**U.S. Army Corps of Engineers**
**Omaha District**

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# Final Site-Specific Work Plan
# Boardman Air Force Range
## FUDS ID F10OR0160

## Site Inspections at Multiple Sites, NWO Region Formerly Used Defense Sites, Military Munitions Response Program

## Contract No. W912DY-04-D-0010
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## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| µg/L | micrograms per liter |
| AFR | Air Force Range |
| AOC | area of concern |
| ASR | Archives Search Report |
| BAIC | Boardman Agri-Industrial Complex |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CSM | Conceptual Site Model |
| DERP | Defense Environmental Restoration Program |
| DMM | discarded military munitions |
| DoD | U.S. Department of Defense |
| DOI | Department of the Interior |
| DQO | Data Quality Objective |
| EOD | Explosive Ordnance Disposal |
| ºF | degrees Fahrenheit |
| FS | Feasibility Study |
| FSP | Field Sampling Plan |
| ft | feet |
| FUDS | Formerly Used Defense Site |
| GP | General Purpose |
| GPS | Global Positioning System |
| HE | High Explosives |
| HRS | Hazard Ranking System |
| IDW | Investigation-Derived Waste |
| INPR | Inventory Project Report |
| MC | munitions constituents |
| MEC | munitions and explosives of concern |
| mm | millimeter |
| MMRP | Military Munitions Response Program |
| MRA | Munitions Response Area |
| MRS | Munitions Response Site |
| MRSPP | Munitions Response Site Prioritization Protocol |
| MS/MSD | matrix spike/matrix spike duplicate |
| Navy | Department of the Navy |
| NCP | National Contingency Plan |
| NDAI | No Department of Defense Action Indicated |
| NG | nitroglycerin |
| NWO | U.S. Army Corps of Engineers, Omaha District Military Munitions Design Center |
| ODEQ | Oregon Department of Environmental Quality |
| PA | Preliminary Assessment |
| PCOC | Potential Contaminant of Concern |
| PGE | Portland General Electric |
| PQL | Practical Quantitation Limit |
| QA/QC | Quality Assurance/Quality Control |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |

## ABBREVIATIONS AND ACRONYMS (CONT.)

| | |
|---|---|
| RAC | Risk Assessment Code |
| RI | Remedial Investigation |
| ROE | Right of Entry |
| SAP | Sampling and Analysis Plan |
| Shaw | Shaw Environmental, Inc. |
| SHPO | State Historic Preservation Office |
| SI | Site Inspection |
| SOP | Standard Operating Procedure |
| SSHP | Site Safety and Health Plan |
| SSWP | Site-Specific Work Plan |
| TPP | Technical Project Planning |
| U.S. | United States |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency |
| UXO | unexploded ordnance |
| UTL | upper tolerance limit |
| Weston | Weston Solutions, Inc. |

# 1.0 INTRODUCTION

This Site-Specific Work Plan (SSWP) presents the information necessary to conduct field activities associated with a Site Inspection (SI) planned at the Boardman Air Force Range (AFR), Boardman, Oregon.

## 1.1 Project Authorization

The United States (U.S.) Army Corps of Engineers (USACE) is conducting environmental response activities at Formerly Used Defense Sites (FUDS) in accordance with Engineer Regulation 200-3-1 (USACE, 2004) and U.S. Department of Defense (DoD) guidance document, *Management Guidance for the Defense Environmental Restoration Program* (DoD, 2001). USACE is conducting these activities under provision of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Control Plan, which is commonly referred to as the National Contingency Plan (NCP). As such, USACE is required to conduct remedial preliminary assessments (PAs) and SIs (U.S. Environmental Protection Agency [USEPA], 2005a, 2005b) to evaluate hazardous substance releases or threatened releases from eligible FUDS.

USACE is evaluating FUDS that were historically used for military training and testing under the Defense Environmental Restoration Program (DERPs) Military Munitions Response Program (MMRP). Based on historical records, these FUDS may contain munitions and explosives of concern (MEC) or munitions constituents (MC). MEC are military munitions that may pose unique explosives safety risks, such as unexploded ordnance (UXO), discarded military munitions (DMM), or MC present in high enough concentrations to pose an explosive hazard. MC 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 (U.S. Department of Army, 2005, and DoD, 2003).

Shaw Environmental, Inc. (Shaw) has prepared this SSWP for the USACE, under USACE Contract No. W912DY-04-D-0010, as a supplement to the *Final Type I Work Plan, Site Inspections at Multiple Sites, NWO Region, Formerly Used Defense Sites, Military Munitions Response Program* (Shaw, 2006a). This document is hereafter referred to as the *Final Type I Work Plan.* Shaw is responsible for conducting SIs at FUDS in the Northwest Region (USACE, Omaha District Military Munitions Design Center [NWO]).

## 1.2 Site Name and Location

The former Boardman AFR (identification number F10OR0160) is located approximately 5.5 miles south of Boardman, Oregon, in Morrow County. Boardman is in the north central portion of Oregon along the Columbia River. The location of the site is shown in Figure 1. Figure 2 shows the site layout.

## 1.3 Scope and Objectives

The scope of the SI is restricted to evaluation of the presence of MEC or MC related to historical use of the FUDS prior to transfer of the property. Potential releases of hazardous, toxic, or

radioactive wastes are not addressed within this scope. The intent of the SI is to confirm the presence or absence of contamination from MEC and/or MC. The general approach for each SI is to conduct records review and site reconnaissance in order to evaluate the presence or absence of MEC, and to collect samples at locations where MC might be expected based on the conceptual site model (CSM).

The primary objective of the SI is to determine whether conditions at the former Boardman AFR warrant further response action because of the presence of MEC and/or MC pursuant to CERCLA and the NCP or whether a determination of No Department of Defense Action Indicated (NDAI)can be made. The SI will collect the minimum amount of information necessary to

- (i) eliminate from further consideration those releases that pose no significant threat to public health or the environment
- (ii) determine the potential need for removal action
- (iii) collect or develop additional data, as appropriate, for Hazard Ranking System (HRS) scoring by the USEPA (USEPA, 1990)
- (iv) collect data, as appropriate, to characterize the release for effective and rapid initiation of the remedial investigation (RI) and feasibility study (FS) process.

A secondary objective of the SI is to collect the appropriate data to complete the Munitions Response Site Prioritization Protocol (MRSPP) (DoD, 2005).

An NDAI recommendation is limited exclusively to munitions and explosives of concern (MEC) and MC contamination issues and not other unrelated hazardous and toxic waste concerns the site may pose. Additionally, if an NDAI recommendation is warranted and MEC and/or MC contamination issues are subsequently identified, the site would be reopened and would start the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process over again.

## 1.4 Site Inspection Process

The steps involved in conducting an SI include the following:

- Review of existing data,
- Application of the Technical Project Planning (TPP) process,
- Preparation of an SSWP,
- Performance of SI field activities (site reconnaissance, media sampling, and analysis),
- Preparation of an SI Report.

The TPP process is one through which project objectives and data collection processes are identified, and site stakeholders are brought together to discuss goals and objectives. This process includes the following phases:

- Identification of the current project area
- Determination of data needs
- Development of data collection options

- Finalization of the data collection program.

A multi-disciplinary team of key stakeholders attends a TPP meeting(s) in order to participate in the process so SI activities can be conducted in a timely and efficient manner.

## 1.5 Munitions Response Site Prioritization Protocol

The DoD is required to assign a relative priority for each Munitions Response Site (MRS) within a Munitions Response Area (MRA). This process is to be completed for all DoD sites, including FUDS, which are known or suspected of containing UXO, DMM, MC, and material potentially presenting an explosive hazard.

Definitions:

- A Defense Site refers to the entire property that was owned, leased, or otherwise possessed or used by the DoD. This definition includes FUDS.
- An MRA refers to any area on a Defense Site that is known or suspected to contain UXO, DMM, or MC. An MRA can be comprised of one or more MRSs.
- An MRS is a discrete location within an MRA that is known to require a munitions response (e.g., remedial response). An MRSPP scoring is completed for each MRS.

Previous documents for FUDS have used the term area of concern (AOC). In some cases, one AOC may be identified as a discrete MRS; in other cases it may be logical to group adjacent or overlapping AOCs as a single MRS. The term AOC is retained for this SSWP as it is logical to defer the decision on how to potentially group AOCs until after the SI data collection is complete. Recommendations on how to group AOCs as MRSs will be included in the draft SI Report.

## 1.6 TPP Summary

The TPP Meeting for the former Boardman AFR was held at the Port of Morrow Riverfront Center in Boardman, Oregon on July 20, 2006. Representatives from the USACE – Omaha Design Center and Seattle District, Oregon Department of Environmental Quality (ODEQ), Oregon State Police, Portland General Electric, Boardman Agri-Industrial Complex (BAIC Inc.), Threemile Canyon Farms, Inland Land Company, The Nature Conservancy, the Boeing Company, and Shaw were in attendance.

Shaw reviewed the site information and presented a summary of the site and the proposed approach for the SI, addressing MEC and MC sampling. All parties were in general agreement with the approach, but reserved judgment until the Draft TPP memo is issued. The property owners and lessees agreed to act on the requests for right-of-entry after they receive the Draft TPP Memo.

Specific discussions during the meeting included:

**AOCs:** There was agreement in the AOCs presented: Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1 (INPR Site No.1, Demolition Area, and Turret Gunnery Range), and Demolition Area No. 2.

Potential AOC(s) were discussed based on information provided by The Nature Conservancy where MEC or munitions debris have been located in areas within the FUDS boundary south of

Demolition Area No. 2. Additional air photo review of this area is warranted along with evaluation of materials (topographic maps with MEC and munitions debris locations) provided by The Nature Conservancy on lands they manage. Following review of data obtained at the TPP Meeting from The Nature Conservancy, an additional AOC, the Impact Area, was added.

A firing target for the Turret Gunnery Range, which is part of Range Complex No. 1, was noted by a representative of The Nature Conservancy as being within the FUDS boundary. He stated that the target was an old car, making it a potential sampling location for projectiles. The car is no longer present at the site.

**Property Ownership:** Ownership was clarified in the meeting. Much of the property is owned by BAIC, Inc. which leases the area for farming, grazing, resource management, and scientific research. Lessees include Inland Land Company, Threemile Canyon farms, the Boeing Company, The Nature Conservancy, and Portland General Electric.

**Air Photo Imagery:** ODEQ has 2005 imagery available, which they will provide. The 2005 imagery was provided by ODEQ following the meeting.

**Sampling:** ODEQ would like to have one of the samples collected from Target No. 1 and Carty Reservoir Bomb Target also analyzed for explosives. The rationale is to demonstrate that no explosives, other than black powder, were used at either of these targets.

**Background Sampling:** Look at available soil data from area (ODEQ to provide) that may be used as background soil data. ODEQ provided background data and these data were reviewed for applicability and completeness. The data were mostly based on x-ray fluorescence analytical methods and reported as oxide percentages. X-ray fluorescence analytical methods do not produce data that are directly comparable to methods used in this SI and will not be used to develop background concentrations.

Based on the TPP meeting and subsequent evaluation of data obtained at the meeting, six AOCs are identified and addressed in the TPP Memo (Shaw, 2006) and this SSWP. The six AOCs are Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1 (includes INPR Site No. 1, Demolition Area, and Turret Gunnery Range), Demolition Area No. 2, and the Impact Area.

## 1.7 Decision Rules

The following is a list of decision rules that will guide Shaw's technical approach at various stages of the SI as the specific AOCs are being evaluated:

- **Based on the presence or absence of MEC, is an NDAI or is an RI/FS warranted?**
  - If no evidence of MEC (non-small arms, munitions debris, or magnetic anomalies) was found during prior investigations and none is observed during SI site reconnaissance, the site will be considered a potential candidate for NDAI with respect to MEC hazard.
  - If MEC was found and/or if abundant or concentrated areas of munitions debris or magnetic anomalies were observed during prior investigations or during SI site reconnaissance, the site will be considered a potential candidate for further investigation with respect to MEC hazard.

- If any evidence is identified that is inconsistent with the CSM for the site (e.g., if munitions debris indicating the potential use of high explosive (HE) munitions at a site for which the CSM was based on practice munitions), the above decision rules will be revised appropriately.

- **Based on the presence or absence of MC, is an NDAI or is an RI/FS warranted?**
  - If sample results are less than human health and ecological screening values, the site will be recommended for NDAI relative to MC.
  - If sample results exceed both human health screening values and background values, the site will be recommended for additional investigation.
  - If sample results do not exceed human health screening values but do exceed both ecological screening values and background values, additional evaluation of the data will be conducted in conjunction with the stakeholders to determine if additional investigation is warranted.

- **Is a time-critical removal action warranted?**
  - A time-critical removal action may be needed if high MEC hazard is identified. Shaw will immediately report any MEC findings so that USACE can determine the appropriate response. An example of a high hazard would be finding sensitive MEC at the surface in a populated area with no barriers to restrict access.

For purposes of applying these decision rules, USACE has provided guidance that evidence of MEC will generally be a basis of recommending RI/FS. Evidence of MEC may include confirmed presence of MEC from historical sources or SI field work, or presence of munitions debris.

- **Comparison to Human Health Screening Criteria**
  - Comparisons of site analytical data to human health screening criteria will be to those listed on Tables 6, 7, and 8. Where multiple values are listed, generally the lowest value is used for comparison. Exceptions to this is where the lower value is a secondary maximum contaminant level (MCL) such as for iron, in this case the U. S. Environmental Protection Agency (USEPA) Region 9 Tap Water Preliminary Remediation Goal is used. Secondary MCLs are not health-based levels but are aesthetic values applicable to taste, odor, or color.

- **Comparison to Ecological Screening Criteria**
  - For ecological screening, the analytical results will be compared to the "Final Ecological Screening Value" on Tables 9, 10, and 11. The Final Ecological Screening Value" listed on the tables is derived from the following hierarchy:
    1. State of Oregon Value
    2. USEPA Region Oregon State is located (Region 10)
    3. Lower of Talmage et al. (1999 or Los Alamos National Laboratory (2005) values.

## 1.8 MEC Technical Approach

If MEC is found during SI field activities, the following excerpted procedures will be followed, per Interim Guidance Document 06-05 and Safety Advisory 06-2 (see Appendix B for complete document):

- The property owner or individual granting rights of entry to the property will be notified of the hazard and advised to call the local emergency response authority (i.e., police, sheriff, or fire department). The individual will also be informed that if they do not call the local response authority within one hour, the individual who identified the UXO item will notify the local emergency response authority.
- The local response authority will decide how to respond to the reported incident, including deciding not to respond (e.g., if the local response authority is already aware of the hazards on the property). If the local response authority decides to respond, the individual who identified the item or his designee will mark the location of the item and provide accurate location information to the emergency response authority. The individual who identified the item or his designee will generally remain in the area until the local response authority arrives, unless specifically indicated by the appropriate response authority that the individual may leave the area.
- Neither the US Army Corps of Engineers personnel, nor their contractors have the authority to call the an Explosives Ordnance Disposal (EOD) team to respond to an explosive hazard. This call is the responsibility of the local emergency response authority for FUDS properties and it must come through the proper chain of command on installations.

The technical approach is based on the *Final Type I Work Plan* (Shaw, 2006a), *Draft Technical Planning Project Memorandum, Boardman Air Force Range* (Shaw, 2006b) and the *Formerly Used Defense Sites, Military Munitions Response Program, Site Inspections, Program Management Plan* (USACE, 2005).

## 1.9 SSWP Organization

This SSWP supplements the *Final Type I Work Plan* (Shaw, 2006a), which includes an Accident Prevention Plan and Site Safety and Health Plan (SSHP), Appendix D, and a Sampling and Analysis Plan (SAP), Appendix E. The *Final Type I Work Plan* (Shaw, 2006a), as amended by this SSWP, governs work that will be implemented during the SI at the former Boardman AFR. This SSWP provides additional information not available in the *Final Type I Work Plan (Shaw, 2006a)*, including site information (background information, summary of historical documents evaluated, and resulting data needs), a discussion of activities to be conducted prior to mobilizing to the field, a presentation of field data to be collected, and appendices with supporting documents. Specifically, this SSWP includes the following sections:

- Section 1.0 Introduction
- Section 2.0 Site Information
- Section 3.0 Pre-Field Activities
- Section 4.0 Site Inspection Activities
- Section 5.0 Inspection-Derived Waste

- Section 6.0 Proposed Schedule
- Figures
- Tables
- Appendix A Conceptual Site Model,
- Appendix B USACE Interim Guidance Document 06-05 and Safety Advisory 06-2, and
- Appendix C Site Safety and Health Plan Addendum.

# 2.0 SITE INFORMATION

## 2.1 Installation History

Following is a brief summary of the military operations conducted at this facility.

- Between 1941 and 1943, the United States Army Air Corps acquired 95,985.51 acres through purchase of private land and transfer of Department of the Interior (DOI) land for a practice bombing and gunnery range. It was used by the Walla Walla Army Air Base for bombing practice during World War II. A small portion was also known to be used by the nearby Umatilla Army Ordnance Depot for the demolition of unserviceable/surplus munitions and small arms trace testing. After World War II, the Army Air Corps categorized the site as surplus land.
- During 1946, the site was inactive and discussions were held concerning authorizing livestock grazing on the range.
- In 1948, the Air Force withdrew the lands from surplus and used the range from 1948 to 1960. The area was renamed the Boardman Precision Bombing Range and was configured with five targets and exclusion areas.
- Between 1952 and 1956, the 57$^{th}$ Air Division, Fairchild Air Force Base, assumed the responsibility, control, and utilization of the former Boardman AFR. A moving 20-mm target gunnery range, with three mounted B-36 turrets, was added in 1952. The gunners fired at remote controlled aerial target drones (OC aircraft) under daylight and night conditions. Practice bombing was also occurring during this time. Target No. 2 was the principal bomb target during this time.
- The degree of site usage between 1956 and 1958 is uncertain. However, in December 1958, the Air Force granted the Department of the Navy permission to use the site as a high altitude bombing range. In 1960, a permit was granted to the Umatilla Army Ordnance Depot to use two small areas for destruction of unusable munitions and small arms ammunition tracer testing.
- The Air Force placed the former Boardman AFR in an excess category in 1960. Later that year, the Air Force transferred 37,320.31 acres to the DOI, 58,372.9 acres to the Navy, and 290 acres to the USACE.
- In 1963, following discussions between the Navy, the DOI, and the State of Oregon, an agreement was reached where the Navy would consolidate its needs to the eastern half of the site and release the western half. This allowed for single contiguous land use by the Navy and DOI. The western half ended up being jointly owned by the State of Oregon, Portland General Electric, and Morrow County. Currently the property within the former

Boardman AFR FUDS is owned by the City of Boardman, Morrow County, BAIC, Inc., and Portland General Electric. Presently BAIC, Inc. leases land to Portland General Electric, the Boeing Company, Inland Land Company, and The Nature Conservancy.

## 2.2 Physical Setting

### 2.2.1 Access and Land Use

The former Boardman AFR is located approximately 5.5 miles southwest Boardman, Oregon, in Morrow County (Figure 1). Boardman is in the north central portion of Oregon along the Columbia River.

Originally the former Boardman AFR occupied approximately 95,985 acres. In 1960, the Air Force declared the property surplus and portions of the site were transferred to the DOI, USACE, and Department of the Navy (Navy). The parcels transferred to the DOI and the Navy were aligned in a checkerboard pattern. In 1963, the area was split into two parcels, with the Navy controlling the eastern portion and the State of Oregon owning the western portion. The USACE maintained ownership of a small parcel (approximately 290 acres) along the Columbia River. After the property redistribution, the former Boardman AFR FUDS occupies an area of approximately 48,976 acres.

The site is currently used for irrigated agricultural and grazing purposes; farming of potatoes, onions, and other vegetables; as a restricted antennae test range owned by the Boeing Company; as a fossil fuel power generating plant owned by Portland General Electric Company; as a habitat management area for the protection of the Washington ground squirrel; and as an airstrip operated and maintained by the Morrow County Port Authority.

### 2.2.2 Topography, Geology, and Climate

The former Boardman AFR lies within the Columbia Basin Subprovince of the Columbia Intermontane Physiographic Province. The topography of the former Boardman AFR slopes gently up from the Columbia River (approximately 310 feet [ft] elevation) near the northern boundary of the site to the southern boundary at about 1,000 ft elevation.

The climate in the Boardman area is semi-arid. It is warm and dry in the summer and cool and dry in the winter. The wettest month is generally December, with the driest month being July. The highest monthly average maximum temperature is 89.7 degrees Fahrenheit (ºF) in July and the lowest monthly average maximum temperature is 27 ºF in January. The average annual precipitation is 8.41 inches per year.

### 2.2.3 Soil

The soils at the former Boardman AFR are composed of four different soil groups: the Quincy loamy fine sand, the Koehler loamy fine sand, the Hezel loamy fine sand, and the Tauton fine sandy loam. The soils of the former Boardman AFR are underlain by alluvium and bed rock consists of the basaltic flows for the Columbia River Basalt Group. The alluvium is up to 70 ft thick.

### 2.2.4 Groundwater

Groundwater occurs within two distinct aquifers, the alluvial aquifer and the Columbia River Basalt aquifer system. Based on documentation received from PGE and included in

*Hydrogeology, Groundwater Chemistry, and Land Use in the Lower Umatilla Basin Groundwater Management Area (ODEQ, 1995)*, prior to construction of Carty Reservoir by PGE in 1977 only thin occurrences of groundwater within the alluvium were reported and Sixmile Canyon Creek was dry. Leakage from Carty Reservoir has resulted in a perched groundwater zone above the uppermost basalt flow. Water levels in the alluvium were observed to rise up to 30 ft (40 ft below ground surface) in wells constructed near Carty reservoir. The water levels have now stabilized. There appears to be a groundwater mound beneath Carty Reservoir.

There are no private irrigation wells, one drinking water source well and several monitoring wells located within the former Boardman AFR (mostly associated with the Portland General Electric Company fossil fuel power plant).

### 2.2.5 Surface Water

The former Boardman AFR is located within the Middle Columbia-Lake Wallula Watershed. Carty Reservoir is located within the former Boardman AFR and portions of the Target No. 1 and Carty Reservoir AOCs are submerged under the reservoir. Carty Reservoir was created when PGE dammed a portion of Sixmile Canyon Creek in 1977. The reservoir level is maintained using water pumped from the Columbia River. There is no surface water outlet from the reservoir. Sixmile Canyon Creek traverses across the western portion of the former Boardman AFR. The creek is not known to support fisheries. Historically the creek was dry except during periods of heavy rain and snow melt. With the creation of Carty Reservoir and the resulting groundwater mound, water now is present in Sixmile Canyon Creek. The creek flows into the Columbia River, which is a major river that supports both federally and state threatened and listed species.

## 2.3 Previous Investigations

### 2.3.1 Historical Records Searches

Historical documents were reviewed to collect information about the former Boardman AFR. A summary of these documents is provided below.

- The USACE prepared an Inventory Project Report (INPR) for the former Boardman AFR in September 1992, in which a potential hazard from UXO at the FUDS was identified.
- The USACE issued an Archives Search Report (ASR) in 1997, which compiled available information for the former Boardman AFR with emphasis on types and areas of ordnance use and disposal.
- An ASR Supplement completed in 2004 identified specific AOCs (Target No. 1, Target No. 2, Carty Reservoir Bomb Target, and Range Complex No. 1 [INPR Site No. 1, Demolition Area, and Turret Gunnery Range]). During 2006 TPP planning for the former Boardman AFR, a new AOC (Demolition Area No. 2) was located that was not included in the ASR or ASR Supplement.
- A Risk Assessment Code (RAC) scoring was conducted by the USACE in 2004. Possible scores range from 5 (no risk) to 1 (high risk). The following table summarizes the RAC determinations for the AOCs and indications of whether MEC has been found at these AOCs since the end of training activities, as summarized in the ASR Supplement:

| AOC | RAC Score | MEC Found |
|---|---|---|
| Target No. 1 | 4 | No |
| Target No. 2 | 4 | Yes |
| Carty Reservoir Bomb Target | 4 | Yes |
| Range Complex No. 1 | 4 | Yes |
| Demolition Area No. 2 | Not Scored | Yes |
| Impact Area | Not Scored | No |

- The USEPA completed a PA/SI for the former the former Boardman AFR in 2004. The scope of the PA/SI largely parallels the scope of this planned SI. To the extent possible, this SI will use data previously collected for the PA/SI. Additional reconnaissance and sampling activities will be planned only to address specific data needs identified during the TPP. The PA/SI collected samples from soil, sediment, surface water, and groundwater. Samples were analyzed for Target Analyte List metals, nitrogen-based explosives, and perchlorate. The PA/SI sample locations are shown on Figure 2. This report concluded that no samples contained significant concentrations of metals and no nitrogen-based explosive compounds were detected. Perchlorate was detected in all five surface water samples from Sixmile Canyon Creek. Surface water concentrations ranged between 0.32 micrograms per liter (µg/L) and 7.49 µg/L. Perchlorate was not detected in the surface water sample collected from Carty Reservoir. Perchlorate was detected in 18 of 25 groundwater samples and ranged in concentration between 0.46 µg/L and 20.7 µg/L. Note the DoD action level for perchlorate is 24 µg/L.

  Additional groundwater and surface water sampling has been completed in the lower Umatilla Basin by the USEPA, ODEQ and the Navy confirming the presence of perchlorate in groundwater and surface water.

  Perchlorate has been identified in a number of groundwater wells within the Lower Umatilla Basin, within which the former Boardman AFR FUDS resides. Locations with perchlorate detections occur both cross (up to several miles) and down gradient of the former Boardman AFR. The source or sources of the perchlorate has not been identified and the ODEQ and USEPA consider the former Boardman AFR FUDS as one of several potential and possible sources. The ODEQ and USEPA are continuing investigations of perchlorate impacts in the Lower Umatilla Basin.

## 2.4 Munitions and Explosives of Concern and Munitions Constituents

MEC has been reported recently (March 2006) at Target No. 2 AOC. These reports were made following the discovery of six AN-M57 General Purpose (GP) practice bombs (capable of detonating) at a local recycler. These 6 bombs and 15 additional bombs recovered from Target

No. 2 were detonated by a Navy EOD team at the nearby Navy Bombing Range. According to reports from the Navy EOD the bombs were training bombs. The bombs had been gathered from agricultural fields and placed in a pile by the agricultural workers.

MEC and munitions debris was reported to the Oregon State Police in the June 2006 at Demolition Area No. 2. The MEC and munitions debris consisted of an M83 Butterfly Bomb, M66 or M68 Base Detonating Fuze for 75-mm or 90-mm projectiles, and a 100-pound (lb) GP Bomb base plate. The Oregon State Police Bomb Squad destroyed these munitions.

A full discussion of MEC and associated MC for the former Boardman AFR is provided in the CSM which is included as Appendix A. The MEC and MC used at the former Boardman AFR are shown on Table 1.

# 3.0 PRE-FIELD ACTIVITIES

## 3.1 Coordination with State Historic Preservation Office

The Oregon State Historic Preservation Office (SHPO) has been contacted to determine if there are any areas of cultural or archaeological significance on FUDS property that could be impacted by field activities. The SHPO responded that while known archeological sites are located within the project boundaries, none of the sites is within an area proposed for sampling. In addition, a 7-mile stretch of the Oregon Trail crosses the extreme southern portion of the former Boardman AFR and has been labeled as “a high potential segment” for archeological resources.

## 3.2 Coordination with Tribes

The USACE Seattle District has contacted the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) concerning SI field activities. It was agreed that if any items of cultural significance are identified during field activities. the CTUIR Cultural Resources organization will be notified promptly.

## 3.3 Coordination Regarding Natural Resources

The Oregon Department of Fish and Wildlife was contacted to determine if there are threatened or endangered species that could be impacted by field activities at the former Boardman AFR. The Oregon Department of Fish and Wildlife indicated that only the Washington Ground Squirrel would be potentially impacted from field activities. They recommended that the field team work closely with The Nature Conservancy, who manages the wildlife recovery area on the FUDS, to avoid impacts.

## 3.4 Review of Historical Aerial Photographs

Historical aerial photographs from 1965 were reviewed prior to preparation of this SSWP. The review confirmed the locations of AOCs addressed in this SSWP.

### 3.5 Coordination of Rights of Entry

Per section 2.5.2 of the *Final Type I Work Plan* (Shaw, 2006a) and as the geographic USACE District office for the former Boardman AFR, the Project Manager from the USACE, Seattle District is responsible for obtaining the Right of Entry (ROE) for the property where the SI activities will be performed. Access to identified property is necessary for conducting field activities. Table 2 identifies the properties of interest and the status of ROEs.

### 3.6 Equipment

A four-wheel drive vehicle will be necessary for access because the ingress and egress to most of the AOCs is via an unpaved dirt road. A hand-held electromagnetic all metal detector will be used by a trained UXO technician during the field reconnaissance to identify subsurface metallic anomalies that need to be avoided during sampling activities. The hand-held electromagnetic all metal detector was selected due to the high iron concentrations in the bedrock. A hand-held global positioning system (GPS) receiver will be used to record the visual field reconnaissance route, document any surface munitions debris or subsurface magnetic anomalies, and document sampling locations. Digital photographs will be taken to document important features (including MEC, munitions debris, targets, and sampling points).

### 3.7 Communications

The primary means of on-site communication will be cellular telephones or radios. A satellite phone will be carried as a backup form of communication. The two-person Field Team (and any other accompanying parties) will remain together throughout all aspects of the field activities.

### 3.8 Training and Briefing

Any additional training will be conducted onsite during the Daily Tailgate Safety Briefing, to include awareness of endangered species, culturally sensitive areas, and anticipated ordnance types. In addition, emphasis will be placed on the known presence of biota at the site.

## 4.0 SITE INSPECTION ACTIVITIES

Site inspection activities to be conducted at the former Boardman AFR include:

- Site reconnaissance,
- Soil sampling,
- Sediment sampling,
- Sampling and site information recording (using a hand-held GPS unit), and
- Photo documentation.

All SI field activities will be conducted in accordance with the *Final Type I Work Plan* (Shaw, 2006a) and the SSHP Addendum (Appendix C). The SSHP Addendum is a supplement to the program-wide Accident Prevention Plan and Site Safety and Health Plan contained in the Work Plan (Shaw, 2006a). All SI field activities will be documented in the field log book.

## 4.1 Key Personnel

This section identifies key project personnel and their specific roles and responsibilities for each SI activity conducted at the former Boardman AFR. Additionally, this section defines the responsibilities, authority, and the interrelationships of all personnel who manage, perform, and verify activities affecting quality, particularly for personnel who need the organizational freedom and authority to:

- Initiate action to prevent the occurrence of non-conformance,
- Identify and record quality problems,
- Initiate, recommend, or provide solutions through designated channels,
- Verify the implementation of solutions, and
- Control further processing, delivery, or installation of non-conforming items until the deficiency or unsatisfactory condition has been corrected.

**Project Manager –** The Shaw Project Manager will have overall responsibility, authority, and accountability for the project. Mr. Peter Kelsall is the Project Manager. He will provide additional management or technical support when needed and will serve as the final reviewer on all technical documents produced for the project.

**Chemical Quality Control Officer –** The Shaw Chemical Quality Control Officer shall ensure that all chemistry related objectives, including responsibilities for data quality objective definitions, sampling and analysis, project requirements for data documentation and validation, and final project reports are attained. Mr. Tim Roth will serve as the Chemical Quality Control Officer for this project.

**Health and Safety Manager –** The Shaw Health and Safety Manager is responsible for the development and implementation of the SSHP for this SI. Ms. Pamela Moore will serve as the Health and Safety Manager for this project.

**Technical Lead –** The Shaw Technical Lead will oversee the technical aspects of the inspection activities. Mr. Dale Landon will serve as the Technical Lead for this site.

**Field Team Leader –** The Shaw Field Team Leader will be responsible for the management and execution of all field project activities in accordance with the approved work plan, and federal, state, and local laws and regulations. Mr. Ryan Pollyea will be the Field Team Lead. The Field Team Lead will function as the primary point of contact for the property owners and field personnel. He will advise the Technical Lead of technical progress, needs, potential problems, and recommended solutions.

**UXO Technician** – The UXO technician will be responsible for the UXO avoidance measures to be implemented during field activities. Mr. Rob Irons will be the UXO Technician.

## 4.2 Visual Field Reconnaissance

A visual field reconnaissance will be completed at Target No. 1 and the Impact Area AOCs shown on Figures 3 and 9 to determine whether MEC or munitions debris is present. The visual reconnaissance will be conducted by the UXO technician and will be aided by a hand-held electromagnetic all-metal detector. At Target No. 1, if MEC or munitions debris is present, a soil

sample will be located at or near the location. If MEC or munitions debris is not present, a soil sample will be located near the reported target center. At the Impact Area, if MEC or munitions debris is present, a soil sample will be located at or near the location. If MEC or munitions debris is not present, a soil sample will be located near one of the impact craters. A GPS receiver will be used to record the visual field reconnaissance route and discovered MEC and munitions debris. Digital photographs will be taken to document significant features.

Visual reconnaissance will also be performed at other sampling locations to aid in sample location selection and to allow the sampler to work safely.

The following conditions at each planned sampling location will be documented or recorded in the field log book and documented by digital photographs:

- Presence or absence of MEC or munitions debris,
- Coordinates of staked sampling locations (using a hand-held GPS unit),
- Access limitations,
- Vegetative cover,
- Soil conditions,
- Presence or absence of water for sediment samples; and
- Other conditions encountered that impact sample collection.

## 4.3 Sampling

This SSWP details sampling by media planned at the former Boardman AFR, as discussed at July 20, 2006 TPP Meeting and as documented in the Final TPP Memo (Shaw 2006). Soil and sediment samples will be collected based upon the rationale described in Sections 4.3.1 and 4.3.2 and summarized on Table 3. The proposed sampling for the former Boardman AFR is summarized in Table 4. Sample designations and quality assurance/quality control (QA/QC) sample requirements are summarized in Table 5.

In all instances, samples will be collected using clean, new, disposable sampling equipment, i.e., a spoon or scoop and bowl. Non-disposable tools, such as a spade, shovel, or trowel, may be used to remove vegetation and roots prior to collection of the soil or sediment sample.

All soil and sediment samples will be collected in accordance with Shaw's Field Sampling Plan (FSP) Section 6.1 and Shaw Standard Operating Procedures (SOPs) T-FS-101 of Appendix E of the *Final Type I Work Plan* (Shaw, 2006a).

Based on the TPP Memo (Shaw, 2006) the constituents of concern include explosive compounds and metals. Analysis of explosive compounds includes the list of explosives identified in Appendix E of the *Type I Work Plan* (Shaw, 2006a). In some cases, as identified below, nitroglycerin and PETN will also be included in the list for explosives analysis. Components of black powder (potassium nitrate, charcoal, and sulfur) are not hazardous materials, and will not be analyzed for. Similarly, the explosive nitrocellulose, which is formed by the combining of nitric acid and cellulose, is not a hazardous substance when not used as an explosive, and will not be analyzed for.

The select metal list was developed from metals that are related to either munitions firing or components of bullets, projectiles, or metal casing. Metals contained in munitions firing include aluminum, lead, magnesium, mercury, and red or white phosphorus, and strontium. Aluminum, lead, mercury, and red or white phosphorous were known to have been used at the former Boardman AFR. Strontium which is present in very small quantities in some bullet tracers compounds, is not expected to be in quantities that would be significant. Therefore, no analysis for strontium will be completed. Red and white phosphorus, while used in incendiary bombs and as signal charges are not hazardous in the environment once they have been expended and phosphorous is a common component of fertilizers. Because of this, no analysis will be completed for red or white phosphorus. Magnesium is a component of some incendiary bombs. However, magnesium is an essential nutrient for humans and wildlife and is not hazardous except in very high quantities. Metals contained in sheet metal and cast iron consist primarily of iron. Other metals that may be present include hazardous substances chromium, copper, and nickel, and non-hazardous substances aluminum, manganese, and molybdenum. Based on the above discussion the select metals list for the former Boardman AFR includes aluminum, chromium, copper, iron, lead, mercury, molybdenum, and nickel. In addition, the manganese will also be included as it is useful in evaluating naturally occurring concentrations of lead in soil, if required. If the this is required, the method of Myers and Thorbjornsen (2004)

### 4.3.1 Soil

Surface soil sample locations identified for this SI are designed to identify the presence of MC associated with past DoD activities. Prior to collecting soil samples, the sampling area will be screened by the UXO technician using a hand-held electromagnetic all-metal detector to avoid subsurface anomalies that may be indicative of buried MEC. The surface soil samples will be collected at a depth of approximately 0 to 6 inches below ground surface (bgs) following removal of any vegetative cover. Surface soil samples will be 7-point composite samples (wheel-pattern with 2-foot radius), collected in accordance with Shaw SOP T-FS-101, and the procedure described in Shaw's FSP located in Appendix E (Shaw, 2006a). No subsurface samples are planned.

The general rationale for collecting surface soil samples at the Boardman AOCs are as follows:

**Target No. 1 AOC (Figure 3)**

One soil sample will be collected from the Target No. 1 AOC at the location of MEC or munitions debris. If no MEC or munitions debris is located, a soil sample will be collected near the reported target center. The sample will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin). The explosives analysis was added at the request of the ODEQ to support the CSM that only black powder explosives and red or white phosphorus were used at this AOC.

**Target No. 2 AOC (Figure 4)**

Two soil samples will be collected from Target No. 2 AOC in the untilled areas to minimize deep soil mixing. The PA/SI (Weston, 2004) sample locations from this area were not within the AOC boundaries and are thus not representative of Target No. 2. The samples will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel).

**Carty Reservoir Bomb Target AOC (Figure 5)**

Two soil samples will be collected from the Carty Reservoir Bomb Target AOC. The two samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin). Explosives will be analyzed for due to the Tetryl contained in boosters for the M75/M84 Target ID bombs.

**Range Complex No. 1 AOC (Demolition Area) (Figure 6)**

Two soil samples will be collected from the Demolition Area to determine impacts to soil from demolition activities. Sample locations will be selected near disposal craters, following UXO avoidance. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin and PETN).

**Range Complex No. 1 AOC (Turret Gunnery Range) (Figure 7)**

Two soil samples will be collected from the Turret Gunnery Range to determine impact to soil from gunnery training. Sample locations will be as shown on Figure 7. One location was chosen to be near where an old car was once located that appeared to be used as a target. The second location is from a down range location and was chosen at random. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) only. Explosive analysis is not warranted as the 20 mm projectiles did not contain any explosives.

**Range Complex No. 1 AOC (INPR Site No. 1)**

No soil samples will be collected from Range Complex No. 1 AOC, INPR Site No. 1. INPR Site No. 1 was sampled previously for metals, nitrogen-based explosive compounds, and perchlorate (Weston, 2004). There were no metals detected that significantly exceeded background concentrations and no explosives or perchlorate were detected in the soils. The site is considered adequately characterized for this SI.

**Demolition Area No. 2 AOC (Figure 8)**

Two soil samples will be collected from Demolition Area No. 2 from near disposal craters, following UXO avoidance. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin and PETN).

**Impact Area AOC (Figure 9)**

One soil sample will be collected from the Impact Area near an impact crater where munitions debris is located. The sample will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin).

### 4.3.2 Sediment

Sediment samples will be collected in accordance with Section 5.1.2 or 5.1.3 of the *USACE Programmatic Sampling and Analysis Plan* (USACE, 2005b). Section 5.1.2 pertains to dry sediment sampling. Section 5.1.3 pertains to wet sediment sampling. Sediment samples will be collected from a 0-inch to 6-inch depth, but will be discrete samples in order to retrieve material from specific, localized, surface water drainage features.

The general rationale for collecting sediment samples at the former Boardman AFR AOCs are as follows:

**Carty Reservoir Bomb Target AOC (Figure 5)**

One sediment sample will be collected from Carty Reservoir which will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin).

**Impact Area AOC (Figure 8)**

One sediment sample will be collected from the Impact Area AOC in the Sixmile Canyon Creek drainage. The location will be at a probable point of entry from the AOC. The sample will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin).

### 4.3.3 Surface Water and Groundwater

As discussed in Section 2.3.1 surface water and groundwater samples were collected and analyzed during the PA/SI (Weston, 2004). Locations of surface water and ground water samples are shown on Figure 2. The surface water and groundwater samples were analyzed for nitrogen-based explosives and perchlorate. No metals analyses were completed. However, because of the types of metals contained in munitions used at the former Boardman AFR, which are not highly soluble, metals are not considered a concern for surface water or groundwater. No explosive compounds were detected in any surface water or ground water sample. Perchlorate has been identified in a number of groundwater wells within the Lower Umatilla Basin, within which the former Boardman AFR FUDS resides. Locations with perchlorate detections occur both cross (up to several miles) and down gradient of the former Boardman AFR. Perchlorate was also detected in surface water samples within the former Boardman AFR. A perchlorate plume is present in much of the lower Umatilla River Basin. Based on the number of samples collected in the vicinity and from within the former Boardman AFR the surface water and groundwater are considered adequately characterized and no additional surface water or groundwater sampling is planned. Surface water and groundwater sampling conducted for the 2004 PA/SI is sufficient to meet data objectives.

### 4.3.4 Background Sampling

Background data provided by the ODEQ following the TPP meeting are not appropriate for use in this SI. The data are from rock analyses and not from soil. In addition the data are primarily the result of X-ray fluorescence analysis and not by USEPA method SW-846 6020A. In addition not all metals of concern are included in the data set.

Ten background soil samples and one background sediment sample will be collected and analyzed for the target analyte list of metals plus molybdenum. Sample locations are shown on Figure 10.

The ten background soil sample analytical results will be used to calculate background metal soil concentrations using published USEPA Guidance (1989, 1992, 1994, 1995, and 2006). A 95th upper tolerance limit (UTL) for normally and lognormally distributed analytes or the 95th percentile for nonparametric distributed analytes will be calculated for background concentrations.

The method for comparing source area sediment analytical results to the single background analysis will be consistent with the USEPA's Hazard Ranking System (40 CFR Part 300: Appendix A): "The minimum standard to establish an observed release by chemical analysis is analytical evidence of a hazardous substance in the media significantly above the background level." Table 2-3, "Observed Release Criteria for Chemical Analysis" in the above referenced regulation has the following criteria:

1. If the sample measurement is less than the sample quantitation limit, no observed release is established.
2. If the sample measurement is greater than or equal to the sample quantitation limit, then an observed release is established as follows:
   - If the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds the sample quantitation limit.
   - If the background concentration equals or exceeds the detection limit, an observed release is established when the sample measurement is three times or more above the background concentration.

These criteria are not applied for soils because a statistically based determination of background has been established, and an exceedance of the 95$^{th}$ UTL or 95$^{th}$ percentile, depending on the individual analyte, is used to establish a release of MC

## 4.4 Analytical Program

Definitive target analyses for soil and sediment samples collected from the former Boardman AFR consist of the following:

- Metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, and nickel) by USEPA SW-846 Method 6020A for soil samples;
- Mercury by USEPA SW-846 Method 7471A; and
- Explosives by USEPA SW846 Method 8330A, and PETN and Nitroglycerin by USEPA SW-846 Method 8330A (Modified).

Soil and sediment samples will be analyzed using USEPA SW-846 methodology as presented in Section 5.0 of the USACE Quality Assurance Project Plan (QAPP).

Tables 6 through 8 compare laboratory target analyte practical quantitation limits (PQLs) to human health and ecological risk based screening concentrations. Chemical data will be reported via a hard-copy data package and electronic format following the requirements referenced in Section 7.1 and 7.2 of the USCAE QAPP. These data deliverables will be validated in accordance to the requirements referenced in Section 8.2 of the USACE QAPP.

### 4.4.1 Quality Assurance/Quality Control Samples

In accordance with the USACE Programmatic SAP, quality control (QC) samples will be collected. The locations planned for the collection of QC samples are noted on Table 5.

The QC samples to be collected include field duplicates and matrix spike/matrix spike duplicate (MS/MSD) samples. The Omaha Design Center has directed that no QA field split samples will be collected for this site.

### 4.4.2 Sample Preservation, Packaging, and Shipping

Sample preservation and packaging are provided in Table 4-1 and Table 4-2 of the USACE QAPP. Sample packaging and shipment will follow the procedures specified in Section 4.0 of the USACE QAPP. Completed analysis request/chain of custody records per Section 7.1.3 of Shaw's SAP will be secured and included with each shipment of coolers to GPL Laboratories, LLC.

All samples will be shipped to the following:

**GPL Laboratories, LLC**

7210A Corporate Court
Frederick, MD 21703
Phone: 301.694.5310
Fax: 301.620.0731
Attention: Sample Receiving/Virginia Zusman

## 5.0 INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) will be managed in accordance with the *Final Type I Work Plan* (Shaw, 2006a) (Section 3.7, and Appendix E, Shaw's FSP Section 9.0). All IDW is presumed non-hazardous unless field observations indicate otherwise. The following types of IDW will be managed as specified in the *Final Type I Work Plan* (Shaw, 2006a) and the USACE FSP (USACE, 2005):

- Personal protective equipment and disposable equipment (i.e., disposable sampling scoop): bagged and routed to a municipal landfill;
- Excess surface soil and sediment material: Returned to source (i.e., ground surface).

## 6.0 PROPOSED SCHEDULE

The proposed schedule for field activities and reporting is provided below. The timing of the field activities assumes there will be no delays because of inclement weather or ROE issues.

February 2007 – Submittal of Final SSWP,

February 2007 – Field activities,

April 2007 – Submittal of Draft SI Report;

April 2007 – Review of Draft SI Report;

May 2007 – Submittal of Draft Final SI Report,

May 2007 – Review of Draft Final SI Report, and

June 2007 – Submittal of Final SI Report.

## 7.0 REFERENCES


U.S. Department of Defense (DoD). 2001. *Management Guidance for the Defense Environmental Program.* September 2001.

DoD. 2003. *Definitions Related to Munitions Response Actions.* Memorandum, Philip W. Grone. December 2003.

DoD. 2005. *Munitions Response Site Prioritization Protocol, Final Rule*, 32 CFR Part 179, 70 FR 192. 5 October 2005.

Myers, Jonathan and Karen Thorbjornsen, 2004, *Identifying Metal Contamination in Soil: A Geochemical Approach,* in Soil and Sediment Contamination, Vol. 12, pp 1-16.

Oregon Department of Environmental Quality (ODEQ). 1995. *Hydrogeology, Groundwater Chemistry, and Land Use in the Lower Umatilla Basin Groundwater Management Area*. Final Review Draft. 1995

Shaw Environmental, Inc. (Shaw). 2006a. *Final Type I Work Plan, Site Inspections at Multiple Sites, NWO Region, Formerly Used Defense Sites, Military Munitions Response Program*. Prepared for the Army Corp of Engineers. February 2006.

Shaw. 2006b. *Draft Technical Project Planning Memorandum, Boardman Air Force Range.* September 2006.

U.S. Army Corps of Engineers (USACE). . 2004. *Environmental Quality Formerly Used Defense Sites (FUDS) Program Policy***,** Engineer Regulation (ER) 200-3-1. May 2004.

U.S. Army Corps of Engineers (USACE). . 2005. *Formerly Used Defense Sites (FUDS) Military Munitions Response Program (MMRP) Site Inspections, Program Management Plan*. February 2005

U.S. Department of Army. 2005. *Munitions Response Terminology***.** Memorandum. Raymond J. Fatz. 21 April 2005.

U.S. Environmental Protection Agency (EPA). 1989. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance*. Office of Solid Waste, Waste Management Division. EPA/530/SW-89/026. July 1989.

U.S. Environmental Protection Agency (USEPA). 1990. *Appendix A to Part 300 – The Hazard Ranking System*. Title 40 CFR Part 300, 55 FR 51583. 14 December 1990.

U.S. Environmental Protection Agency (EPA). 1992. *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance*. Environmental Statistics and Information Division, Office of Policy Planning, and Evaluation. EPA/530/R-93/003. July 1992.

U.S. Environmental Protection Agency (EPA). 1994. *Statistical Methods for Evaluating The Attainment Of Cleanup Standards.* Environmental Statistics and Information Division, Office of Policy, Planning, and Evaluation. EPA/230/R-94/004. June 1994.

U.S. Environmental Protection Agency (EPA). 1995. *Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites*. Office of Research and Development. EPA/540/S-96/500. December 1995.

USEPA. 2005a. *Federal Facilities Remedial Preliminary Assessment Summary Guide.* July 2005.

USEPA. 2005b. *Federal Facilities Remedial Site Inspection Summary Guide*. 21 July 2005.

U.S. Environmental Protection Agency (EPA). 2006. *Data Quality Assessment: Statistical Methods for Practitioners*. EPA/240/B-06/003. Office of Environmental Information. February 2006.

Weston Solutions, Inc. (Weston). 2004. *Boardman AFR FUDS Preliminary Assessment/Site Inspection Report*. TDD:01-08-0006. Seattle, WA. September 2004

# TABLES

## Table 1
## Munitions Information

| AOC | Range Munitions | Munitions Constituents | Land Use Controls |
|---|---|---|---|
| Target No. 1 | Practice Bombs: AN-Mk 5, AN-Mk 23, AN-Mk 43, Mk 4 (signal charge) | Steel, cast iron, or lead, black powder (potassium nitrate, sulfur, charcoal), red phosphorus | None |
| Target No. 2 | AN-M50A2 Incendiary bomb, 4 lb | Magnesium alloy casing, 0.63 lb thermite (powdered aluminum metal and ferric oxide) | None |
| | AN-M52 Incendiary bomb, 2 lb | Magnesium alloy, 0.4 lb thermite (powdered aluminum metal and ferric oxide) | |
| | M38A2 practice bomb, 100 lb | sheet metal, inert sand filled, 3 lb black powder (potassium nitrate, sulfur, charcoal) | |
| | AN M-47 | Steel Sheet metal, inert | |
| | MK-15, Mod 3 | Steel sheet metal, spotting charge consisting of 1 lb. black powder (potassium nitrate, sulfur, charcoal) | |
| | 2.25-inch Practice Rocket MK6 | sheet metal, Ballistite (nitrocellulose and nitroglycerin) | |
| | AN-M57 GP Practice Bomb | Sheet metal, spotting charge, Amatol (ammonium nitrate and TNT), or TNT | |
| Carty Reservoir | AN-Mk 23 | Cast iron, black powder (potassium nitrate, sulfur, charcoal), red phosphorus | None |
| | M38A2 | sheet metal, inert sand filled, 3 lb black powder (potassium nitrate, sulfur, charcoal) | |
| | M75/M84 Target ID bomb | sheet metal, red iron oxide, Tetryl | |
| | M89 | sheet metal, black powder (potassium nitrate, sulfur, charcoal) | |

## Table 1 (Continued)
## Munitions Information

| AOC | Range Munitions | Munitions Constituents | Land Use Controls |
|---|---|---|---|
| Range Complex No. 1 | Small Arms – 50 caliber, M2 ball, M1 Tracer, M10 Tracer | Soft Steel, lead, single (nitrocellulose) or double base (nitrocellulose and nitroglycerin) powder, tracer (calcium resinate, strontium peroxide, magnesium powder, strontium nitrate), perchlorate | None |
| | BDU-33, MK 76 | Cast iron, steel sheet metal, 10 gauge shotgun shell | |
| | Mk-84 | Inert, steel sheet metal | |
| | BLU-95 (likely drift over from adjacent Navy range) | Ethylene oxide | |
| | Mark-12 Practice Nuclear bomb | Inert, concrete filled, steel sheet metal | |
| | Mk 106 5 lb | Sheet metal, single- (nitrocellulose) or double-base (nitrocellulose and nitroglycerin) powder | |
| | Mk 89, 56-lb | Soft steel, 10 gauge shotgun shell, red phosphorus | |
| | Medium caliber practice – 20-mm Ball Mk 1 | Soft Steel, single (nitrocellulose) or double base (nitrocellulose and nitroglycerin) powder | |
| | Explosives C-4 blocks | RDX | |
| | Explosives Detonating Cord, M60 Igniter | PETN | |
| Demolition Area No. 2 | M83 Fragmentation Bombs (Butterfly Bomblets) | Steel sheet metal, TNT | None |
| | M66, M68 detonating fuzes | Mercury Fulminate, lead azide, tetryl, | |
| | 100-lb GP Bomb | Cast iron, TNT, Amatol (ammonium nitrate, TNT), Tritonal (TNT aluminum powder), lead styphnate, lead azide, Tetryl, mercury fulminate | |
| | Explosives C-4 blocks | RDX | |
| | Explosives Detonating Cord, M60 Igniter | PETN | |
| Impact Area (note munitions listed are only suspected) | Practice Bombs: AN-Mk 5, AN-Mk 23, AN-Mk 43, Mk 4 (signal charge) | Steel, cast iron, or lead, black powder (potassium nitrate, sulfur, charcoal), red phosphorus | None |
| Suspected Use but no AOC Specified | Practice bomb BDU-10 series, 2,025 lb | Inert (hot gas generator in folding fins configuration) | None |
| | M66 and M68 base detonating fuze for 75mm and 90mm projectiles | TNT or 50/50 Pentolite, mercury fulminate, tetryl | |

AOC = area of concern

lb = pound

PETN = pentaerythritol tetranitrate

RDX=- Hexahydro-1,3,5-trinitro-1,3,5-triazine

TNT = 2,4,6-Trinitrotoluene

**Table 2**
**Rights of Entry Status**

| Area of Concern | Land Owner | Date Signed by Land Owner | Land Owner Concerns | Estimated Date to Contact Prior to Field Work |
|---|---|---|---|---|
| Target No. 1 | Portland General Electric, Parcels R05255 and R05258 | January 31, 2007 | Notify Mr. Steve Anderson at 541-481-1233 or cell 541-561-6293 prior to starting work. Escort may be required. | 1 week |
| Target No. 2 | Private Owner | February 7, 2007 | Notify owner, Coordinate field work with on-going farming activities, Escort may be required | 1 week |
| | The Boeing Co. Parcel R04665 | October 16, 2006 | Notify Mr. Steve Tochko at 206-290-6577 prior to starting field work. Escort may be required. | 1 week |
| Carty Reservoir Bomb Target | Portland General Electric, Parcel R05258 | January 31, 2007 | Notify Mr. Steve Anderson at 541-481-1233 or cell 541-561-6293 prior to starting work. Escort may be required. | 1 week |
| | The Nature Conservancy Parcel R10096 | 5 Feb 07 | Notify Ms. Leslie Nelson at 541-383-4766 or cell 541-980-3633 prior to starting field work. **Escort required.** | 1 week |
| Range Complex No. 1 Demolition Area | The Boeing Co. Parcel R04665 | 16 Oct 06 | Notify Mr. Steve Tochko at 206-290-6577 prior to starting field work. Escort may be required. | 1 week |
| Range Complex No. 1 Turret Gunnery Range | The Nature Conservancy Parcel R10102 | 5 Feb 07 | Notify Ms. Leslie Nelson at 541-383-4766 or cell 541-980-3633 prior to starting field work. **Escort required.** | 1 week |
| Demolition Area No. 2 | The Boeing Co. Parcel R04665 | 16 Oct 06 | Notify Mr. Steve Tochko at 206-290-6577 prior to starting field work. Escort may be required. | 1 week |
| | The Nature Conservancy Parcel R04665 | 5 Feb 07 | Notify Ms. Leslie Nelson at 541-383-4766 or cell 541-980-3633 prior to starting field work. **Escort required.** | 1 week |
| Impact Area | The Nature Conservancy Parcel R10096 | 5 Feb 07 | Notify Ms. Leslie Nelson at 541-383-4766 or cell 541-980-3633 prior to starting field work. **Escort required.** | 1 week |

Note it is the USACE Seattle District policy to not release names of private property owners in public documents.

## Table 3
## Sample Location Rationale

| AOC | Sample Location | Sample Media | Sample Location Rationale |
|---|---|---|---|
| Target No. 1 | 030A001 | Surface Soil | One soil sample will be collected from the Target No. 1 AOC at the location of MEC or munitions debris. If no MEC or munitions debris is located, a soil sample will be collected near the reported target center. The sample will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin). |
| Target No 2 | 030A002 | Surface Soil | Two soil samples will be collected from Target No. 2 AOC in the untilled areas to minimize deep soil mixing. The samples will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). |
| | 030A003 | Surface Soil | |
| Carty Reservoir Bomb Target | 030A004 | Surface Soil | Two soil samples will be collected from the Carty Reservoir Bomb Target AOC. The two samples will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). |
| | 030A005 | Surface Soil | |
| | 030A006 | Sediment | One sediment sample will be collected from Carty Reservoir which will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives including nitroglycerin. |
| Range Complex No. 1 Demolition Area | 030A007 | Surface Soil | Two soil samples will be collected to determine impacts to soil from demolition activities. Sample locations will be selected near disposal craters, following UXO avoidance. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin and PETN). |
| | 030A008 | Surface Soil | |
| Range Complex No. 1 Turret Gunnery Range | 030A009 | Surface Soil | Two soil samples will be collected to determine impact to soil from gunnery training. One location will be where an old car was once located that appeared to be used as a target. The second location is from a downrange location. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) only. |
| | 030A010 | Surface Soil | |
| Demolition Area No. 2 | 030A011 | Surface Soil | Two soil samples will be collected from Demolition Area No. 2 from near disposal craters, following UXO avoidance. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin and PETN). |
| | 030A012 | Surface Soil | |

## Table 3 (Continued)
## Sample Location Rationale

| AOC | Sample Location | Sample Media | Sample Location Rationale |
|---|---|---|---|
| Impact Area | 030A013 | Surface Soil | One soil sample will be collected from the Impact Area near an impact crater where munitions debris is located. The sample will be analyzed for select metals (aluminum, , chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin). |
| | 030A0014 | Sediment | One sediment sample will be collected from the Impact Area AOC in the Six-mile Canyon Creek drainage. The location will be at a probable point of entry from the AOC. The sample will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) and explosives (including nitroglycerin). |

AOC = area of concern
MEC = munitions ad explosives of concern
PETN = pentaerythritol tetranitrate

# Table 4
# Proposed Sampling Approach
# Boardman Air Force Base

| Area of Concern | Media | Samples | Contaminants of Concern | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lead | Metals | Mercury | PAHs | Explosives | PETN | Nitroglycerine | Perchlorate | Sieving (No. 10) |
| Target No. 1 | Soil | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| | Sediment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Target No. 2 | Soil | 2 | 0 | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 0 |
| | Sediment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carty Reservoir Bomb Target | Soil | 2 | 0 | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 0 |
| | Sediment | 1 | 0 | 1 | 1 | 0 | 2 | 0 | 2 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Range Complex No. 1, Demolition Area & Turret Gunnery Range | Soil | 4 | 0 | 4 | 4 | 0 | 2 | 2 | 2 | 0 | 0 |
| | Sediment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Demolition Area No. 2 | Soil | 2 | 0 | 2 | 2 | 0 | 2 | 2 | 2 | 0 | 0 |
| | Sediment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Impact Area | Soil | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| | Sediment | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Background | Soil | 10 | 0 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sediment | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Totals | 0 | 25 | 25 | 0 | 13 | 4 | 13 | 0 | 0 |

| QC Required Samples | Media | Samples | Lead | Metals | Mercury | PAHs | Explosives | PETN | Nitroglycerine | Perchlorate | Sieving (No. 10) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Duplicate | Soil | 2 | 0 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 0 |
| | Sediment | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Totals | 0 | 3 | 3 | 0 | 2 | 1 | 2 | 0 | 0 |
| MS/MSD | Soil | 2 | 0 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 0 |
| | Sediment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Surface Water | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Groundwater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Totals | 0 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 0 |

Notes:

1) In addition to the QC samples shown above, temperature blanks will be submitted with samples, one blank per cooler.

2) Lead and metals by SW-846 6020A. Mercury by SW-846 7470A/7471A. PAHs by SW-846 8270 Low Level. Explosives by SW-846 8330A. PETN and Nitroglycerin by SW-845 8330A (Modified). Perchlorate by LC/MS (DataChem SOP Document Control # LCMS-CL04-Rev 2 titled "The Determination of Perchlorate in Water, Soil and Biota by LC/MS" dated July 19, 2006).

3) Select metals for range samples. Select metals are aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel.

MS/MSD - matrix spike/matrix spike duplicate

PAHs - polycyclic aromatic hydrocarbons

PETN - pentaerythritol tetranitrate

QC - quality control

# Table 5
# Sample Designations and Analyses

| Area of Concern | Sample Location | Sample Type | Sample Number | Sample Media | QA/QC Sample | | EPA Method |
|---|---|---|---|---|---|---|---|
| | | | | | Field Duplicate | MS/MSD | |
| Target No. 1 | 030A001 | Composite | NWO-030-0001 | Soil | | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A<br>Explosives by SW-846 8330A<br>Nitroglycerine by SW-846 8330A (Modified) |
| Target No. 2 | 030A002 | Composite | NWO-030-0002 | Soil | | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A<br>Explosives by SW-846 8330A<br>Nitroglycerine by SW-846 8330A (Modified) |
| | 030A003 | Composite | NWO-030-0003 | Soil | | | |
| Carty Reservoir Bomb Target | 030A004 | Composite | NWO-030-0004 | Soil | | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A |
| | 030A005 | Composite | NWO-030-0005 | Soil | | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A<br>Explosives by SW-846 8330A<br>Nitroglycerine by SW-846 8330A (Modified) |
| | 030A006 | Grab | NWO-030-1001 | Sediment | NWO-030-1003 | | |
| Range Complex No. 1, Demolition Area | 030A007 | Composite | NWO-030-0006 | Soil | | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A<br>Explosives by SW-846 8330A<br>Nitroglycerine by SW-846 8330A (Modified)<br>PETN by SW-846 8330A (Modified) |
| | 030A008 | Composite | NWO-030-0007 | Soil | NWO-030-0013 | | |
| Range Complex No. 1, Turret Gunnery Range | 030A009 | Composite | NWO-030-0008 | Soil | | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A |
| | 030A010 | Composite | NWO-030-0009 | Soil | | | |
| Demolition Area No. 2 | 030A011 | Composite | NWO-030-0010 | Soil | | NWO-030-0010-MS/MSD | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A<br>Explosives by SW-846 8330A<br>Nitroglycerine by SW-846 8330A (Modified)<br>PETN by SW-846 8330A (Modified) |
| | 030A012 | Composite | NWO-030-0011 | Soil | | | |

## Table 5 (Continued)
## Sample Designations and Analyses

| Area of Concern | Sample Location | Sample Type | Sample Number | Sample Media | QA/QC Sample | | USEPA Method |
|---|---|---|---|---|---|---|---|
| | | | | | Field Duplicate | MS/MSD | |
| Impact Area | 030A013 | Composite | NWO-030-0012 | Soil | | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A<br>Explosives by SW-846 8330A<br>Nitroglycerine by SW-846 8330A (Modified) |
| | 030A014 | Grab | NWO-030-1002 | Sediment | | | |
| Background Samples | 030A015 | Composite | NWO-030-5001 | Soil | NWO-030-5012 | | Aluminum, chromium, copper, iron, lead, manganese, molybdenum and nickel by SW-846 6020A<br>Mercury by SW7471A |
| | 030A016 | Composite | NWO-030-5002 | Soil | | | |
| | 030A017 | Composite | NWO-030-5003 | Soil | | | |
| | 030A018 | Composite | NWO-030-5004 | Soil | | | |
| | 030A019 | Composite | NWO-030-5005 | Soil | | NWO-030-5005-MS/MSD | |
| | 030A020 | Composite | NWO-030-5006 | Soil | | | |
| | 030A021 | Composite | NWO-030-5007 | Soil | | | |
| | 030A022 | Composite | NWO-030-5008 | Soil | | | |
| | 030A023 | Composite | NWO-030-5009 | Soil | | | |
| | 030A024 | Composite | NWO-030-5010 | Soil | | | |
| | 030A025 | Grab | NWO-030-5011 | Sediment | | | |

USEPA = U.S. Environmental Protection Agency
MS/MSD = method spike/method spike duplicate
PETN =- pentaerythritol tetranitrate
QA/QC = Quality Assurance/Quality Control

# Table 6
# Human Health Screening Criteria for Soil/Sediment at Oregon Sites

| Analyte | Abbreviation | CAS No. | USEPA Region 9 Human Health Screening Values [a] | | | |
|---|---|---|---|---|---|---|
| | | | Residential PRG [b] (mg/kg) | SSL [c] DAF=1 (mg/kg) | SSL [c] DAF=20 (mg/kg) | Laboratory PQL (mg/kg) |
| **Explosives** | | | | | | |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine | RDX | 121-82-4 | 4.4 | | | 0.075 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine | HMX | 2691-41-0 | 3,100 | | | 0.050 |
| 2,4,6-Trinitrotoluene | 2,4,6-TNT | 118-96-7 | 16 | | | 0.040 |
| 1,3,5-Trinitrobenzene | 1,3,5-TNB | 99-35-4 | 1,800 | | | 0.020 |
| 1,3-Dinitrobenzene | 1,3-DNB | 99-65-0 | 6.1 | | | 0.020 |
| 2,4-Dinitrotoluene[d] | 2,4-DNT | 121-14-2 | 0.72 | 0.00004 | 0.0008 | 0.040 |
| 2,6-Dinitrotoluene[d] | 2,6-DNT | 606-20-2 | 0.72 | 0.00004 | 0.0008 | 0.040 |
| 2-Amino-4,6-dinitrotoluene | 2-Am-DNT | 35572-78-2 | 12 | | | 0.040 |
| 2-Nitrotoluene | 2-NT | 88-72-2 | 0.88 | | | 0.075 |
| 3-Nitrotoluene | 3-NT | 99-08-1 | 730 | | | 0.050 |
| 4-Amino-2,6-dinitrotoluene | 4-Am-DNT | 19406-51-0 | 12 | | | 0.040 |
| 4-Nitrotoluene | 4-NT | 99-99-0 | 12 | | | 0.040 |
| Nitrobenzene | NB | 98-05-3 | 20 | 0.007 | 0.1 | 0.020 |
| Nitroglycerin | NG | 55-63-0 | 35 | | | 10 |
| Pentaerythritol tetranitrate | PETN | 78-11-5 | 0.50 | NVA | NVA | 0.5 |
| Methyl-2,4,6-trinitrophenylnitramine | Tetryl | 479-45-8 | 610 | | | 0.065 |
| **Metals/Inorganics** | | | | | | |
| Aluminum | Al | 7429-90-5 | 76,000 | | | 20.0 |
| Chromium [e] | Cr | 7440-47-3 | 210 | 2 | 38 | 1.0 |
| Copper | Cu | 7440-50-8 | 3,100 | | | 1.0 |
| Iron | Fe | 7439-89-6 | 23,000 | | | 15.0 |
| Lead | Pb | 7439-92-1 | 400 [f] | | | 1.0 |
| Mercury | Hg | 7439-97-6 | 23 | | | 0.06 |
| Molybdenum | Mo | 7439-98-7 | 390 | | | 0.5 |
| Nickel | Ni | 7440-02-0 | 1,600 | 7 | 130 | 1.0 |

DAF = Dilution Attenuation Factor
PQL = Practical Quantitation Limit
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
NVA = no value available
PRG = Preliminary Remediation Goal
SSL = Soil Screening Level
USEPA = U.S. Environmental Protection Agency.

# Table 6
# Human Health Screening Criteria for Soil/Sediment at Oregon Sites

a If laboratory cannot meet any of the preferred QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL. In those cases, the QL achievable with a routine SW 846 methodology would be accepted.

b PRGs from Region 9 PRG Table dated October 2004 and addendum dated 28 December 2004, based on single chemical.

c SSLs from Region 9 PRG Table dated October 2004 and revision note dated 28 December 2004.

d Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

e Total chromium values used.

f Values listed from Oregon risk-based concentrations: 400 mg/kg (residential)

# Table 7
# Human Health Screening Criteria for Groundwater at Oregon Sites

| Analyte [a] | Abbreviation | CAS No. | Laboratory PQL (µg/L) | USEPA Region 9 Tap Water PRG [b] (µg/L) | Federal Drinking Water Criteria MCLs [c] (µg/L) |
|---|---|---|---|---|---|
| **Explosives** | | | | | |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine | RDX | 121-82-4 | 0.8 | 0.61 | |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine | HMX | 2691-41-0 | 0.4 | 1,800 | |
| 2,4,6-Trinitrotoluene | 2,4,6-TNT | 118-96-7 | 0.3 | 2.2 | |
| 1,3,5-Trinitrobenzene | 1,3,5-TNB | 99-35-4 | 0.2 | 1,100 | |
| 1,3-Dinitrobenzene | 1,3-DNB | 99-65-0 | 0.2 | 3.6 | |
| 2,4-Dinitrotoluene [d] | 2,4-DNT | 121-14-2 | 0.3 | 0.099 | |
| 2,6-Dinitrotoluene [d] | 2,6-DNT | 606-20-2 | 0.3 | 0.099 | |
| 2-Amino-4,6-dinitrotoluene | 2-Am-DNT | 35572-78-2 | 0.2 | 7.3 | |
| 2-Nitrotoluene | 2-NT | 88-72-2 | 0.4 | 0.049 | |
| 3-Nitrotoluene | 3-NT | 99-08-1 | 0.8 | 120 | |
| 4-Amino-2,6-dinitrotoluene | 4-Am-DNT | 19406-51-0 | 0.2 | 7.3 | |
| 4-Nitrotoluene | 4-NT | 99-99-0 | 0.4 | 0.66 | |
| Nitrobenzene | NB | 98-05-3 | 0.2 | 3.4 | |
| Methyl-2,4,6-trinitrophenylnitramine | Tetryl | 479-45-8 | 0.75 | 360 | |
| Nitroglycerin | NG | 55-63-0 | 0.5 | | |
| Pentaerythritol tetranitrate | PETN | 78-11-5 | 1.3 | | |
| **Metals/Inorganics** | | | | | |
| Aluminum | Al | 7429-90-5 | 60 | 36,000 | 50 [e] |
| Chromium [f] | Cr | 7440-47-3 | 2.0 | 110 | 100 |
| Copper | Cu | 7440-50-8 | 3.0 | 1,500 | 1,000 [e]<br>1,300 [g] |
| Iron | Fe | 7439-89-6 | 5.0 | 11,000 | 300 [e] |
| Lead | Pb | 7439-92-1 | 1.0 | | 15 [g] |
| Mercury | Hg | 7439-97-6 | 0.3 | | |
| Molybdenum | Mo | 7439-98-7 | 5.0 | 180 | |
| Nickel | Ni | 7440-02-0 | 1.0 | 730 | |

PQL = Practical Quantitation Limit
MCL = Maximum Contaminant Level
PRG = Preliminary Remediation Goal
µg/L = micrograms per liter
USEPA = U.S. Environmental Protection Agency

## Table 7 (Continued)
## Human Health Screening Criteria for Groundwater at Oregon Sites

Note: For comparison to site analytical data the lower values will be used unless lower value is a secondary MCL, which are aesthetic values applicable to taste, odor, or color.

a If laboratory cannot meet these QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL.

b Region 9 PRG Table dated October 2004 and revision note dated 28 December 2004, based on single chemical.

c Primary MCL from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004, is listed unless otherwise indicated.

d Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

e Secondary MCL from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004.

f Total chromium values used if available.

g Action level from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004.

# Table 8
# Human Health Screening Criteria for Surface Water at Oregon Sites

| Analyte [a] | Abbreviation | CAS Number | USEPA Region 9 Tap Water PRG [b] (µg/L) | ODEQ Water Quality Criteria[c] | |
|---|---|---|---|---|---|
| | | | | Water and Fish Ingestion [d] (µg/L) | Fish Consumption Only [e] (µg/L) |
| **Explosives** | | | | | |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine | RDX | 121-82-4 | 0.61 | | |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine | HMX | 2691-41-0 | 1,800 | | |
| 2,4,6-Trinitrotoluene | 2,4,6-TNT | 118-96-7 | 2.2 | | |
| 1,3,5-Trinitrobenzene | 1,3,5-TNB | 99-35-4 | 1,100 | | |
| 1,3-Dinitrobenzene | 1,3-DNB | 99-65-0 | 3.6 | | |
| 2,4-Dinitrotoluene [g] | 2,4-DNT | 121-14-2 | 0.099 | 0.11[h] | 9.1[h] |
| 2,6-Dinitrotoluene [g] | 2,6-DNT | 606-20-2 | 0.099 | | |
| 2-Amino-4,6-dinitrotoluene | 2-Am-DNT | 35572-78-2 | 7.3 | | |
| 2-Nitrotoluene | 2-NT | 88-72-2 | 0.049 | | |
| 3-Nitrotoluene | 3-NT | 99-08-1 | 120 | | |
| 4-Amino-2,6-dinitrotoluene | 4-Am-DNT | 19406-51-0 | 7.3 | | |
| 4-Nitrotoluene | 4-NT | 99-99-0 | 0.66 | | |
| Nitrobenzene | NB | 98-05-3 | 3.4 | 19,800 | |
| Nitroglycerin | NG | 55-63-0 | 4.8 | | |
| Methyl-2,4,6-trinitrophenylnitramine | Tetryl | 479-45-8 | 360 | | |
| Pentaerythritol tetranitrate | PETN | 78-11-5 | | | |
| **Metals/Inorganics** | | | | | |
| Aluminum | Al | 7429-90-5 | 36,000 | | |
| Chromium [i] | Cr | 7440-47-3 | 110 | 50 | |
| Copper | Cu | 7440-50-8 | 1,500 | | |
| Iron | Fe | 7439-89-6 | 11,000 | 300 | |
| Lead | Pb | 7439-92-1 | | 50 | |
| Mercury | Hg | 7439-97-6 | 11 | 0.144 | 0.146 |
| Molybdenum | Mo | 7439-98-7 | 180 | | |
| Nickel | Ni | 7440-02-0 | 730 | 13.4 | 100 |

MCL = Maximum Contaminant Level
ODEQ = Oregon Department of Environmental Quality
PRG = Preliminary Remediation Goal
µg/L = micrograms per liter
USEPA = U.S. Environmental Protection Agency

## Table 8 (Continued)
## Human Health Screening Criteria for Surface Water at Oregon Sites

[a] If laboratory cannot meet these QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL.

[b] Preliminary Remediation Goal (PRG) table, dated October 2004 and revision note dated 28 December 2004. Values are based on a single chemical.

[c] Values from Oregon DEQ Water Quality Criteria (OAR 340 Division 41, Table 20).

[d] Values represent the maximum ambient water concentration for consumption of both contaminated water and fish or other aquatic organisms.

[e] Values represent the maximum ambient water concentration for consumption of fish or other aquatic organisms.

[f] Values represent the drinking water Maximum Contaminant Level.

[g] Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

[h] Value is based on a cancer risk of $1.0 \times 10^{-6}$.

[i] Because the form of chromium has not yet been determined, the values for Chromium VI are used as a conservative measure.

## Table 9
## Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

| Analyte | ODEQ Level II Screening Level [a] | Proposed Benchmarks | | | | | | | | | | Potential Bio-accumulative Constituent? [h] | Final Ecological Screening Value Soil [i] (mg/kg) | Laboratory PQL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lowest Value for Plants/Invertebrate/ Birds/Mammals (mg/kg) | USEPA Region 5 ESL [b] (2003) (mg/kg) | USEPA Region 7 [c] (mg/kg) | | USEPA Region 8 [d] (mg/kg) | | USEPA Region 10 [e] (mg/kg) | | Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg) | | | | |
| **Metals/Inorganics** | | | | | | | | | | | | | |
| Aluminum | 50 | NVA | 50 | EPA-R4 | NVA | | 50 | EPA-R4 | 5.5 | LANL | | 50 | 20.0 |
| Chromium (total) | 0.4 | 0.4 | 26 | SSL | 26 | SSL | 26 | SSL | 2.3 | LANL | Yes | 0.4 | 1.0 |
| Copper | 50 | 5.4 | 60 | ORNL | 190 | Dutch | 60 | ORNL | 10 | LANL | Yes | 50 | 1.0 |
| Iron | 10 | NVA | 200 | EPA-R4 | NVA | | 200 | EPA-R4 | NVA | | | 10 | 15.0 |
| Lead | 16 | 0.0537 | 11 | SSL | 11 | SSL | 11 | SSL | 14 | LANL | Yes | 16 | 1.0 |
| Mercury | 0.1 | 0.1 | 0.00051 | ORNL | 0.00051 | ORNL | 0.00051 | ORNL | 0.013 | LANL | Yes | 0.1 | 0.06 |
| Molybdenum | 2 | NVA | 2 | ORNL | 2 | ORNL | 2 | ORNL | NVA | | | 2 | 0.5 |
| Nickel | 30 | 13.6 | 30 | ORNL | 30 | ORNL | 30 | ORNL | 20 | LANL | Yes | 30 | 1.0 |

Dutch = Dutch Intervention Value
EPA-R4 = USEPA Region 4
ESL = Ecological Screening Level
LANL = Los Alamos National Laboratory
mg/kg = milligrams per kilogram
NVA = No value available
ODEQ = Oregon Department of Environmental Quality
ORNL = Oak Ridge National Laboratory Ecological PRGs (Efroymson et al)
PQL = Practical Quantitation Limit
SSL = USEPA Eco Soil Screening Level
USEPA = U.S. Environmental Protection Agency

## Table 9 (Continued)
## Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

| Analyte | ODEQ Level II Screening Level [a] | Proposed Benchmarks | | | | | | | | | Potential Bio-accumulative Constituent? [h] | Final Ecological Screening Value Soil [i] (mg/kg) | Laboratory PQL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lowest Value for Plants/Invertebrates/ Birds/Mammals (mg/kg) | USEPA Region 5 ESL [b] (2003) (mg/kg) | USEPA Region 7 [c] (mg/kg) | | USEPA Region 8 [d] (mg/kg) | | USEPA Region 10 [e] (mg/kg) | | Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg) | | | | |
| **Explosive** | | | | | | | | | | | | | |
| 2,4-Dinitrotoluene | NVA | 1.28 | 1.28 | EPA-R4 | NVA | | 1.28 | EPA-R4 | 0.52 | LANL | | 1.28 | 0.040 |
| 2,6-Dinitrotoluene | NVA | 0.0328 | 0.0328 | EPA-R4 | NVA | | 0.0328 | EPA-R4 | 0.37 | LANL | | 0.0328 | 0.040 |
| 2-Amino-4,6-Dinitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 2.1 | LANL | | 2.1 | 0.040 |
| 4-Amino-2,6-Dinitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 0.73 | LANL | | 0.73 | 0.040 |
| 1,3-Dinitrobenzene | NVA | 0.655 | 0.655 | EPA-R4 | NVA | | 0.655 | EPA-R4 | 0.073 | LANL | | 0.655 | 0.020 |
| HMX | NVA | NVA | NVA | | NVA | | NVA | | 27 | LANL | | 27 | 0.050 |
| Nitrobenzene | 8 | 1.31 | 1.31 | EPA-R4 | NVA | | 1.31 | EPA-R4 | 2.2 | LANL | | 8 | 0.020 |
| RDX | NVA | NVA | NVA | | NVA | | NVA | | 7.5 | LANL | | 7.5 | 0.075 |
| 1,3,5-Trinitrobenzene | NVA | 0.376 | 0.376 | EPA-R4 | NVA | | 0.376 | EPA-R4 | 6.6 | LANL | | 0.376 | 0.020 |
| 2,4,6-Trinitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 6.4 | LANL | | 6.4 | 0.040 |
| 2-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 2.0 | LANL | | 2.0 | 0.075 |
| 3-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 2.4 | LANL | | 2.4 | 0.050 |
| 4-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 4.4 | LANL | | 4.4 | 0.040 |
| Tetryl | NVA | NVA | NVA | | NVA | | NVA | | 0.99 | LANL | | 0.99 | 0.065 |
| PETN | NVA | NVA | NVA | | NVA | | NVA | | 8600 | LANL | | 8600 | 0.50 |
| Nitroglycerin | NVA | NVA | NVA | | NVA | | NVA | | 71 | LANL | | 71 | 10 |

## Table 9 (Continued)

## Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

a Oregon Department of Environmental Quality Screening Level Values (December 2001).
b Ecological Screening Levels (ESLs), U.S.EPA Region 5, August 2003.
c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: USEPA EcoSSLs; ORNL Efroymson values; USEPA Region 4 values; other published values.
d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: USEPA SSLs; Dutch Intervention Values or ORNL Efroymson values.
e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel, 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values, **'Revisions Environmental Contaminant Toxicology.'**
g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.
h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
i Final Screening Value selected using the following hierarchy:
   1. State Value (Oregon)
   2. USEPA Region State Located In (USEPA Region 10)
   3. Lower of Talmage et al. (1999) or LANL (2005) values.

**Other References:**

U.S. Environmental Protection Agency, 2005, Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs), Office of Solid Waste and Emergency Response, website version last updated March 15, 2005: http://www.epa.gov/ecotox/ecossl.

U.S. Environmental Protection Agency, 2001, Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001: http://www.epa.gov/region4/waste/ots/ecolbul.htm.

Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints. Lockheed Martin Energy Systems, Inc. (ORNL) ES/ER/TM-162/R2.

Dutch Intervention Values:

Swartjes, F.A. 1999. Risk-based Assessment of Soil and Groundwater Quality in the Netherlands: Standards and Remediation Urgency. Risk Analysis 19(6): 1235-1249

The Netherlands Ministry of Housing, Spatial Planning and Environment's Circular on target values and intervention values for soil remediation http://www2.minvrom.nl/Docs/internationaal/S_I2000.pdf and Annex A:

Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination http://www2.minvrom.nl/Docs/internationaal/annexS_I2000.pdf were also consulted.

## Table 10
## Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

| Analyte | ODEQ Screening Level Values Freshwater [a] (mg/L) | USEPA Region 5 ESL [b] (2003) (mg/L) | USEPA Region 7 [c] (mg/L) | | USEPA Region 8 [d] (mg/L) | | USEPA Region 10 [e] (mg/L) | | Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/L) | | Potential Bio-accumulative Constituent [h] | Final Ecological Value Surface Water [i] (mg/L) | Laboratory PQL (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals/Inorganics** | | | | | | | | | | | | | |
| Aluminum | 8.70E-02 | NVA | 8.70E-02 | AWQC | 8.70E-02 | AWQC | 8.70E-02 | AWQC | 8.70E-02 | LANL | | 8.70E-02 | 6.0E-02 |
| Chromium (Cr-III) | 7.40E-02 | 4.20E-02 | 7.40E-02 | AWQC | 7.40E-02 | AWQC | 7.40E-02 | AWQC | 7.70E-02 | LANL | Yes | 7.40E-02 | 2.0E-03 |
| Copper | 9.00E-03 | 1.58E-03 | 9.00E-03 | AWQC | 9.00E-03 | AWQC | 9.00E-03 | AWQC | 5.00E-03 | LANL | Yes | 9.00E-03 | 3.0E-03 |
| Iron | 1.00E+00 | NVA | 1.00E+00 | AWQC | 1.00E+00 | AWQC | 1.00E+00 | AWQC | 1.00E+00 | LANL | | 1.00E+00 | 5.0E-02 |
| Lead | 2.50E-03 | 1.17E-03 | 2.50E-03 | AWQC | 2.50E-03 | AWQC | 2.50E-03 | AWQC | 1.20E-03 | LANL | Yes | 2.50E-03 | 1.0E-03 |
| Mercury | 7.70E-04 | 1.30E-06 | 7.70E-01 | AWQC | 7.70E-01 | AWQC | 7.70E-01 | AWQC | 7.70E-04 | LANL | Yes | 7.70E-04 | 3.0E-04 |
| Molybdenum | 3.70E-01 | NVA | 3.70E-01 | EPRG | 3.70E-01 | Tier II | 3.70E-01 | EPRG | NVA | | | 3.70E-01 | 5.0E-03 |
| Nickel | 5.20E-02 | 2.89E-02 | 5.20E-02 | AWQC | 5.20E-02 | AWQC | 5.20E-02 | AWQC | 2.80E-02 | LANL | Yes | 5.20E-02 | 1.0E-03 |

AWQC = National Ambient Water Quality Criteria
CCME = Canadian Council of Ministers of the Environment, Environmental Quality Guideline
EPRG = Oak Ridge National Laboratory Ecological PRG
LANL = Los Alamos National Laboratory
mg/L = milligrams per liter
NVA = No Value Available
ODEQ = Oregon Department of Environmental Quality
PQL = Practical Quantitation Limit
SSL = Ecological Screening Level
Tier II = Great Lakes Tier II Water Quality Criteria
TAL = Talmage et al (1999)
USEPA = U.S. Environmental Protection Agency

## Table 10 (Continued)

## Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

| Analyte | ODEQ Screening Level Values Freshwater [a] (mg/L) | USEPA Region 5 ESL [b] (mg/L) | USEPA Region 7 [c] (mg/L) | | USEPA Region 8 [d] (mg/L) | | USEPA Region 10 [e] (mg/L) | | Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/L) | | Potential Bio-accumulative Constituent? [h] | Final Ecological Value Surface Water [i] (mg/L) | Laboratory PQL (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Explosives** | | | | | | | | | | | | | |
| RDX | NVA | NVA | NVA | | NVA | | NVA | | 1.90E-01 | TAL | | 1.90E-01 | 8.0E-04 |
| HMX | NVA | NVA | NVA | | NVA | | NVA | | 3.30E-01 | TAL | | 3.30E-01 | 4.0E-04 |
| 1,3-Dinitrobenzene | NVA | 2.20E-02 | NVA | | NVA | | NVA | | 2.00E-02 | TAL | | 2.00E-02 | 2.0E-04 |
| 1,3,5-Trinitrobenzene | NVA | NVA | NVA | | NVA | | NVA | | 1.00E-02 | TAL | | 1.00E-02 | 2.0E-04 |
| 2-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 8.00E+00 | LANL | | 8.00E+00 | 4.0E-04 |
| 3-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 9.60E+00 | LANL | | 9.60E+00 | 8.0E-04 |
| 4-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 1.70E+01 | LANL | | 1.70E+01 | 4.0E-04 |
| 2,4-Dinitrotoluene | 2.30E-01 | 4.40E-02 | NVA | | NVA | | NVA | | 3.10E-01 | LANL | | 2.30E-01 | 3.0E-04 |
| 2,6-Dinitrotoluene | 2.30E-01 | 8.10E-02 | NVA | | NVA | | NVA | | 6.00E-02 | LANL | | 2.30E-01 | 3.0E-04 |
| 2-Amino,4,6-Dinitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 2.00E-02 | TAL | | 2.00E-02 | 2.0E-04 |
| 4-Amino-2,6-Dinitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 8.60E+00 | LANL | | 8.60E+00 | 2.0E-04 |
| 2,4,6-Trinitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 9.00E-02 | TAL | | 9.00E-02 | 3.0E-04 |
| Nitrobenzene | 5.40E-01 | 2.20E-01 | NVA | | NVA | | NVA | | 2.70E-01 | LANL | | 5.40E-01 | 2.0E-04 |
| Tetryl | NVA | NVA | NVA | | NVA | | NVA | | 5.80E+00 | LANL | | 5.80E+00 | 7.5E-04 |
| Nitroglycerin | NVA | NVA | NVA | | NVA | | NVA | | 4.30E+02 | LANL | | 4.30E+02 | 5.0E-02 |
| PETN | NVA | NVA | NVA | | NVA | | NVA | | 2.60E+04 | LANL | | 2.60E+04 | 1.3E-03 |

## Table 10 (Continued)
## Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

a Oregon Department of Environmental Quality Screening Level Values (December 2001).
b Ecological Screening Levels (ESLs), U.S.EPA Region 5, August 2003.
c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: National Ambient Water Quality Criteria; ORNL Efroymson values (ORNL, 1977).
d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: National Ambient Water Quality Criteria; Great Lakes Tier II Values; Canadian Environmental Quality Guidelines (CCME, 2003) or ORNL Efroymson values (ORNL, 1977).
e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values. Revisions Environmental Contaminant Toxicology.'
g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005**.**
h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
i Final Screening Value selected using the following hierarchy:
   1. State Value (Oregon)
   2. USEPA Region State Located In (USEPA Region 10)
   3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values.

**Other References:**

Efroymson, R.A., et al., 1997, Preliminary Remediation Goals (EPRGs), ORNL, ES/ER/TM-162/R2,
Canadian Environmental Quality Guidelines (for Freshwater) Summary Table, CCME, December 2003.
Great Lakes Tier II Values from Suter, G.W. and C.L. Tsao, 1996, Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Rev, ES/ER/TM-96/R2.
National AWQC from USEPA Water Quality Criteria Web Site: http://www.epa.gov/waterscience/criteria/wqcriteria.html.

## Table 11
## Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

| Analyte | ODEQ Screening Level Values Freshwater [a] (mg/L) | USEPA Region 5 ESL [b] (mg/kg) | USEPA Region 7 [c] (mg/kg) | | USEPA Region 8 [d] (mg/kg) | | USEPA Region 10 [e] (mg/kg) | | Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg) | | Potential Bio-accumulative Constituent? [h] | Final Ecological Screening Value Sediment [i] (mg/kg) | Laboratory PQL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals/Inorganics** | | | | | | | | | | | | | |
| Aluminum | NVA | NVA | NVA | | NVA | | NVA | | 2.80E+02 | LANL | | 2.80E+02 | 20.0 |
| Chromium | 3.70E+01 | 4.34E+01 | 4.34E+01 | MAC | 4.34E+01 | MAC | 4.34E+01 | MAC | 5.60E+01 | LANL | Yes | 3.70E+01 | 1.0 |
| Copper | 1.00E+01 | 3.16E+01 | 3.16E+01 | MAC | 3.16E+01 | MAC | 3.16E+01 | MAC | 1.70E+01 | LANL | Yes | 1.00E+01 | 1.0 |
| Iron | NVA | NVA | NVA | | NVA | | NVA | | 2.00E+01 | LANL | | 2.00E+01 | 15.0 |
| Lead | 3.50E+01 | 3.58E+01 | 3.58E+01 | MAC | 3.58E+01 | MAC | 3.58E+01 | MAC | 2.70E+01 | LANL | Yes | 3.50E+01 | 1.0 |
| Mercury | 2.00E-01 | 1.74E-01 | 1.80E-01 | MAC | 1.80E-01 | MAC | 1.80E-01 | MAC | 1.80E-02 | LANL | Yes | 2.00E-01 | 0.06 |
| Molybdenum | NVA | NVA | NVA | | NVA | | NVA | | NVA | | | NVA | 0.5 |
| Nickel | 1.80E+01 | 2.27E+01 | 2.27E+01 | MAC | 2.27E+01 | MAC | 2.27E+01 | MAC | 3.90E+01 | LANL | Yes | 1.80E+01 | 1.0 |

EPRG = Oak Ridge National Laboratory Ecological PRG
ESL = Ecological Screening Level
ISQG = Canadian Interim Sediment Quality Guideline
LANL = Los Alamos National Laboratory
MAC = MacDonald Consensus Value
mg/kg = milligrams per kilogram
NVA = No Value Available
ODEQ = Oregon Department of Environmental Quality
PQL = Practical Quantitation Limit
TAL = Talmage et al (1999)
USEPA = U.S. Environmental Protection Agency

## Table 11 (Continued)

## Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

| Analyte | ODEQ Screening Level Values Freshwater [a] (mg/L) | USEPA Region 5 Ecological Screening Levels [b] (mg/kg) | USEPA Region 7 [c] (mg/kg) | | USEPA Region 8 [d] (mg/kg) | | USEPA Region 10 [e] (mg/kg) | | Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg) | | Potential Bio-accumulative Constituent? [h] | Final Ecological Screening Value Sediment [i] (mg/kg) | Laboratory PQL (mg/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Explosives** | | | | | | | | | | | | | |
| RDX | NVA | NVA | NVA | | NVA | | NVA | | 1.30E-01 | TAL | | 1.30E-01 | 0.075 |
| HMX | NVA | NVA | NVA | | NVA | | NVA | | 4.70E-02 | TAL | | 4.70E-02 | 0.050 |
| 1,3,5-Trinitrobenzene | NVA | NVA | NVA | | NVA | | NVA | | 2.40E-02 | TAL | | 2.40E-02 | 0.020 |
| 1,3-Dinitrobenzene | NVA | 8.61E-03 | NVA | | NVA | | NVA | | 6.70E-02 | TAL | | 6.70E-02 | 0.020 |
| 2,4-Dinitrotoluene | NVA | 1.44E-03 | NVA | | NVA | | NVA | | 2.90E-01 | LANL | | 2.90E-01 | 0.040 |
| 2,6-Dinitrotoluene | NVA | 3.98E-03 | NVA | | NVA | | NVA | | 1.90E+00 | LANL | | 1.90E+00 | 0.040 |
| 2,4,6-TNT | NVA | NVA | NVA | | NVA | | NVA | | 9.20E-01 | TAL | | 9.20E-01 | 0.040 |
| 2-Amino-4,6,-Dintrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 7.00E+00 | LANL | | 7.00E+00 | 0.040 |
| 4-Amino-2,6,-Dintrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 1.90E+00 | LANL | | 1.90E+00 | 0.040 |
| 2-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 5.60E+00 | LANL | | 5.60E+00 | 0.075 |
| 3-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 4.90E+00 | LANL | | 4.90E+00 | 0.050 |
| 4-Nitrotoluene | NVA | NVA | NVA | | NVA | | NVA | | 1.00E+01 | LANL | | 1.00E+01 | 0.040 |
| Nitrobenzene | NVA | 1.45E-01 | NVA | | NVA | | NVA | | 3.20E+01 | LANL | | 3.20E+01 | 0.020 |
| Tetryl | NVA | NVA | NVA | | NVA | | NVA | | 1.00E+02 | LANL | | 1.00E+02 | 0.065 |
| Nitroglycerin | NVA | NVA | NVA | | NVA | | NVA | | 1.70E+03 | LANL | | 1.70E+03 | 10 |
| PETN | NVA | NVA | NVA | | NVA | | NVA | | 1.20E+05 | LANL | | 1.20E+05 | 0.50 |

## Table 11 (Continued)

## Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern at Oregon Sites

a Oregon Department of Environmental Quality Screening Level Values (December 2001).
b Ecological Screening Levels (ESLs), U.S.EPA Region 5, August 2003.
c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); ORNL Efroymson values (ORNL, 1977).
d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); Canadian ISQG values (CCME, 2003) or ORNL Efroymson values (ORNL, 1977).
e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values, Revisions Environmental Contaminant Toxicology.'
g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.
h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
i Final Screening Value selected using the following hierarchy:
1. State Value (Oregon)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values; the TAL screening values assume 10% organic carbon in the sediment.

**Other References:**

Efroymson, R.A., et al., 1997, Preliminary Remediation Goals (EPRGs), ORNL, ES/ER/TM-162/R2,
Canadian Interim Sediment Quality Guidelines (ISQGs) Summary Table, CCME, December 2003.
MacDonald, D.D, C.G. Ingersoll and T.A. Berger, 2000, Development and Evaluation of Consensus-Based Sediment Quality Criteria for Freshwater Ecosystems, Archives of Environmental Contamination and Toxicology 39:20-31

# APPENDIX A

# CONCEPTUAL SITE MODEL

# Overview

A site-specific CSM summarizes available site information and identifies relationships between exposure pathways and associated receptors. A CSM is used to determine the data types necessary to describe site conditions and quantify receptor exposure, and discusses the following information:

- Current site conditions and future land use;
- Potential contaminant sources (e.g., lead projectiles in an impact berm);
- Affected media;
- Governing fate and transport processes (e.g., surface water runoff and/or groundwater migration);
- Exposure media (i.e., media through which receptors could contact site-related contamination);
- Routes of exposure (e.g., inhalation, incidental ingestion, and dermal contact); and
- Potential human and/or representative ecological receptors at the exposure point. Receptors likely to be exposed to site contaminants are identified based on current and expected future land uses.

The CSM is evaluated for completeness and further developed as needed through TPP meetings. Based on a review of documents and interviews, the following AOCs have been identified within the Boardman AFR:

- Target No. 1,
- Target No. 2,
- Carty Reservoir Bomb Target,
- Range Complex No. 1,
- Demolition Area No. 2, and
- Impact Area.

Because of dissimilar historical use, site conditions, or prior investigations, a CSM is developed for each AOC. MEC and MC are analyzed individually within the CSM.

MEC was reported as recently as Spring of this year (2006) at Target No. 2 AOC and Demolition Area No. 2. At the Target Area No. 2 AOC, reports were made following the discovery of remnants of six AN-M57 GP practice bombs with spotting charges (capable of detonating) at a local recycler. These 6 bombs and remnants of 15 additional bombs recovered from the Target No. 2 AOC were detonated by a Navy EOD team at the nearby Navy Bombing Range. The bombs remnants had been gathered from agricultural fields and placed in a pile by the agricultural workers.

At the Demolition Area No. 2 AOC, the property lease holder reported to the Oregon State Police the discovery of an M83 butterfly bomb and various fuzes. These MEC were destroyed by the Oregon State Police bomb unit in June 2006.

**Note: Because this text is taken from the Final TPP Memo, all figures and tables referenced in this appendix refer to figures and tables contained in that document.**

# Conceptual Site Model – Target No. 1 AOC

The Target No. 1 AOC consists of a single target configured with concentric circles with radii of 100, 200, and 300 ft, which was standard range layout for the time of use. The target name is consistent with the ASR Supplement. The southern one-third of the AOC overlaps with Carty Reservoir Target AOC. Figure 1 shows the general location of the Target No.1 AOC. Figure 2 shows a more detailed view of the AOC using an aerial photo overlay.

**Current and Future Land Use**

- The Target No. 1 AOC is located on BAIC, Inc. and PGE property adjacent to Carty Reservoir. Approximately 40 percent of the target drop area safety zone is flooded by Carty Reservoir. The safety zone is an area surrounding a target where the potential for bomb impacts exists.
- The terrain is flat with a gradual slope toward the shoreline of Carty Reservoir.
- The area northeast of the safety zone has been extensively reworked during power plant construction and the building of an earthen dam for Carty Reservoir. The property to the north and west of the target is now used for irrigated farming.
- One groundwater monitoring well installed by the PGE Power Generating Station is located within the AOC. A water supply well is located approximately 650 ft northeast of the outer boundary of the AOC.
- Carty Reservoir is the nearest surface water body to the AOC. Sixmile Canyon Creek flows through the northeast corner of the target.
- The source of water for Carty Reservoir is via pump from the Columbia River. The reservoir water is used for cooling at the PGE Power Generating Station.
- Future land use is expected to remain the same.

**Former Range Use**

- The target was used between 1948 and 1960 and is thought to be a replacement target for the Carty Reservoir Target, which was used between 1942 and 1945.
- It is unclear of the extent of use of this target. During the ASR field visit, no MEC or munitions debris were identified within the target footprint or safety zone. The contractor that conducted the INPR for the USACE identified several small items and according to the ASR, “the description matched that of a 31-lb practice bomb.” This munitions debris is thought to be from a MK-76 25-lb practice bomb.

**Potential Contaminant Sources**

- The ASR Supplement identified the likely range munitions used at this AOC as being AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs. These practice bombs contained black powder and a spotting charge.

## MEC Evaluation

### Types of MEC

- No MEC or munitions debris were identified during the ASR site visit in 1997. However, the contractor that conducted the INPR for the USACE identified several small items and according to the ASR, "the description matched that of a 31-lb practice bomb." This munitions debris is thought to be from a MK-76 25-lb practice bomb.
- The potential for UXO to be present at this AOC is low, based on the lack of MEC or munitions debris located in the area.

### Surface Exposure Pathway

- The potential route of human exposure (PGE and agricultural workers) to MEC or munitions debris includes direct contact by vehicles, agricultural tilling, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

### Subsurface Exposure Pathway

- The potential routes of human exposure (PGE and agricultural workers) to MEC or munitions debris would be by intrusive drilling or digging activities (including agricultural tilling) or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

### MEC Evaluation/Investigation Needed

- Visual field reconnaissance of the target area, particularly near the location of the target, will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer. Four transects will be completed as shown on Figure 2. Transects will be completed on non-tilled ground as the crop circles will likely be planted. Property owners prefer not to have activity on the fields when planted.

## MC Evaluation

### Types of MC

- Munitions debris from practice bombs consists primarily of light gauge sheet metal, cast iron, or lead. Iron is the primary constituent of sheet metal and cast iron. Other metals that may be present in sheet metal and cast iron include aluminum, chromium, copper, lead, manganese, molybdenum, and nickel.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a blank shotgun shell with black powder. Black powder consists of potassium nitrate, sulfur, and charcoal. A red or white phosphorous pyrotechnic charge may also have been used.

- Although not documented, other bomb munitions may have been used on this range that contained other explosives including nitroglycerin. This is based on munitions used at nearby Target No. 2 and INPR Site No. 1.

**Overview of Pathways**

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential surface water, sediment, groundwater, or air contamination.
- Surface Water: Carty Reservoir may be potentially affected, although the MC from munitions used at this AOC may not pose a significant risk.
- Sediment: Sediment in Carty Reservoir may be potentially affected by surface water runoff from impacted soil areas or from MC in the soil present prior to inundation when Carty Reservoir was created. The migration of metals within the sediments is relatively low because of the low mobility of the metals in water and the arid climate.
- Groundwater: Groundwater is a potentially affected media since the creation of Carty Reservoir has resulted in a groundwater mound beneath the reservoir. Migration of MC directly to the groundwater via surface water infiltration is considered to be possible. However, the constituents of the MC may not pose a significant risk.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Boardman AFR include soil, surface water, sediment, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figure 3 illustrates the CSM for the Target No.1 AOC and potential pathways of MC contamination.

**Soil Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

**Receptors**

- Workers (PGE and agricultural).
- Wildlife.

### MC Soil Evaluation/Investigation Needed

- One soil sample will be collected from the Target No. 1 AOC at the location of MEC or munitions debris. If no MEC or munitions debris is located a soil sample will be collected near the reported target center. The sample will be collected from one location and analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). While only black powder explosives and red or white phosphorous signals were documented as being used at this AOC, ODEQ requested that one sample be analyzed for explosives (including nitroglycerin) to demonstrate that no explosives, other than black powder, were used at the target. The select metal list was developed from metals that are related to either munitions firing or components of bullets, projectiles, or metal casing. Metals contained in munitions firing include aluminum, lead, magnesium, mercury, and red or white phosphorus, and trace amounts of strontium. Aluminum, lead, mercury, and red or white phosphorous were known to have been used at the former Boardman AFR. Strontium which is present in very small quantities in some bullet tracers compounds, is not expected to be in quantities that would be significant and no analysis will be completed. Red and white phosphorus, while used in incendiary bombs and as signal charges are not hazardous in the environment once they have been expended and phosphorous is a common component of fertilizers. Because of this, no analysis will be completed for red or white phosphorus. Magnesium is a component of some incendiary bombs. However, magnesium is an essential nutrient for humans and wildlife and is not hazardous except in very high quantities. Metals contained in sheet metal and cast iron consist primarily of iron. Other metals that may be present include hazardous substances chromium, copper, and nickel, and non-hazardous substances aluminum, manganese, and molybdenum. Based on the above discussion the select metals list for the former Boardman AFR includes aluminum, chromium, copper, iron, lead, mercury, molybdenum, and nickel. In addition, the manganese will also be included as it is useful in evaluating naturally occurring concentrations of lead in soil.

## Surface Water Exposure Pathway

### Exposure Routes

- The potential routes of human exposure to contaminated surface water include incidental ingestion of, dermal contact with, and inhalation of surface water.
- The potential routes of wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion of and direct contact with surface water present at or near the AOC.

### Receptors

- Workers (PGE and agricultural).
- Wildlife.

### MC Surface Water Evaluation/Investigation Needed

- No water samples will be collected from Carty Reservoir from this AOC. One surface water sample was collected from Carty Reservoir during the PA/SI and analyzed for perchlorate. No detectable concentrations of perchlorate were found in the surface water sample collected from Carty Reservoir. The samples were not analyzed for metals or explosives. However, water quality (including metals) of Carty Reservoir is monitored monthly by PGE. Results from the monitoring data do not indicate metal concentrations that are above PGE operating permit conditions. The makeup water for Carty Reservoir is pumped directly from the Columbia River. Lack of MEC and munitions debris resulting from use of Target No.1 suggest that the likelihood of MC impacts to surface water is low. Only black powder explosives and red or white phosphorous signals were known to have been used and the metals contained in the bomb casings consisted of either sheet metal, iron, or lead.

## Sediment Exposure Pathway

### Exposure Routes

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

### Receptors

- Workers (PGE and agricultural).
- Wildlife.

### MC Sediment Evaluation/Investigation Needed

- No sediment sample will be collected from Carty Reservoir for this AOC. A sediment sample will be collected as part of the Carty Reservoir Bomb Target evaluation.

## Groundwater Exposure Pathway

### Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

### Receptors

- Workers (PGE and agricultural workers).

### MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for the Target No. 1 AOC. The PA/SI addressed the groundwater pathway for the Boardman AFR. Two groundwater samples were collected from the Target No. 1 AOC vicinity. Results for both samples show concentrations of explosives and perchlorate were below analytical reporting limits. Metals analyses are included in the PGE groundwater monitoring program and are available for use in this SI.

## Air Exposure Pathway

### Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

### Receptors

- Workers (PGE and agricultural).
- Wildlife.

### MC Air Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be us used in the evaluation of the air pathway. The 2004 USEPA Region 9 Preliminary Remediation Goals (PRGs) incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

# Conceptual Site Model – Target No. 2 AOC

The Target No. 2 AOC consists of a single target configured with concentric circles in 200- and 400-yard radii. In addition, there were three scoring towers 120 degrees apart near the target. This range was previously assessed during the PA/SI. The target name is consistent with the ASR Supplement. Figure 1 shows the general location of the Target No. 2 AOC. Figure 4 shows the configuration and current land uses in the vicinity of the target.

**Current and Future Land Use**

- The Target No. 2 AOC is located on agricultural property owned by Three-mile Canyon Farms. The area is currently used for irrigated farming.
- No groundwater wells are located within the boundary of Target No 2 AOC.
- The nearest surface water is Sixmile Canyon Creek located approximately 1,800 ft west of the southwest boundary of the AOC.
- The future land use is not expected to change from the present use.

**Former Range Use**

- The target was used between 1942 and 1960 for practice bombing.

**Potential Contaminant Sources**

- Likely range munitions used at this AOC are listed as AN-M50 incendiary bombs, M38A2 practice bombs and Mk 6 2.25-inch practice rockets. Recent MEC finds at Target No. 2 included AN-M57 GP practice bomb. Munitions debris from AN-47, and Mk-15 Mod 3 100lb practice bombs has also been reported.
- The AN-M50 incendiary bombs were cased in a magnesium shell and contained a fuze and thermite. Thermite consists of a mixture of powdered aluminum metal and ferric oxide.
- The M38A2 practice bombs were a sand-filled, sheet metal cased, 100-lb practice bomb and contained a black powder spotting charge.
- The Mk 6 2.25-inch practice rockets were constructed from sheet metal. The propellant used in the rocket was Ballistite, which consists of nitrocellulose and nitroglycerin. There was no spotting charge with the Mk 6 rockets. The use of the Mk 6 practice rocket is thought to be limited at this target as evidenced by the scarcity of spent rocket motors..
- The reported AN-M57 G.P practice bombs contained a spotting charge only. The high explosive version of this bomb contains Amatol or TNT.
- The AN-47 practice bombs are inert.

**MEC Evaluation**

**Types of MEC**

- The types of munitions used at the Target No. 2 AOC are listed above. Debris from these munitions was observed during the ASR site visit in 1997, during the 2004 PA/SI investigation, and in 2006 during a Navy EOD recovery. In addition, four 75-mm HEAT,

M66 projectiles were reported to have been destroyed in the target area by Army EOD in 1987. The ASR indicated that the 75-mm projectiles were likely brought to the site for disposal and not used at the site.

- MEC was reported from this AOC as recently as March 2006.
- The potential for MEC to be present at this AOC is high. This is based on prior use, historical documents, interviews, identification of munitions debris, and results of the ASR site visit.

**Surface Exposure Pathway**

- The potential route of human exposure (agricultural workers) to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

**Subsurface Exposure Pathway**

- The potential routes of human exposure (agricultural workers) to MEC or munitions debris would be by intrusive drilling or digging activities, agricultural tilling, or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

**MEC Evaluation/Investigation Needed**

- No MEC reconnaissance will be conducted at this AOC. The potential for MEC is indicated by previous and recent finds.

**<u>MC Evaluation</u>**

**Types of MC**

- MC from practice bombs consists primarily of light gauge sheet metal and magnesium metal. Iron is the primary constituent of sheet metal. The incendiary bomb casings are constructed from magnesium. Other metals that may be present in sheet metal include iron include aluminum, chromium, copper, lead, manganese, molybdenum, and nickel.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder, which contains potassium nitrate, sulfur, and charcoal, and thermite, which contains iron oxide, aluminum, and sulfur. In addition, the AN-M57 GP bombs may have contained either Amatol (TNT and ammonium nitrate) or TNT.
- The propellant used in the Mk 6 2.25-inch practice rockets contained nitrocellulose and nitroglycerin.

**Overview of Pathways**

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: Sixmile Canyon Creek may be potentially affected by runoff from the target area.
- Sediment: Sediment in Sixmile Canyon Creek may be potentially affected by surface water runoff from impacted soil areas. However, Sixmile Canyon Creek is located approximately 1,800 ft west of the AOC boundary (Figure 4) and the target itself was located approximately 6,100 ft east. The potential for metals migration within the sediments is relatively low because of the low mobility of the metals in water and the arid climate.
- Groundwater: Groundwater is a potentially affected media. There are potential receptors downgradient and outside of the FUDS boundary and the pathway is considered potentially complete While no groundwater depths are available for the Target No. 2 area, thin perched groundwater layers above the basalt bedrock are possible, particularly with the irrigated farming that is occurring in the area. There is the potential for MC migration to groundwater. No groundwater drinking water wells are within the AOC.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Boardman AFR include soil, surface water, sediment, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figure 3 illustrates the CSM for the Target No. 2 AOC and potential pathways of MC contamination.

**Soil Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

**Receptors**

- Workers (agricultural).
- Wildlife.

### MC Soil Evaluation/Investigation Needed

Two soil samples will be collected from the Target No. 2 AOC. Samples will be located in untilled areas between crop circles. Samples will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). The basis for this metals list is provided in "MC Soil Evaluation/Investigation Needed" for Target No. AOC. Soil samples were collected from near the Target No. 2 AOC during the PA/SI. However, the samples were not from within the AOC. Samples were analyzed for metals and perchlorate. There were no metals reported that significantly exceeded background concentrations. There were no detections of perchlorate in the soil samples collected within this AOC. Black powder, nitrocellulose, nitroglycerin, and TNT were the primary explosives used.

## Surface Water Exposure Pathway

### Exposure Routes

- The potential routes of human exposure to contaminated surface water include incidental ingestion of, dermal contact with, and inhalation of surface water.
- The potential routes of wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion of and direct contact with surface water present at or near the AOC.
- There are no surface water bodies or streams within the AOC.

### Receptors

- Workers (agricultural).
- Wildlife.

### MC Surface Water Evaluation/Investigation Needed

- Surface water sampling for metals is not warranted. The overland travel distance for water is at least 1,800 ft and it is doubtful that overland flow from the AOC to the stream would occur in this arid environment and silty/sandy soil type.

## Sediment Exposure Pathway

### Exposure Routes

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

### Receptors

- Workers (agricultural).
- Wildlife.

### MC Sediment Evaluation/Investigation Needed

- No sediment samples will be collected from this AOC. A sediment sample was collected from a point near the AOC during the PA/SI. The sample was analyzed for metals only. Analytical results indicate that there were no metals reported that significantly exceeded background concentrations. In addition, the overland travel distance for soil and water is at least 1,800 ft and it is doubtful that overland flow from the AOC to the stream would occur in this arid environment and silty/sandy soil type.

## Groundwater Exposure Pathway

### Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

### Receptors

- Workers (agricultural).

### MC Groundwater Evaluation/Investigation Needed

- No groundwater samples are planned for the Target No. 2 AOC. The PA/SI addressed the groundwater pathway for the Boardman AFR. Groundwater samples were collected both up and downgradient of this AOC. Sample results show that no explosive compounds were detected. However, perchlorate was detected in both up and downgradient samples. Metals were not included in the PA/SI analytical suite. However, the types of metals contained in munitions used at Target No. 2 have a low solubility of the metals associated with munitions used at this AOC, the expected depth to groundwater (>40 ft), the thin occurrence of groundwater (few feet thick) would make it unlikely that impacts from metals would be noted. Therefore, metals are not considered a contaminant of concern for groundwater.

## Air Exposure Pathway

### Exposure Routes

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

### Receptors

- Workers (agricultural).
- Wildlife.

### MC Air Evaluation/Investigation Needed

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be us used in the evaluation of the air pathway. The 2004 USEPA Region 9 PRGs incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

# Conceptual Site Model – Carty Reservoir Bomb Target AOC

The Carty Reservoir Bomb Target AOC consists of a single target configured with concentric circles (spacing not identified). This target is located on the western side of Carty Reservoir. Prior to the ASR, this target was not identified in any historical documents. It is thought that this target was the original target at the range. The ASR team believed that the original Target No. 1 was located in this area and then was relocated approximately 1 mile north in approximately 1946. The Carty Reservoir Bomb Target was located in a depression which made scoring difficult. The new target No. 1 location is much flatter and at a higher elevation. This range was assessed during the PA/SI. The target name is consistent with the ASR Supplement. Figure 1 shows the general location of Carty Reservoir Bomb Target AOC. Figure 5 shows a more detailed view of the AOC. The configuration and current land uses in the vicinity of the target. This AOC overlaps Target No. 1 AOC.

**Current and Future Land Use**

- The Carty Reservoir Bomb Target AOC is located on PGE and BAIC, Inc (leased by Three-mile Canyon Farms) property. The western half of the AOC is currently used for irrigated farming and the southern and eastern portion is native vegetation consisting of grasses. There is evidence of one time livestock grazing in the area.
- The terrain slopes toward Carty Reservoir.
- No groundwater wells are located within the boundary of this AOC.
- Carty Reservoir covers approximately 30 percent of the area.

**Former Range Use**

- The target is thought to have been used between 1942 and 1944 for practice bombing; however, the actual date of use is not known.

**Potential Contaminant Sources**

- Likely range munitions used at this AOC was the Mk 23, and M38A2 practice bombs and the M75 and M84 target marker bomb.
- The Mk 23 practice bombs were constructed from cast iron and contained black powder and a red phosphorus pyrotechnic signal charge.
- The M38A2 practice bombs were a sand-filled sheet metal cased 100-lb practice bomb and contained a black powder spotting charge.
- The M75 and M84 target marker bombs were cased in sheet metal and contained a burster and fuze and a charge of red iron ore (hematite) that was used as a marker.

**MEC Evaluation**

**Types of MEC**

- The types of munitions used at the Carty Reservoir Bomb Target AOC are listed above. Large amounts of debris from these munitions were observed during the ASR site visit in 1997. This AOC was the only area where the ASR team observed relatively intact, fuzed, and suspected live munitions (M75/M84 practice bomb) during the 1997 site visit.

- The potential for UXO to be present at this AOC is high. This is based on prior use, historical documents, interviews, and results of the ASR site visit.

**Surface Exposure Pathway**

- The potential route of human exposure (PGE and agricultural workers) to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

**Subsurface Exposure Pathway**

- The potential routes of human exposure (primarily agricultural workers) to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

**MEC Evaluation/Investigation Needed**

- No visual field reconnaissance of the target area will be conducted with the objective to locate MEC, however, a visual reconnaissance will be completed to clear soil sample locations. The reconnaissance will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer or metal detector.

**<u>MC Evaluation</u>**

**Types of MC**

- Munitions debris from practice bombs consists primarily of light gauge sheet metal and cast iron. Iron is the primary constituent of sheet metal and cast iron. Other metals that may be present in sheet metal include iron include aluminum, chromium, copper, lead, manganese, molybdenum, and nickel.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder that contains potassium nitrate, sulfur, and charcoal. The M75/M84 Target ID bomb also used a booster charge containing Tetryl.

**Overview of Pathways**

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: Carty Reservoir may be potentially affected by MC contained in soils prior to water inundation of portions of the target area.
- Sediment: Sediment in Carty Reservoir may be potentially affected by MC in soils prior to water inundation of portions of the target area.

- Groundwater: Groundwater is a potentially affected media since the creation of Carty Reservoir has resulted in a groundwater mound beneath the reservoir. Migration of MC directly to the groundwater via surface water infiltration is considered to be possible. However, the constituents of the MC may not pose a significant risk.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Boardman AFR include soil, surface water, sediment, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figure 3 illustrates the CSM for the Carty Reservoir Bomb Target AOC and potential pathways of MC contamination.

**Soil Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

**Receptors**

- Workers (PGE and agricultural).
- Wildlife.

**MC Soil Evaluation/Investigation Needed**

- Two soil samples will be collected from for the Carty Reservoir Bomb Target AOC. Soil samples will be located near the target center where a high density of munitions debris has been reported. Samples will be analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). The basis for this metals list is provided in "MC Soil Evaluation/Investigation Needed" for Target No. AOC. The primary explosive used in the practice bombs was black powder explosives and red or white phosphorous signals were documented as being used at this AOC. In addition the M75/M84 Target ID bomb also used a booster containing the explosive Tetryl. The two samples will also be analyzed for explosives (including nitroglycerin).

**Surface Water Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated surface water include incidental ingestion of, dermal contact with, and inhalation of surface water.

- The potential routes of wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion of and direct contact with surface water present at or near the AOC.

**Receptors**

- Workers (PGE and agricultural).
- Wildlife.

**MC Surface Water Evaluation/Investigation Needed**

- No surface water samples will be collected from Carty Reservoir. A water sample was collected from Carty Reservoir during the PA/SI in 2004 and analyzed for perchlorate only. Perchlorate was not detected in the surface water sample.
- Sampling for metals and explosives is not required. Water samples from the reservoir are analyzed monthly for metals and other water quality parameters. The only documented explosive used at this target was black powder, whose constituents are nonhazardous.

**Sediment Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

**Receptors**

- Workers (PGE and agricultural).
- Wildlife.

**MC Sediment Evaluation/Investigation Needed**

- One sediment sample will be collected from Carty Reservoir and analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). The basis for this metals list is provided in "MC Soil Evaluation/Investigation Needed" for Target No. AOC. While only black powder explosives and red or white phosphorous signals were documented as being used at this AOC, ODEQ requested that one sample be analyzed for explosives (including nitroglycerin) to demonstrate that no explosives, other than black powder, were used at the target. Sampling for perchlorate is not required as no perchlorate was detected in the surface water sample collected during the PA/SI and perchlorate containing compounds were not part of the munitions used at this AOC.

**Groundwater Exposure Pathway**

**Exposure Routes**

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.

- Direct exposure to wildlife is not a concern.

**Receptors**

- Workers (PGE and agricultural).

**MC Groundwater Evaluation/Investigation Needed**

- No additional groundwater samples will be collected from the Carty Reservoir Bomb Target AOC. The PA/SI addressed the groundwater pathway for the Boardman AFR. Groundwater samples were collected both up and downgradient of this AOC. Sample results show that no explosive compounds were detected. Perchlorate was detected in an upgradient sample, and in downgradient samples off the FUDS property boundary. Metals were not included in the PA/SI analytical suite. However, metals are routinely analyzed for in groundwater samples collected from nearby downgradient PGE monitoring wells. These results are available for use in this SI.

**Air Exposure Pathway**

**Exposure Routes**

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

**Receptors**

- Workers (agricultural).
- Wildlife.

**MC Air Evaluation/Investigation Needed**

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be us used in the evaluation of the air pathway. The USEPA 2004 Region 9 PRGs incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

# Conceptual Site Model – Range Complex No. 1 AOC

The Range Complex No. 1 AOC consists of a three areas: INPR Site No. 1, the Demolition Area, and the Turret Gunnery Training Range. Figure 1 shows the general location of the Range No. 1 Complex AOC. Figures 6 through 8 show details of the AOC.

The INPR Site No. 1 is a bomb target that was in use between 1946 and 1960. The ASR Supplement indicated that the target was configured with concentric circles of 100, 200, and 300 ft. However, analysis of recent aerial photos shows faint concentric circles at 75, 500, and 1000 ft (see Figure 6). A portion of the safety zone for this site lies within the non-FUDS property currently used by the Navy Bombing Range. Soil samples were collected from INPR Site No.1 during the PA/SI.

The Demolition Area was used for the demolition of munitions between 1952 and 1960 and may be the area used by the Umatilla Ordinance Deport for demolition of unserviceable munitions. The area consists of two rows, approximately 200 ft apart. Each row has 20 pits (craters) spaced 50 ft apart. Munitions debris is embedded in the crater walls and scattered in a wide radius from the craters.

The Turret Gunnery Training Range was used to train B-36 Bomber gunners to fire at target drones that flew across their front. The turret gun firing points were located on current Navy Bombing Range Property and are not FUDS property. Only the downrange portion of the range is within the Boardman AFR FUDS. A portion of the safety zone is outside of the FUDS boundary on the active Navy bombing range. The range name is consistent with the ASR Supplement.

**Current and Future Land Use**

- Range Complex No.1 is shown on Figures 6 through 8. Much of the northern and eastern portions of the range complex are currently being used for irrigated crops. The southern portion of the range is used for the Boeing Antennae Test Range, and wildlife conservation area managed by The Nature Conservancy.
- No groundwater wells are located within the boundary of this AOC.
- Future land use is expected to remain the same as current land use.

**Former Range Use**

- The INPR Site No. 1 was active from 1946 to 1960 and was used for practice bombing.
- The Demolition Area was active from between 1952 and 1960 and was used for demolition and disposal of munitions.
- The Turret Gunnery Training Range was used between 1952 and 1960. It was used to train B-36 Bomber gunners.

**Potential Contaminant Sources**

- The likely range munitions used were:
    - INPR Site No. 1 – Mk 23, Mk 76, Mk 84, Mk 89, Mk 106, M38A2, BDU 10, and BDU 33 practice bombs. In addition Weston (2004) reported finding a Mark-12 practice nuclear bomb (inert training bomb) and a Fuel-Air-Explosive BLU-95

bomb. The BLU-95 was likely a bomb that drifted over from the adjacent Navy Bomb Range.

- Demolition Area – C-4 Blocks, M60 igniter, detonation cord and time blasting fuze, blasting caps both electric and non-electric, all other munitions types used on the Boardman AFR.
- Turret Gunnery Training Range – 20-mm Ball practice ammunition. The projectile is machined from bar steel.

Table 2 summarizes the constituents of the munitions.

**MEC Evaluation**

**Types of MEC**

- The types of munitions used at the Range Complex No. 1 AOC are listed above. Debris from these munitions were observed during the ASR site visit in 1997. The ASR noted that other than the Mk 23 practice bomb, the remaining bombs on the INPR Site No. 1 site are post Korean War vintage, particularly the BDU 10 practice nuclear bomb.
- The potential for UXO to be present at this AOC is high within INPR Site No.1 and the Demolition Area and low within the Turret Gunnery Range . This is based on prior use, historical documents, interviews, and results of the ASR site visit.

**Surface Exposure Pathway**

- The potential route of human exposure (Boeing, agricultural workers, and natural area workers) to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

**Subsurface Exposure Pathway**

- The potential routes of human exposure (Boeing, agricultural workers, and natural area workers) to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

**MEC Evaluation/Investigation Needed**

- No visual field reconnaissance of the Range Complex No. 1 AOC will be conducted with the objective to locate MEC; however, a visual will be completed to clear soil sample locations. The reconnaissance will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer or metal detector.

## MC Evaluation

### Types of MC

- Munitions debris from practice bombs consists primarily of light gauge sheet metal and cast iron. Iron is the primary constituent of sheet metal and cast iron. Other metals that may be present in sheet metal include aluminum, chromium, copper, lead, manganese, molybdenum, and nickel.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder that contains potassium nitrate, sulfur, and charcoal. The BLU-95 contained ethylene oxide.
- Demolition charges C-4 and detonation cord contain explosives RDX and PETN.
- MC in the Turret Gunnery Training Range consists of metals from steel projectiles.

### Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: The nearest surface water is Carty Reservoir located approximately 6 miles southwest of the center of the range complex. Because of the distance, there is no complete surface water pathway.
- Sediment: Because of the distance to the nearest surface water, there is no complete pathway for sediment.
- Groundwater: Groundwater is a potentially affected media. There are potential receptors downgradient and outside of the FUDS boundary and the pathway is considered potentially complete. While no groundwater depths are available for Range Complex No. 1 area, thin perched groundwater layers above the basalt bedrock are possible, particularly with the irrigated farming that is occurring in the area. There is the potential for MC migration to groundwater. No groundwater drinking water wells are within the AOC.
- Groundwater is a potentially affected media since it is approximately 10 ft bgs at the site and migration of MC directly to the groundwater from the soil is considered to be possible.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at Range Complex No. 1 AOC include soil, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3.

Figures 3 and 9 illustrate the CSMs for Range Complex No. 1 AOC and potential pathways of MC contamination.

## Soil Exposure Pathway

### Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

### Receptors

- Workers (Boeing, wildlife conservation, and agricultural).
- Wildlife.

### MC Soil Evaluation/Investigation Needed

- Four soil samples will be collected from the Range Complex No. 1 AOC. Two soil samples will be collected from the Demolition Area and will be located near two of the detonation craters where a high density of munitions debris is present. The sampling locations will be selected following a visual reconnaissance conducted by a UXO technician aided by magnetometer. Samples will be analyzed for explosives (including nitroglycerin and PETN) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). The basis for this metals list is provided in "MC Soil Evaluation/Investigation Needed" for Target No. AOC.
- Two soil samples will be collected from the Turret Gunnery Range and analyzed for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel) only. No explosive analysis is required as the range was only used for small arms firing.
- A soil sample was collected from INPR SITE No. 1 during the PA/SI and analyzed for metals, explosives, and perchlorate. Metals were not detected in significant concentrations and explosives and perchlorate were not detected. Additional soil samples are not required for this area.

## Groundwater Exposure Pathway

### Exposure Routes

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

### Receptors

- Workers (Boeing, wildlife conservation, and agricultural).

### MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples will be collected from the Range Complex No. 1. The PA/SI addressed the groundwater pathway for the Boardman AFR, and sufficient

data exist to assess groundwater. Groundwater samples were collected within and downgradient of the Boardman AFR. Sample results show that no explosive compounds were detected in any sample. However, perchlorate was detected in some wells. Metals were not included in the PA/SI analytical suite. However, the types of metals contained in munitions used at Range Complex No. 1 have a low solubility of the metals associated with munitions used at this AOC, the expected depth to groundwater (>40 ft), the thin occurrence of groundwater (few feet thick) would make it unlikely that impacts from metals would be noted. Therefore, metals are not considered a contaminant of concern for groundwater.

**Air Exposure Pathway**

**Exposure Routes**

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

**Receptors**

- Workers (Boeing, wildlife conservation, and agricultural).
- Wildlife.

**MC Air Evaluation/Investigation Needed**

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be us used in the evaluation of the air pathway. The USEPA 2004 Region 9 PRGs incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

# Conceptual Site Model – Demolition Area No. 2 AOC

Demolition Area No. 2 is a newly identified AOC. The identification was made through interviews with a property leaseholder (The Nature Conservancy) and the Oregon State Police. The AOC consists of a number of detonation craters with munitions debris (Figure 10). Fuzes and munitions debris were recently destroyed by the Oregon State Police.

**Current and Future Land Use**

- Little is known of the Demolition Area No. 2 AOC and who used it.
- No groundwater wells are located within the boundary of this AOC.
- The land is currently used as a wildlife conservation area.
- Future land is expected to remain the same as current land use.

**Former Range Use**

- The area appears to have been used as an ordnance disposal/demolition area.
- It is unknown who was responsible for the demolition area.

**Potential Contaminant Sources**

- The likely munitions used at this AOC are:
    - M83 Butterfly bombs, M66 base detonator fuzes, 100-lb GP bomb base plate, C-4 blocks, detonation cord and time blasting fuze, and blasting caps both electric and non-electric.

**MEC Evaluation**

**Types of MEC**

- The types of munitions used at the Demolition Area No. 2 AOC are listed above. Debris from these munitions was located by employees of The Nature Conservancy who manage a portion of land for critical wildlife habitat.
- Ordnance disposal of the M83 Butterfly bomb was completed by the Oregon State Police in June 2006.
- The potential for UXO to be present at this AOC is high. This based on recent UXO finds in the area.

**Surface Exposure Pathway**

- The potential route of human exposure to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

**Subsurface Exposure Pathway**

- The potential routes of human exposure to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).

- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

**MEC Evaluation/Investigation Needed**

- No visual reconnaissance of Demolition Range No. 2 AOC is necessary. MEC and munitions debris has been identified at the AOC. Prior to collection of soil samples a visual MEC avoidance survey will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer.

**<u>MC Evaluation</u>**

**Types of MC**

- Munitions debris from the M83 Butterfly Bombs consists primarily of light gauge sheet metal.
- Demolition charges C-4 and detonation cord contain explosives RDX and PETN.
- TNT is found in the M83 bomblets.
-
- Unidentified munitions destroyed at this site may have contained perchlorate but likely not in significant quantities.

**Overview of Pathways**

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from demolition activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: The nearest surface water is Carty Reservoir, located approximately 4 miles to the southwest. Because of this distance, there is no complete surface water pathway.
- Sediment: Because of the distance to the nearest surface water, there is no complete pathway for sediment.
- Groundwater: Groundwater is a potentially affected media. There are potential receptors downgradient and outside of the FUDS boundary and the pathway is considered potentially complete. While no groundwater depths are available for Range Complex No. 1 AOC area, thin perched groundwater layers above the basalt bedrock are possible, particularly with the irrigated farming that is occurring in the area. There is the potential for MC migration to groundwater. No groundwater drinking water wells are within the AOC.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Demolition Area No. 2 AOC include soil, groundwater, and air. A pathway evaluation for each media is discussed below and provided in Table 3. Figure 9 illustrates the CSM for the Demolition Area No. 2 AOC.

**Soil Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

**Receptors**

- Workers (agricultural).
- Wildlife.

**MC Soil Evaluation/Investigation Needed**

- Two soil samples will be collected from the Demolition Area No. 2 AOC. A soil sample will be collected near two of the demolition craters. The sampling location will be selected following visual reconnaissance UXO survey utilizing a magnetometer to avoid UXO. Samples will be analyzed for explosives (including nitroglycerin and PETN) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). The basis for this metals list is provided in "MC Soil Evaluation/Investigation Needed" for Target No. AOC.

**Groundwater Exposure Pathway**

**Exposure Routes**

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

**Receptors**

- Workers (agricultural).

**MC Groundwater Evaluation/Investigation Needed**

- No additional groundwater samples will be collected from this AOC. The PA/SI addressed the groundwater pathway for the Boardman AFR, and sufficient data exist to assess groundwater. Groundwater samples were collected within and downgradient of the Boardman AFR. Sample results show that no explosive compounds were detected in any sample. However, perchlorate was detected in some wells. Metals were not included in the PA/SI analytical suite. However, the types of metals contained in munitions used at Demolition Area No. 2 have a low solubility of the metals associated with munitions used at this AOC, the expected depth to groundwater (>40 ft), the thin

occurrence of groundwater (few feet thick) would make it unlikely that impacts from metals would be noted. Therefore, metals are not considered a contaminant of concern for groundwater.

**Air Exposure Pathway**

**Exposure Routes**

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

**Receptors**

- Workers (agricultural).
- Wildlife.

**MC Air Evaluation/Investigation Needed**

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be us used in the evaluation of the air pathway. The USEPA 2004 Region 9 PRGs incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

# Conceptual Site Model – Impact Area AOC

The Impact Area is a newly identified AOC. The identification was made through interviews with a property leaseholder (The Nature Conservancy). The AOC consists of a number of impact craters with a small amount of munitions debris (Figure 11). The AOC is locally known as the "Ship in the Desert". Impact craters are also visible on aerial photographs (Figure 11).

**Current and Future Land Use**

- Little is known of the Impact Area and who used it.
- One groundwater well is located approximately 1 mile south (upgradient) of the AOC.
- The land is currently used as a wildlife conservation area.
- Future land is expected to remain the same as current land use.

**Former Range Use**

- The area appears to have been used as an unofficial bomb target. Review of historical and recent aerial photographs does not indicate any established targets.
- The period of use is unknown.

**Potential Contaminant Sources**

- The potential munitions used at this AOC are:
- AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs. These practice bombs contained black powder and a red or white phosphorus pyrotechnic charge. The use of other practice bombs is possible.

**MEC Evaluation**

**Types of MEC**

- The types of munitions used at the Impact Area are listed above. The nature of the debris found at the AOC is unknown, however, it was described as only a small amount.
- The potential for UXO to be present at this AOC is moderate. This is based on suspected prior use as a practice bomb target.

**Surface Exposure Pathway**

- The potential route of human exposure to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of wildlife exposure to MEC or munitions debris would be by directly walking on them.

**Subsurface Exposure Pathway**

- The potential routes of human exposure to MEC or munitions debris would be by intrusive drilling or digging activities or geologic instability (erosion, freeze-thaw, etc.).
- The potential route of wildlife exposure to MEC or munitions debris would be by burrowing activities.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

**MEC Evaluation/Investigation Needed**

- A visual field reconnaissance of the Impact Area will be complete to identify and MEC and munitions debris on the ground surface. The reconnaissance will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer.

**<u>MC Evaluation</u>**

**Types of MC**

- Munitions debris is thought to be from AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs. The bomb consists of a cast iron body. These practice bombs contained black powder and a red or white phosphorus pyrotechnic charge. Additional munitions may have been used. Four reconnaissance transects are planed as shown on Figure 11.

**Overview of Pathways**

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from demolition activities. The soil also serves as a secondary source of potential air, surface water, or groundwater contamination.
- Surface Water: Surface water is a potentially affected media. However the pathway is considered incomplete because, the upper portion of Sixmile Canyon Creek flows only during high precipitation events and the creek is dry much of the time.
- Sediment: Sediment is a potentially affected media. The upper portion of Sixmile Canyon Creek is adjacent to the AOC. However, flow is seasonal and the creek is dry much of the time.
- Groundwater: Groundwater is a potentially affected media. There are potential receptors downgradient and outside of the FUDS boundary and the pathway is considered potentially complete. While no groundwater depths are available for Range Complex No. 1 area, thin perched groundwater layers above the basalt bedrock are possible, particularly with the irrigated farming that is occurring in the area. There is the potential for MC migration to groundwater. No groundwater drinking water wells are within the AOC.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. Blowing dust from the target could mobilize soil particles. This pathway is considered to be complete.

Exposure media at the Impact Area include soil, sediment, and air. A pathway evaluation for each media is discussed below and provided in Table 3. Figure 3 illustrates the CSM for the Impact Area.

**Soil Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.

- The potential routes of wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

**Receptors**

- Workers (agricultural).
- Wildlife.

**MC Soil Evaluation/Investigation Needed**

- One soil sample will be collected from the Impact Area AOC. A soil sample will be collected near one of the impact craters where munitions debris is located. The sampling location will be selected following visual field reconnaissance utilizing a magnetometer. Samples will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). The basis for this metals list is provided in "MC Soil Evaluation/Investigation Needed" for Target No. AOC.

**Sediment Exposure Pathway**

**Exposure Routes**

- The potential routes of human exposure to contaminated sediment include incidental ingestion of and dermal contact with sediment.
- The potential routes of wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

**Receptors**

- Workers (agricultural).
- Wildlife.

**MC Sediment Evaluation/Investigation Needed**

- One sediment sample will be collected from this AOC. The sample will be collected from the bottom of the Sixmile Canyon Creek drainage at a probable point of entry. The sample will be analyzed for explosives (including nitroglycerin) and select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, mercury, and nickel). This metals list is based on expected metals to be contained in the munitions (bomb casings, explosives, and fuzes) plus metals that may be used during background comparisons.

**Groundwater Exposure Pathway**

**Exposure Routes**

- The potential routes for human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure to wildlife is not a concern.

**Receptors**

- Workers (agricultural).

**MC Groundwater Evaluation/Investigation Needed**

- No additional groundwater samples will be collected from this AOC. The PA/SI addressed the groundwater pathway for the Boardman AFR, and sufficient data exist to assess groundwater. Groundwater samples were collected within and downgradient of the Boardman AFR. Sample results show that no explosive compounds were detected in any sample. However, perchlorate was detected in some wells. Metals were not included in the PA/SI analytical suite. However, the types of metals contained in munitions used at the Impact Area have a low solubility of the metals associated with munitions used at this AOC, the expected depth to groundwater (>40 ft), the thin occurrence of groundwater (few feet thick) would make it unlikely that impacts from metals would be noted. Therefore, metals are not considered a contaminant of concern for groundwater.

**Air Exposure Pathway**

**Exposure Routes**

- The potential route of human exposure to contaminated air includes inhalation during times of blowing dust.
- The potential route of wildlife exposure to contaminated air includes inhalation of air during times of blowing dust.

**Receptors**

- Workers (agricultural).
- Wildlife.

**MC Air Evaluation/Investigation Needed**

- No air samples will be collected from the Boardman AFR. Analytical results from soil samples will be us used in the evaluation of the air pathway. The USEPA 2004 Region 9 PRGs incorporate dust exposure into the values and additional exposure data beyond soil data is not required.

# Data Gaps

- The presence of MEC and munitions debris has been established in all AOCs except Target No 1. MEC has been reported as recently as March 2006 at the Target No. 2 AOC and June 2006 at the Demolition Area No. 2 AOC.
- Some sampling for MC has been completed as part of the PA/SI. Perchlorate has been detected in surface water and groundwater. Table 1 summarizes the PA/SI sampling that was performed and notes the data gaps.

Results of the current status of data requirements with respect to MEC and MC for the AOCs located at the former Boardman AFR are summarized below:

| AOC | Presence of MEC | Presence of MC | Proposed Inspection Activities |
|---|---|---|---|
| Target No. 1 | Unknown | Unknown | A visual field reconnaissance and soil sampling. |
| Target No. 2 | Established | Unknown | UXO avoidance survey for sample locations. Soil and sediment sampling. |
| Carty Reservoir Bomb Target | Established | Unknown | UXO avoidance survey for sample locations. Soil and sediment sampling. |
| Range Complex No. 1 | Established | Absent on INPR Site No.1: unknown at demolition pits.<br>Only small arms used on Turret Gunnery Range. | UXO avoidance survey for sample locations. Soil sampling in Demolition Area and Turret Gunnery Range. |
| Demolition Area No. 2 | Established | Unknown | UXO avoidance survey for sample locations. Soil sampling. |
| Impact Area | Unknown | Unknown | A visual field reconnaissance and soil and sediment sampling |

Note: Analytical data gathered through previous investigations may, or may not, meet fully the DQOs of the current SI (i.e., the analytical methodology and analyte list may, or may not, conform to the USACE Programmatic Sampling and Analysis Plan). Therefore, those analytical results previously collected are not interpreted with the sole purpose of making a determination that no further investigation is required at a particular AOC. However, the previous data collected can be used reasonably to make a recommendation for further action beyond the scope

# APPENDIX B

# USACE INTERIM GUIDANCE DOCUMENT 06-05 AND SAFETY ADVISORY 06-2

DEPARTMENT OF THE ARMY
HUNTSVILLE CENTER, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

REPLY TO
ATTENTION OF:

MAR 1 6 2006

CEHNC-OE-CX

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Procedure for Preliminary Assessment (PA) and Site Inspection (SI) Teams that Encounter Unexploded Ordnance (UXO) While Gathering Non-UXO Field Data, Military Munitions Center of Expertise (MM CX) Interim Guidance Document (IGD) 06-05

1. PURPOSE: This procedure describes the responsibilities of project teams during the preliminary assessment and site investigation phases should unexploded ordnance (UXO) be discovered.

2. APPLICABILITY: This guidance is applicable to the geographic military Districts, Military Munitions Response Program (MMRP) Design Centers, Major Subordinate Commands (MSCs), and designated Remedial Action Districts performing MMRP response actions.

3. REQUIREMENTS AND PROCEDURES:

a. During site visits to formerly used defense site (FUDS) properties to gather PA or SI information, in the rare instance that a UXO-qualified individual identifies an item that is an explosive hazard, the following actions will occur:

(1) The property owner or individual granting rights of entry to the property will be notified of the hazard and advised to call the local emergency response authority (i.e., police, sheriff, or fire department). The individual will also be informed that if they do not call the local response authority within 1 hour, the individual who identified the UXO item will notify the local emergency response authority.

(2) The local response authority will decide how to respond to the reported incident, including deciding not to respond (e.g., if the local response authority is already aware of the hazards on the property). If the local response authority decides to respond, the individual who identified the item or his designee will mark the location of the item and provide accurate location information to the emergency response authority. The individual who identified the item or his designee will generally remain in the area until the local response authority arrives, unless specifically indicated by the appropriate response authority that the individual may leave the area.

(3) During the SI, the state regulator may also be notified at their request.

MAR 1 6 2006

CEHNC-OE-CX
SUBJECT: Procedure for Preliminary Assessment (PA) and Site Inspection (SI) Teams that Encounter Unexploded Ordnance (UXO) While Gathering Non-UXO Field Data, Military Munitions Center of Expertise (MM CX) Interim Guidance Document (IGD) 06-05

b. During site visits to active installations or Base Realignment and Closure (BRAC) sites to gather PA or SI information, in the rare instance that a UXO-qualified individual identifies an item that is an explosive hazard, the following actions will occur:

(1) The installation point of contact (POC) or the BRAC coordinator will be notified of the hazard and requested to notify explosive ordnance disposal (EOD) through their channels.

(2) The installation/EOD will make the determination if they are going to respond to the incident. The installation/EOD may be aware of the hazards at the site and make the decision not to respond. If the installation/EOD decides to respond, the individual who identified the item or his designee will mark the location and provide accurate location information to the installation/EOD unit and will remain in the area unless the installation/EOD unit requests otherwise.

c. Neither the US Army Corps of Engineers personnel, nor their contractors have the authority to call EOD to respond to an explosive hazard. This call is the responsibility of the local emergency response authority for FUDS properties and it must come through the proper chain of command on installations.

d. AR 75-14 and AR 75-15 contain the information on how EOD responds to explosives hazards.

4. EFFECTIVE DATES: The requirements and procedures set forth in this interim guidance are effective immediately. They will remain in effect indefinitely, unless superseded by other policy or regulation.

5. POINT OF CONTACT: If you need additional information, please contact Mr. Brad McCowan at 256-895-1174.

Carol A. Youkey

CAROL A. YOUKEY, P.E.
Chief, Center of Expertise for Ordnance
and Explosives Directorate

DEPARTMENT OF THE ARMY
HUNTSVILLE CENTER, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

May 23, 2006

REPLY TO
ATTENTION OF:

OE Safety Division for Ordnance
and Explosives Directorate

Shaw Environmental
4171 Essen Lane
Baton Rouge, Louisiana 70809

Dear Sir/Madam:

This is Safety Advisory 06-2 – Munitions and Explosives of Concern (MEC) Safety During Site Inspections (SI), Pre-Work Plan Visits, Archive Search Reports (ASR) Investigations and Other Site Visits of a Non-Intrusive Nature.

Reference EP 75-1-1, EP 385-1-95a, and Interim Guidance Document (IGD), March 15, 2006.

The following procedures will be followed if an item is found that has an explosive hazard during the activities identified in the subject line:

a. MEC items are not to be moved or disturbed during the above subject SI, Pre-Work Plan visits, ASR Investigations and other site visits of a non-intrusive nature.

b. The locations of any discovered explosive hazardous items should be marked for accurate relocating purposes and the information provided to the designated Point of Contact (POC) and any emergency response authorities as may be required.

c. During site visits to active Installations and/or Base Realignment and Closure (BRAC) sites the identified Installation POC or the BRAC coordinator should be notified of discovered MEC hazards. They then will request any appropriate emergency response action as deemed necessary through their channels if required.

d. When a site visit is on a Formerly Utilized Defense Site, the property owner shall be notified in the event of finding any found explosive hazards along with the location of the explosive item(s) found, the property owner should then in turn notify their local emergency response authorities.

e. During these site visits all required MEC security requirements should be implemented as necessary and required. All team members are to be instructed in and made aware of any MEC security requirements.

f. All team members will be briefed on these procedures prior to any site investigations being performed and daily before any work begins.

This Safety Advisory is intended to serve as an explosives safety reminder.

Comments or questions about this Safety Advisory can be directed to the undersigned at (256) 895-1598/82.

Sincerely,

Wayne H. Galloway
Chief, OE Safety Division for
Ordnance and Explosives Directorate

# APPENDIX C

# SITE SAFETY AND HEALTH PLAN ADDENDUM

| ADDENDUM OR-2 TO SITE SAFETY AND HEALTH PLAN (SSHP)<br>**REVIEWS AND APPROVAL**<br>US Army Corps of Engineers, Omaha District | This SSHP is a part of the Omaha District Safety Program. Please read and comply with USACE EM 385-1-1 and CENWO OM 385-1-1. |
|---|---|

| Reviewer | Date | Signatures |
|---|---|---|
| **Authored by:**<br>Pamela Moore | Feb 8, 2007 | **Signature:**<br>Pamela Moore |
| **Peer Review by:**<br>Dale Landon | 2/8/07 | **Signature:** |
| **Quality Control Review (QCR) by:**<br>Kathy Stroppel-Holl | 02 / 08/ 2007 | **Signature:**<br>K. Stroppel-Holl |
| **Project Manager Reviewed by:**<br>Peter Kelsall | FEB 8, 2007 | **Signature:** |

| | | |
|---|---|---|
| **USACE Omaha District MM DC OE Safety Specialist Review:**<br>Andrew G. Marks | | **Signature:** |
| **USACE Omaha District MM DC Project Manager Acceptance:**<br>Mike Watson | | **Signature:** |

| ADDENDUM OR-2 TO SITE SAFETY AND HEALTH PLAN (SSHP)<br>**TITLE PAGE**<br>US Army Corps of Engineers, Omaha District | This SSHP is a part of the Omaha District Safety Program. Please read and comply with USACE EM 385-1-1 and CENWO OM 385-1-1. |
|---|---|

PROJECT NAME: FUDS SI – BOARDMAN AIR FORCE RANGE

PURPOSE OF ADDENDUM:

This Addendum provides details specific to activities at this FUDS that were not provided in the approved Accident Prevention Plan and Site Safety and Health Plan included in the "Final Type I Work Plan, Site Inspections at Multiple Sites, NWO Region" (Shaw, 2006).

DESCRIBE THE CHANGES EFFECTED BY THIS ADDENDUM:

Add site-specific supplemental information.

**SITE SAFETY AND HEALTH PLAN ADDENDUM**

FOR

| | |
|---|---|
| Site Name: | Boardman Air Force Range |
| Site Location: | Boardman Air Force Range is located approximately 5.5 miles south of Boardman, Oregon in Morrow County. |
| Purpose of Visit: | Site Inspection of the FUDS for MEC reconnaissance and MC sampling. |
| Date(s) of Site Visit: | Approximately January 2007 |
| Office: | Shaw Environmental, Inc. Richland, Washington office |
| Address: | 1045 Jadwin Ave, Suite C<br>Richland, Washington 99352 |
| Telephone: | (509) 946-2069 |

Date Prepared: 2 November 2006

Site inspection work at this FUDS will be conducted in accordance with the approved Accident Prevention Plan and Site Safety and Health Plan (SSHP) included in Appendix D of the "Final Type I Work Plan, Site Inspections at Multiple Sites, NWO Region" (Shaw, 2006). This Addendum provides details specific to activities at this FUDS that were not provided in the SSHP.

## I. SITE DESCRIPTION AND PREVIOUS INVESTIGATIONS

(For complete background, see text and figures of Site-Specific Work Plan included with this document. A brief summary follows.)

A. SITE DESCRIPTION:

- Size: Six AOCs covering approximately 48,980 acres.
- Present Usage (Check all that apply)

| | | |
|---|---|---|
| ☐ Military | ☐ Recreational | ☒ Agricultural |
| ☐ Residential | ☐ Commercial | ☐ Landfill |
| ☒ Natural Area | ☒ Industrial | |
| ☒ Other Specify Airstrip (Morrow County) and restricted antennae test range (Boeing Co.) | | |

| | | |
|---|---|---|
| ☒ Secured | ☒ Active | ☐ Unknown |
| ☒ Unsecured | ☐ Inactive | |

B. PAST USES:

- Between 1941 and 1943 the US Army Air Corps acquired land for a practice bombing range. Used for practice bombing, ground-to-air gunnery practice, and demolition of unserviceable/surplus munitions and small arms trace testing. After World War II, site was categorized as surplus land. In 1948, the Air Force withdrew the land from surplus and used the range from 1948 to 1960. Was renamed the Boardman Precision Bombing Range and was configured with five targets and exclusion areas. In 1963 the eastern half of the site was given to the Navy and DOI for use. Currently the property within the Boardman AFR FUDS is owned by the City of Boardman, Morrow County, BAIC, Inc., and Portland General Electric. Presently BAIC, Inc. leases land to Portland General Electric, the Boeing Company, Inland Land Company, and The Nature Conservancy.

C. SURROUNDING POPULATION:

| | | |
|---|---|---|
| ☒ Rural | ☒ Residential | ☒ Commercial |
| ☐ Urban | ☐ Industrial | |
| ☐ Other Specify | | |

D. PREVIOUS SAMPLING/INVESTIGATION RESULTS:

(1) MEC ENCOUNTERED: See SSWP figure for specific locations of MEC finds.

| Area of Concern: | | Description: |
|---|---|---|
| Target No. 2 | | Unexploded practice bombs and general purpose bombs. AN-M57 general purpose bombs recovered in March 2006. |
| Carty Reservoir Bomb Target | | Unexploded practice bombs |
| Range Complex No. 1 | | Unexploded practice bombs |
| Demolition Area No. 2 | | Unexploded munitions, munitions debris, and kickouts from demolition craters |

(2) SAMPLES: (Air, Water, Soil, and Vegetation): Site and surrounding area has been previously sampled for metals, explosives and perchlorate. Perchlorate was the only potential munitions constituent found and was detected in 18 of 25 groundwater samples and in 5 surface water samples.

## II. DESCRIPTION OF ON-SITE ACTIVITIES:

| | | |
|---|---|---|
| ☒ Walk Through | ☒ Drive Through | ☐ Fly Over |
| ☒ On-Road | ☐ Off-Road | ☒ On-Path |
| ☒ Off-Path | | |
| ☒ Other Specify: Soil and sediment sampling | | |

Activities/Tasks to be Performed (Summarize)

A visual field reconnaissance will be completed at Target No. 1 and the Impact Area AOCs to determine whether MEC or munitions debris is present. The visual survey will be conducted by a qualified UXO technician, with the aid of a hand-held electromagnetic all-metal detector to look for evidence of munitions activity and to assure that personnel avoid any potential MEC. Reconnaissance will follow a meandering survey path within the AOC. Paths are shown on Figures 3 and 9. Special attention will be given to physical features such as depressions, craters, or pits that could be present at impact locations of munitions. A global positioning system (GPS) unit will be used to record the survey path and the location of any MEC, munitions debris, or other significant features (such as remnant evidence of targets or other range-related structures) observed. Digital photographs will be taken to document significant features.

Visual reconnaissance surveys will also be performed at other sampling locations to aid in sample location selection and to allow the sampler to work safely.

Soil and sediment sampling will be performed at locations that have been cleared by the UXO technician. Samples will be collected to determine MC impacts. Sampling locations will be recorded using GPS. Sampling protocols will be as specified in the SSWP and the Type 1 Work Plan.

## III. SITE PERSONNEL AND RESPONSIBILITIES:

| Name/Responsibility | Training | | | | | |
|---|---|---|---|---|---|---|
| | HAZWOPER 40-hour | 8-hour HAZWOPER refresher | Hazardous Waste Site Supervisor | First Aid | Cardiopulmonary Resuscitation | UXO Specialist |
| Ryan Pollyea Field Team Leader/SSHO | X | X | X | X | X | |
| Rob Irons (1137) UXO Technician | X | X | | X | X | X |

## IV. HAZARD ANALYSIS:

A. SAFETY AND HEALTH HAZARDS ANTICIPATED:

| | | |
|---|---|---|
| ☐ Heat Stress | ☒ Cold Stress | ☒ Tripping Hazard |
| ☐ Noise | ☐ Electrical | ☐ Falling Objects |
| ☒ Foot Hazard | ☒ Biological | ☐ Overhead Hazard |
| ☐ Radiological | ☐ Confined Space | ☒ Water |
| ☒ Explosive | ☐ Climbing | ☐ Flammable |
| ☒ Other Specify : UXO and munitions debris | | |

B. OVERALL HAZARD EVALUATION:

| | | | |
|---|---|---|---|
| ☐ High | ☒ Moderate | ☐ Low | ☐ Unknown |

JUSTIFICATION: (Provide a brief justification supporting the overall evaluation.)

| |
|---|
| Munitions debris and UXO have been documented or observed near certain AOCs. Anomaly avoidance will be conducted to minimize contact with MEC. |

V. SITE INSTRUCTIONS FOR MEC AVOIDANCE:

See Section 4.3 of the SSHP for full scope of MEC avoidance requirements.
a. DO NOT touch or move any ordnance items regardless of the marking or apparent condition.
b. DO NOT visit an ordnance site if an electrical storm is occurring or approaching. If a storm approaches during a site visit, leave the site immediately and seek shelter.
c. DO NOT use radio or cellular phones in the vicinity of suspect ordnance items.
d. DO NOT walk across an area where the ground cannot be seen. If dead vegetation or dead animals are observed, leave the area immediately due to potential chemical agent contamination.
e. DO NOT drive vehicles into suspected MEC areas; use clearly marked lanes.
f. DO NOT carry matches, lighted cigarettes, lighters or other flame producing devices into a MEC site.
g. DO NOT rely on color codes for positive identification of ordnance items or their contents.

h. Only the on-site UXO Specialist is allowed to approach suspected ordnance items to take photographs, and prepare a full description (take notes of the markings or any other identifiers/features).
i. The location of any ordnance items found during the site investigation should be clearly marked so it can be easily located and avoided.
j. Always assume ordnance items contain a live charge until it can be determined otherwise.

Section 4.3 of the SSHP defines on-site MEC avoidance requirements for FUDS properties. In general, the purpose of MEC or anomaly avoidance during SI activities is to avoid any potential surface or subsurface anomalies. Intrusive anomaly investigation is not authorized during MEC avoidance operations. The reconnaissance and sampling field work shall include a minimum of two people, one of whom shall be a UXO technician. This team will be on-site during all sampling activities. Sampling personnel must be escorted at all times in areas potentially containing MEC until the UXO team has completed the access surveys and the cleared areas are marked. If anomalies or MEC are detected, the UXO team will halt escorted personnel in place, select a course around the item, and instruct escorted personnel to follow. If MEC is encountered, Shaw will stop work in the vicinity and make notifications as outlined in the Work Plan. Shaw is not to conduct further investigation or removal of any MEC.

## VI. SITE CONTROL AND COMMUNICATIONS:

A. SITE WORK ZONES:
Rigid demarcation of work zones, e.g., using barricades or caution tape, will generally not be required for this project. The Field Team Leader/SSHO, in consultation with the UXO Technician, will determine the boundary of an Exclusion Zone (EZ) to be established around a specific area of activity, appropriate to the potential hazards. The boundaries may be described by physical features, e.g., fences, tree lines, or topographic features, or may be defined by a radius around the center of activity. The EZ boundary will be verbally communicated to team members, who will maintain a watch to assure that only field team members are within the work zone. If a bystander or intruder approaches the EZ, the field team will cease work and ask the person to remain outside the area. A Contamination Reduction Zone (CRZ) will generally not be required because personnel decontamination is not anticipated. If required, a CRZ will be established in a manner similar to that described for the EZ. The support zone will consist of all portions of the site not defined as an EZ or CRZ.

B. COMMUNICATIONS:

(1) ON-SITE: Verbal communications will be used among team members to communicate to each other on-site. If this communication is not possible, the following hand signals will be used.

GRIP PARTNER'S WRIST OR BOTH HANDS AROUND WAIST – Leave the area immediately.

HAND GRIPPING NOSE – Unusual smell detected.

THUMBS UP – OK, I am alright or I understand.

THUMBS DOWN – No, negative.

(2) OFF-SITE: Off-site communications will be established at the site and may be include an on-site cellular phone or the nearest public phone or private phone that may be readily accessed.

☒ Cellular Phone: TBD

☐ Public/Private phone

TELEPHONE NUMBERS:

| | |
|---|---|
| 1. MEDICAL FACILITY (Emergency Care): Good Shepherd Medical Center | (541) 667-3400 |
| 2. MEDICAL FACILITY (Non-Emergency Care-Shaw-Approved Occupational Health Clinic): Lourdes Business Health Services | (509) 546-2222 |
| 3. FIRE DEPARTMENT: | No local Fire Department call 911 |
| 4. Oregon State Police MEC Notification: Mr. Dennis Wagner | (541)-276-3629 |
| 5. POLICE DEPARTMENT: Morrow County Sheriff | (541) 676-5129 or 911 |
| 6. POISON CONTROL CENTER | (800) 222-1222 |
| 7. USACE MM DC PROJECT MANAGER: Mike Watson | (402) 221-7703 |
| 8. USACE PROJECT MANAGER: Mike Nelson | (206) 764-3458 |
| 9. USACE OE Safety: Glenn Marks | (402) 221-7683 (Office)<br>(402) 740-4954 (Cell) |
| 10. SHAW PROJECT MANAGER: Peter Kelsall | (303) 793-5252 (Office)<br>(303) 981-8435 (Cell) |
| 11. SHAW TECHNICAL LEAD: Dale Landon | (509) 946-2069 (Office)<br>(509) 521-1437 (Cell) |
| 12. SHAW FIELD TEAM LEADER: Ryan Pollyea | (503) 816-5240 (Cell) |
| 13. SHAW OE SAFETY: Brian Hamilton | (303) 690-3117 (Office)<br>(303) 809-0416 (cell) |
| 14. SHAW UXO TECHNICIANS: Rob Irons | (530) 713-2245 (Cell) |

(3) EMERGENCY SIGNALS: In the case of small groups, a verbal signal for emergencies shall suffice. The emergency signal for large groups should be incorporated at the discretion of the UXO Technician.

☒ Verbal

☐ Nonverbal (Specify)

## VII. EMERGENCY RESPONSE:

(1) ACCIDENTS: Safety-related incidents and accidents will be immediately reported to the Shaw Project Manager and the USACE MM DC Project Manager. Additional notifications within the USACE organization will be coordinated by the USACE MM DC Project Manager. Additional accident reporting responsibilities of Shaw personnel are described in Section 1.9 of the Accident Prevention Plan.

(2) DIRECTIONS TO THE NEAREST HOSPITAL/MEDICAL FACILITY:

Good Shepherd Medical Center
610 Northwest 11th Avenue
Hermiston, Oregon
(541) 667-3400

See next page.

**Figure 1: Map of Route to Good Shepherd Medical Center, Hermiston, Oregon**

| Directions | | Distance | Detail Map |
|---|---|---|---|
| **Start:** | Depart on Local road(s) (North) | 0.3 mi | |
| **1:** | Turn LEFT (West) onto Local road(s) | 0.2 mi | |
| **2:** | Turn RIGHT (North-West) onto Tower Rd | 8.2 mi | |
| **3:** | Take Ramp (RIGHT) onto I-84 [US-30] towards I-84 / US-30 | 23.2 mi | |
| **4:** | At exit 182, turn LEFT onto Ramp towards Or-207 / Hermiston / Lexington | 0.3 mi | |
| **5:** | Turn LEFT (North-East) onto SR-207 | 1.8 mi | |
| **6:** | Keep STRAIGHT onto SR-207 [SW Butter Creek Rd] | 1 mi | |
| **7:** | Keep STRAIGHT onto SR-207 [SW 11th St] | 1.3 mi | |
| **8:** | Bear RIGHT (North) onto SR-207 [CR-1247] | 0.4 mi | |
| **End:** | Arrive at 610 Northwest 11th Avenue, Hermiston, OR 97838 | | |

(3) DIRECTIONS TO THE NON-EMERGENCY FACILITY:

**Non-Emergency Facility:**
The following occupational health clinic is approved by Health Resources for non-life-threatening medical treatment of Shaw employees:

| Location | City | Clinic | Address | Zip | Telephone | Contact |
|---|---|---|---|---|---|---|
| Pasco, WA | Pasco | Lourdes Business Health Services | 9915 Sandifur Pkwy | 99301 | 509-546-2222 | Cynthia Gluck |

**Figure 2: Map of Route to Lourdes Business Health Services, Pasco, Washington**

| Directions | | Distance | Detail Map |
|---|---|---|---|
| **Start**: | Depart on Local road(s) (North) | 0.3 mi | |
| **1**: | Turn LEFT (West) onto Local road(s) | 0.2 mi | |
| **2**: | Turn RIGHT (North-West) onto Tower Rd | 8.2 mi | |
| **3**: | Take Ramp (RIGHT) onto I-84 [US-30] towards I-84 / US-30 | 19.6 mi | |
| **4**: | At exit 179, take Ramp onto I-82 towards I-82 / Hermiston / Umatilla | 30.8 mi | |
| **5**: | Entering Washington | | |
| **6**: | At exit 113, turn off onto Ramp towards US-395 / I-182 / Kennewick / Pasco | 0.4 mi | |
| **7**: | Road name changes to US-395 [Evergreen Hwy] | 5 mi | |
| **8**: | Keep STRAIGHT onto Ramp towards US-395 / Spokane | 0.3 mi | |
| **9**: | Road name changes to US-395 | 1.8 mi | |
| **10**: | Take Ramp (LEFT) onto I-182 [US-12] towards I-182 / US-12 / Richland / Yakima | 4.9 mi | |
| **11**: | At exit 7, turn RIGHT onto Ramp towards Broadmoor Blvd | 0.4 mi | |
| **12**: | Turn RIGHT (North) onto Broadmoor Blvd | 0.2 mi | |
| **13**: | Turn RIGHT (East) onto Sandifur Pkwy | 0.1 mi | |
| **End**: | Arrive at 9915 Sandifur Parkway, Pasco, Washington 99301 | | |

## VIII. PERSONAL PROTECTIVE EQUIPMENT:

For field work to be performed at this site, Level D is required. Level D Protection requirements are defined in section 5.1.5 of the SSHP. In general, the use of hard hats is required on all USACE work sites, except on MEC-contaminated sites. Hard hats will only be worn if an overhead hazard is identified. If hard hats are worn, they will be securely fastened to the wearers head.

Contingency: Evacuate site if higher level of protection is needed.

## IX. DECONTAMINATION PROCEDURES:

Decontamination procedures are not anticipated as Level D PPE is being used. If decontamination is deemed necessary, procedures defined in Section 7.0 of the SSHP of the Work Plan will be followed. Team members are cautioned not to walk, kneel, or sit on any surface with potential leaks, spills, or contamination.

## X. TRAINING:

Training specific to this site includes Hazard Communications and MEC safety procedures as determined by the UXO Technician.

## XI. GENERAL:

### Site Visitors

The number of persons visiting the site will be held to a minimum. The UXO Technician can supervise no more than six non-UXO qualified persons while on MEC sites performing intrusive or non-intrusive work.

### Modifications to SSHP Addendum

The Field Team Leader may modify this SSHP Addendum if site conditions warrant. All changes to the SSHP Addendum require USACE review and concurrence before new procedures can be applied in the field.

### Severe Weather Contingency Plan

Sudden changes in the weather, extreme weather conditions, and natural disasters can create a number of subsequent hazards. Inclement weather may cause poor working conditions including slip, trip and fall hazards to exist. Natural disasters can create many secondary hazards such as release of hazardous materials to the environment, structure failure, and fires.

Weather conditions will be monitored throughout the day by all field team members. Additionally, field personnel should be aware of/informed of daily weather forecasts. Local weather broadcasts and information from a severe weather alert radio will be monitored by the Field Team Leader, SSHO, or designee when the likelihood for severe weather exists. The

location of Tornado Shelters that may be located in the general area where field work is being performed will be identified. Severe weather may include:

- Tornadoes,
- Thunderstorms (lightning, rain, flash flooding),
- Hail, and
- High wind.

Generally, cellular telephone communication will be used to alert crews to threatening weather. The necessary precautions or response, as directed by the Field Team Leader, to implement the Severe Weather Contingency Plan include:

- Drilling and sampling operations will be suspended when the potential for lightning occurs. Operations may resume 30 minutes after the last observed lightning strike.
- For most types of severe weather, personnel should take refuge in vehicles or inside a designated office.
- In the event of a tornado, personnel should take cover in a basement, ditch, culvert, open "igloo," or interior room of a strong building. Personnel should be aware that ditches and culverts may fill up with water quickly and should only use these as shelters as a last resort.
- The Field Team Leader must decide what operations, if any, are safe to perform based on existing conditions and anticipated conditions.

Additional information will be developed and communicated to personnel before commencing new tasks or activities. It may be necessary to halt certain hazardous operations or stop work altogether to allow the weather situation to pass.

Routinely monitoring weather conditions and reports may help reduce the impact of severe weather and natural disasters. The best protection against most severe weather episodes and natural disasters is to avoid them. This means seeking shelter before the storm hits. If lightning is a threat, stay away from pipes and electrical equipment and watch for damage caused by nearby lightning strikes.

SAFETY BRIEFING CHECKLIST
(Check subjects discussed)

| SITE NAME: Boardman Air Force Range | DATE/TIME: / |
|---|---|

GENERAL INFORMATION

☐ PURPOSE OF VISIT

☐ IDENTIFY KEY SITE PERSONNEL

☐ TRAINING AND MEDICAL REQUIREMENTS

SPECIFIC INFORMATION

☐ SITE DESCRIPTION/PAST USES

☐ RESULTS OF PREVIOUS STUDIES

☐ POTENTIAL SITE HAZARDS

☐ MEC SAFETY PROCEDURES

☐ SITE SOPs

☐ SITE CONTROL AND COMMUNICATIONS

☐ EMERGENCY RESPONSE

- ☐ LOCATION OF FIRST AID KIT
- ☐ EMERGENCY PHONE NUMBERS & LOCATION
- ☐ LOCATION OF AND MAP TO NEAREST MEDICAL FACILITY
- ☐ PPE AND DECONTAMINATION

Stress the following during the briefing: If hazardous conditions arise, stop work, evacuate the area, and notify the SSHO and Shaw PM immediately.

PLAN ACCEPTANCE FORM

SITE SAFETY AND HEALTH PLAN AND ADDENDUM

FOR

Site Name: Boardman Air Force Range
Location: Morrow County, Oregon

I have read and agree to abide by the contents of the Site Safety and Health Plan and Addendum and I have attended the Safety Briefing for the aforementioned site.

| NAME (PRINTED) | OFFICE | SIGNATURE | DATE |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Person presenting the safety briefing:

_____ _____
SIGNATURE DATE