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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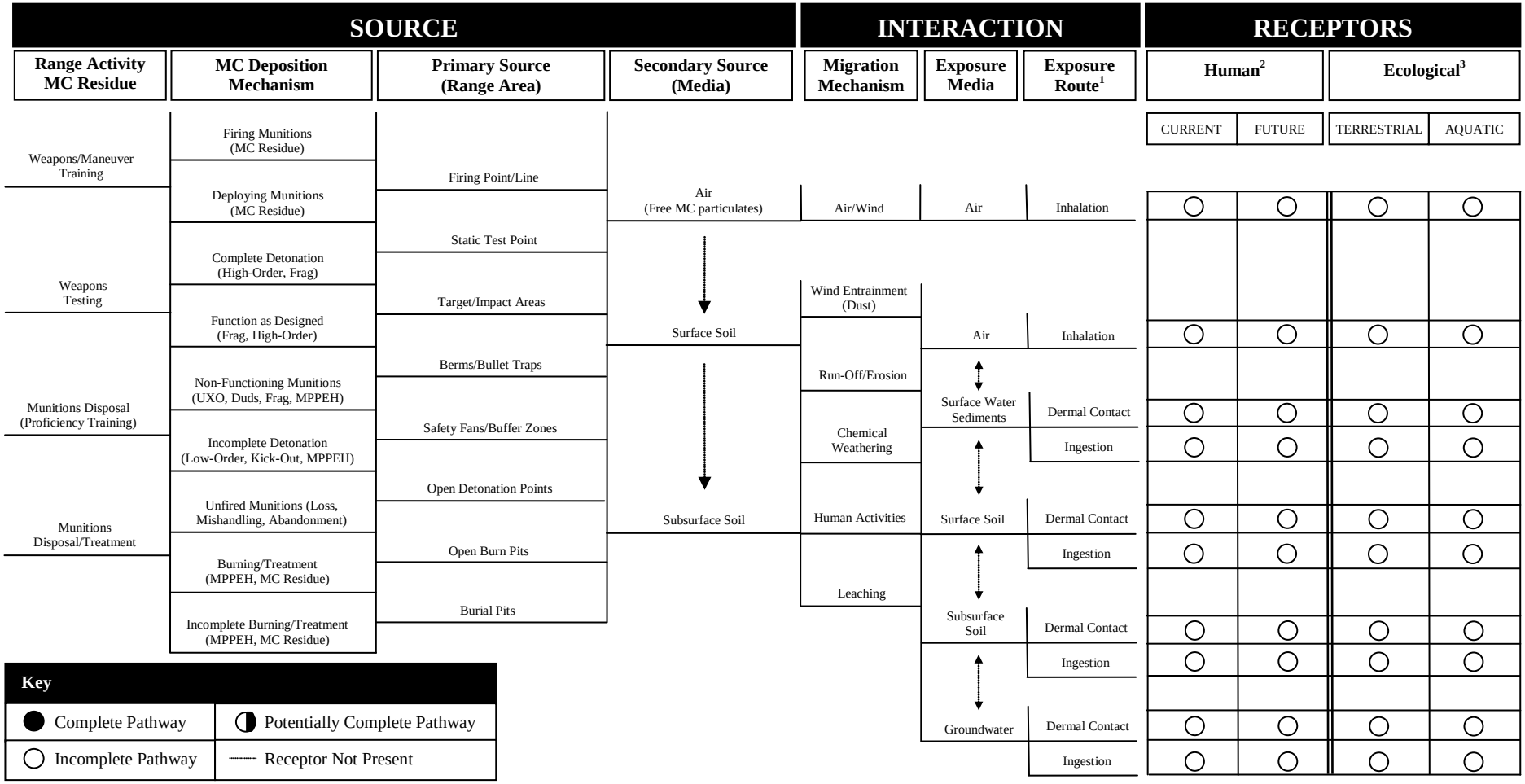
APPENDIX C.1: GRAPHICAL CSM TEMPLATE



[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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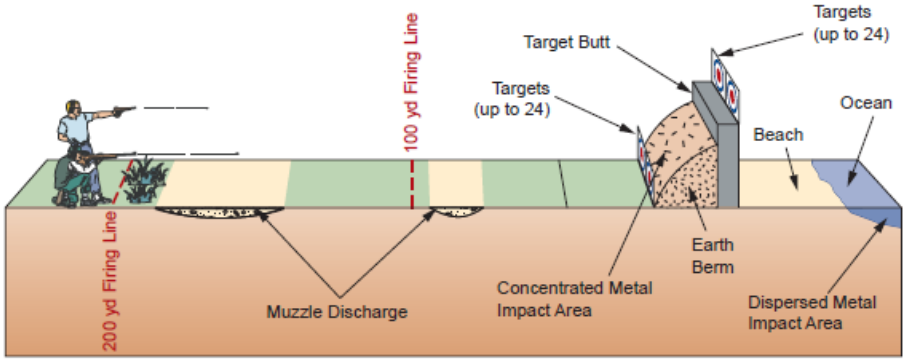
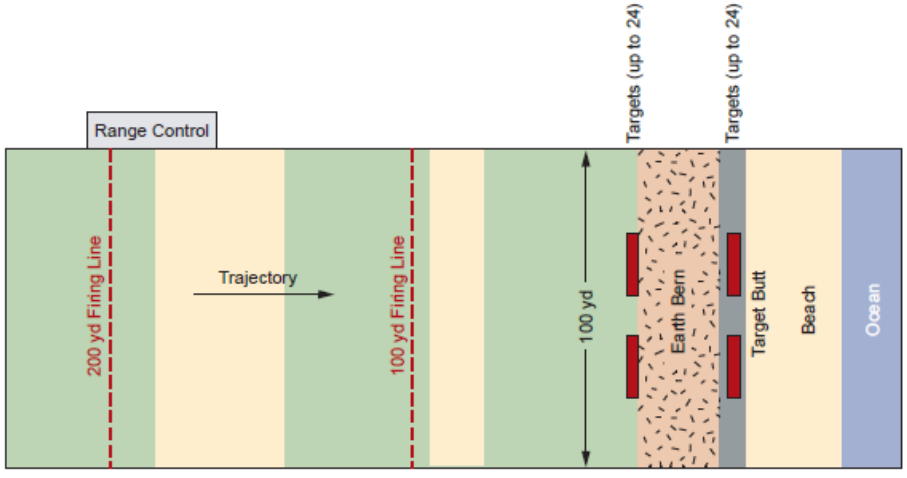
APPENDIX C.2: PICTORIAL CSM TEMPLATE



Schematic Cross Section View



Plan View

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APPENDIX D

OPERATIONAL RANGE ASSESSMENT REPORT FORMATS

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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

Alex A. Beehler
Acting, Deputy Under Secretary of Defense
(Installations and Environment)

cc:
DUSD(R)
PD(DOTE)

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

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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.

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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

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[o]
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[l]
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[l]	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.