EPA OSWER[c]
Molybdenum	7439-98-7	240	EPA OSWER[c]	4	D.D.MacDonald et al., 1994[g]
Nickel	7440-02-0	52	EPA NRWQC[2,3,b]	21	EPA OSWER[c]
Silver	7440-22-4	3.2	EPA NRWQC[2,3,b]	2	EPA Region 4[d]
Vanadium	7440-62-2	19	EPA OSWER[c]	50	NOAA Screening Tables[h]
Zinc	7440-66-6	120	EPA NRWQC[2,3,b]	150	EPA OSWER[c]
HMX	2691-41-0	150	EPA Region 3[a]	.0047-.47	EPA Region 4[1,d]
RDX	121-82-4	190	EPA Region 4[d]	.013-1.3	EPA Region 4[1,d]
TNT	118-96-7	90	EPA Region 4[d]	.092-9.2	EPA Region 4[1,d]
1,3,5-TNB	99-35-4	11	EPA Region 4[d]	.0024-.24	EPA Region 4[1,d]
1,3-DNB	99-65-0	20	EPA Region 4[d]	.0067-.67	EPA Region 4[1,d]
tetryl	479-45-8	NA		53.4	Nipper et al., 2002[j] (fine grain sediment)
NB	98-95-3	270	EPA Region 4[d]	0.488	EPA Region 4[d]
2A-4,6-DNT	35572-78-2	20	EPA Region 4[d]	NA	
4A-2,6-DNT	1946-51-0	NA		NA	
2,6-DNT	606-20-2	42	EPA Region 4[d]	0.0206	EPA Region 4[d]
2,4-DNT	121-14-2	44	EPA Region 3[a]	0.0751	EPA Region 4[d]
2-NT (o-)	88-72-2	NA		NA	
3-NT (m-)	99-08-1	750	EPA Region 3[a]	NA	
4-NT (p-)	99-99-0	1900	EPA Region 3[a]	NA	
Nitroglycerin	55-63-0	138	EPA Region 3[a]	NA	
PETN	78-11-5	85000	EPA Region 3[4,a]	NA	
Perchlorate	14797-73-0	9300	Dean et al.[e]	NA	

Notes:
NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. E.g. for TNT in sediment w/ 5% TOC it would be: 0.46 (5*0.092=0.46)
2 - Value applies to dissolved metals
3 - The value is dependent on the hardness of the water, provided value is for a water hardness of 100 mg/L as CaCO3.
4 – For PETN, EPA Region III values came from TNRCC 2001 & 2000, which are documented sources k & l below.

Sources:
a - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
b - EPA, Office of Water, Office of Science and Technology (4304T), National Recommended Water Quality Criteria, 2006.

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c - EPA Office of Solid Waste and Emergency Response Ecotox Thresholds, January 1996
d - EPA Region 4, Ecological Risk Assessment Bulletins – Supplement to RAGS (EPA 2001)
e - Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
f - EPA Region 6, Screening Level Ecological Risk Assessment Protocol, Aug 1999.
g – A Review of Environmental Quality Criteria and Guidelines for Priority substances in the Fraser River Basin, Prepared by D.D. MacDonald, MacDonald Environmental Sciences Limited, March 1994
h - NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages. Buchman, M.F., 1999.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
j - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
k - TNRCC 2001 Guidance for Conducting Ecological Risk Assessment and Remediation Sites in Texas, Toxicology and Risk Assessment Section, December.
l - TNRCC 2000 Texas Surface water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Effective 17, 2000.

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Table 3 – Ecological Marine Surface Water System Values

		Marine Surface Water		Marine Sediment	
MC	**CAS #**	**Value (µg/L)**	**Source**	**Value (mg/kg)**	**Source**
Antimony	7440-36-0	30	Suter and Tsao, 1996[e]	2	NOAA 1990[g]
Arsenic	7440-38-2	36	USEPA, 2004[b]	7.24	MacDonald et al., 2000[*,h]
Barium	7440-39-3	4	Suter and Tsao, 1996[e]	NA	
Cadmium	7440-43-9	8.8	USEPA, 2004[b]	0.68	MacDonald et al., 2000[h]
Chromium (VI)	7440-47-3	50	USEPA, 2004[b]	52.3	MacDonald et al., 2000[h]
Copper	7440-50-8	3.1	USEPA, 2004[b]	18.7	MacDonald et al., 2000[h]
Lead	7439-92-1	8.1	USEPA, 2004[b]	30.2	MacDonald et al., 2000[h]
Manganese	7439-96-5	120	Suter and Tsao, 1996[e]	460	Ontario Guidelines[i]
Mercury	22967-92-6	0.94	USEPA, 2004[b]	0.14	
Molybdenum	7439-98-7	370	Suter and Tsao, 1996[e]	NA	
Nickel	7440-02-0	8.2	USEPA, 2004[b]	15.9	MacDonald et al., 2000[h]
Silver	7440-22-4	1.9	USEPA, 2004[b]	0.73	MacDonald et al., 2000[h]
Vanadium	7440-62-2	20	Suter and Tsao, 1996[e]	NA	
Zinc	7440-66-6	81	USEPA, 2004[b]	124	MacDonald et al., 2000[h]
HMX	2691-41-0	330	Talmage et al., 1999[o]	.0047-.47	EPA Region 4[1,a]
RDX	121-82-4	5000	Nipper et al., 2001[k]	.013-1.3	EPA Region 4[1,a]
TNT	118-96-7	180	Nipper et al., 2001[k]	.092-9.2	EPA Region 4[1,a]
1,3,5-TNB	99-35-4	25	Nipper et al., 2001[k]	.0024-.24	EPA Region 4[1,a]
1,3-DNB	99-65-0	180	Nipper et al., 2001[k]	.0067-.67	EPA Region 4[1,a]
tetryl	479-45-8			53.4	Nipper et al., 2002[l] (fine grain sediment)
NB	98-95-3	66.8	USEPA, 2002[c]	27	Talmage and Opresko, 1995[j]
2A-4,6-DNT	35572-78-2	1480	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
4A-2,6-DNT	1946-51-0	NA	NA	NA	
2,6-DNT	606-20-2	1000	Nipper et al., 2001[k]	0.55	Nipper et al., 2002[l]
2,4-DNT	121-14-2	480	Nipper et al., 2001[k]	0.23	Talmage and Opresko, 1995[j]
2-NT (o-)	88-72-2	NA	NA	NA	
3-NT (m-)	99-08-1	NA	NA	NA	
4-NT (p-)	99-99-0	NA	NA	NA	
Nitroglycerin	55-63-0	138	TNRCC, 2001[m] and TNRCC, 2000[n]	NA	
PETN	78-11-5	85000	EPA Region 3[2,d]	NA	
Perchlorate	14797-73-0	9300	Dean et al., 2004[f]	NA	

Notes:

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NA – Not Available (Screening levels were not developed due to the lack of scientific data on the specific constituents.
* - Arsenic values for sediment will be compared to background sampling data, if available. The range will not be considered a source of MC migration when the sampling results are less than or equivalent to background concentrations.

1 - These values are dependent on the sediment TOC. The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound. (e.g. for TNT in sediment w/ 5% TOC it would be: 0.46)(5*0.092=0.46)
2 - EPA Region III for PETN marine water refers to US EPA Region 3's Freshwater Screening Benchmark table for a value. These values came from TNRCC 2001 & 2000, which are documented sources m & n below.

Sources:
a - EPA Region 4, Ecological Risk Assessment Bulletins - Supplement to RAGS (EPA 2001)
b – EPA – USEPA 2004 National Recommended Water Quality Criteria Office of Water and Office of Science and Technology.
c – EPA – USEPA 2002 Ecological Risk Assessment Bulletin 2/11/2002. Waste Management Division, Freshwater Surface Screening Values for Hazardous Waste Sites, February.
d - EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007
e – Suter and Tsao, 1996 Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 196 Revision. ES/ER/Tm-96/R2.
f – Dean, K.E., R.M. Palachek, J.L. Noel, R. Warbritton, J. Aufderheide, and J. Wireman. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
g - The potential for biological effects of sediment-sorbed contaminants tested in the national status and trends program. NOAA Technical Memorandum NOS OMA 52. Long, E.R. and L.G. Morgan. 1990.
h - MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology, 39: 20-31.
i - Guidelines for the protection and management of aquatic sediment quality in Ontario. Ontario Ministry of the Environment. Queen's Printer of Ontario. Persaud, D., R. Jaagumagi, and A. Hayton. 1993.
j - Talmage, S.S., and D.M. Opresko. 1995. Draft Ecological Criteria Documents for Explosives, Oak Ridge National Laboratory, Oak Ridge, Tennessee.
k – Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, K. Miller, and S. Saepoff, 2001. Development of Marine Toxicity Data for Ordnance Compounds, Archives of Environmental Contamination and Toxicology, 41:308-31.
l - Nipper, M., R.S. Carr, J.M. Biedenbach, R.L. Hooten, and K. Miller. 2002. Toxicological and Chemical Assessment of Ordnance Compounds in Marine Sediments and Porewaters. Marine Pollution Bulletin, 44: 789-806.
m – TNRCC 2001 Guidance for Conducting Ecological Risk Assessment and Remediation Sites in Texas, Toxicology and Risk Assessment Section, December.
n – TNRCC 2000 Texas Surface water Quality Standards, Texas Administrative Code, Title 30, Chapter 307, Effective 17, 2000.
o – Talmage, S.S., D.M. Opresko, C.J. Maxwell, J.E. Welsh, M. Cretelia, P.H. Reno, and F.B. Daniel. 1999. Nitroaromatic munition compounds: Environmental effects and screening values. Reviews in Environmental Contamination and Toxicology, 161: 1-156.

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