Site: Boardman Air Force Range
Location: Boardman, Oregon
USACE District: Seattle
TPP #1 Meeting Location: Port of Morrow, River Front Center, Boardman, Oregon
TPP #1 Meeting Date: 7/20/06

Agenda (tentative)

Thursday, July 20, 2006 (all times are Pacific Standard Time)

- **1:00 PM Convene at Port of Morrow River Front Center Meeting Room**
  - Introductions
  - Review Site Inspection Objectives
    - Goals, Objectives, Roles & Responsibilities
    - Site Inspection Process
    - Technical Project Planning (TPP) Process
    - Review of Background Information

- **2:30 PM Technical Project Planning Discussion**

- **5:00 PM Conclude Meeting**

- **7:00 PM Public Meeting**

This Technical Project Planning (TPP) Meeting Package contains information for discussion and evaluation of Formerly Used Defense Sites (FUDS) at the TPP Meeting. It is provided to participants of the TPP Meeting and will be updated and redistributed as the Draft TPP Memorandum.

Sign-in Sheet
Technical Project Planning Meeting
Boardman Air Force Range
July 20, 2006

Name	Affiliation	Address	Phone Number	E-mail
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Sign-in Sheet
Technical Project Planning Meeting
Boardman Air Force Range
Public Meeting
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U.S. Army Corps of Engineers
Omaha District

Technical Project Planning Meeting Package 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
Delivery Order No. 003

July 13, 2006

Shaw® Shaw Environmental, Inc.

9201 East Dry Creek Road
Centennial, CO 80112

Technical Project Planning Memorandum

Site Inspection
Boardman Air Force Range
Formerly Used Defense Site
FUDS ID F10OR0160

Military Munitions Response Program

Documentation for Technical Project Planning Meeting
Port of Morrow Riverfront Center
Boardman, Oregon
July 20, 2006

Hosted by U.S. Army Corps of Engineers

Prepared by Shaw Environmental, Inc.

July 13, 2006

Concurrences

USACE Omaha Design Center	_____ Mike Watson
USACE Seattle District	_____ Mike Nelson
Oregon Department of Environmental Quality	_____ David Anderson
Shaw Environmental, Inc.	_____ Peter Kelsall

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ABBREVIATIONS AND ACRONYMS

AFR	Air Force Range
AOC	area of concern
ASR	Archives Search Report
BAIC	Boeing Agri-Industrial Company
bgs	below ground surface
CSM	Conceptual Site Model
DoD	Department of Defense
DOI	Department of the Interior
DQO	Data Quality Objective
EOD	Explosives Ordnance Disposal
ft	foot or feet
FS	Feasibility Study
ºF	degrees Fahrenheit
FUDS	Formerly Used Defense Site
HRS	Hazard Ranking System
INPR	Inventory Project Report
lb	pound
MC	munitions constituents
MEC	munitions and explosives of concern
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
µg/L	microgram(s) per liter
mm	millimeter
MMRP	Military Munitions Response Program
MRSPP	Munitions Response Site Prioritization Protocol
Navy	Department of the Navy
NDAI	No Department of Defense Action Indicated
ODEQ	Oregon Department of Environmental Quality
PA	Preliminary Assessment
PCOC	potential contaminant of concern
PGE	Portland General Electric
PRG	Preliminary Remediation Goal
RAC	Risk Assessment Code
RBC	Risk-Based Concentration
RI	Remedial Investigation
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SSWP	Site-Specific Work Plan
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance

Administrative Information

The Technical Project Planning (TPP) Memorandum is one in a series of documents used during the Site Inspection (SI) process to document the information collected and processes used to evaluate Formerly Used Defense Sites (FUDS) for the possible presence of munitions and explosives of concern (MEC) and/or munitions constituents (MC). TPP Meeting information provided in the Memorandum reflects both the original version of information shared with meeting participants, as well as changes/updates to site-specific information obtained during the TPP Meeting.

The TPP Meeting for the former Boardman Air Force Range (Boardman AFR) will be conducted on July 20, 2006 at the Port of Morrow Riverfront Center in Boardman, Oregon. Representatives from the U.S. Army Corps of Engineers (USACE) – Omaha Design Center and Seattle District, the Oregon Department of Environmental Quality (ODEQ), and Shaw Environmental, Inc. (Shaw) will be in attendance. In addition, stakeholders from Portland General Electric, Boeing Agri-Industrial Company (BAIC), and Threemile Canyon Farms will also be invited to attend. A separate public meeting will be held in the evening of the July 20, 2006. A site tour may be conducted as part of this meeting.

The TPP Memorandum documents discussions for the TPP meeting and includes the sections described below:

- **Administrative Information:** includes meeting logistics and the list of attendees;
- **Site Inspection Objectives:** provides the goal and objectives of the SI, roles and responsibilities, the SI process, and the TPP process;
- **Background Information:** includes site and project history, area physical setting, a summary of previous environmental work, and an introduction to the areas of concern (AOCs) addressed by the SI;
- **Conceptual Site Model (CSM):** identifies environmental attributes, potential human and ecological receptors in the area's environment, and the relationships between these factors;
- **Proposed Sampling Scheme:** describes the type and quantity of samples to be taken, and the analytical methods to be used for characterizing the AOC;
- **TPP Notes and Data Quality Objectives (DQOs):** captures project and site-specific information as discussed during the TPP Meeting to ensure the necessary and appropriate information is shared among meeting participants, and that meeting participants concur with the identified goal, objectives, and approach used to complete the SI process; and
- **Worksheets:** includes the **Site Information Worksheet,** Draft **Munitions Response Site Prioritization Protocol** (MRSPP) **Data Gaps, and Hazard Ranking System** (HRS) **Data Gaps.**

Site Inspection Objectives

Goal

- The USACE is conducting SIs of FUDS properties to determine if any MEC or related MC are present on property formerly owned or leased by the Department of Defense (DoD).

Objectives

- Determine if the site requires further response action because of the presence of MEC/MC.
- Collect minimum information needed to:
    - Eliminate a site from further consideration if:
        - No evidence of MEC and/or
        - Concentrations of MC in samples are below risk-based action levels, or below background concentrations; or
    - Determine the potential need for removal action or initiation of the Remedial Investigation/Feasibility Study (RI/FS) if:
        - MEC identified and/or
        - Concentrations of MC in samples exceed risk-based action levels and background concentrations.
    - Provide sufficient data for the U.S. Environmental Protection Agency (USEPA) and the Army to prioritize future actions using the HRS and MRSPP.

Roles & Responsibilities

- **USACE:** Acts as the executing agency for the DoD with regard to the FUDS program. In this role, the USACE has decision making authority and is responsible for ensuring work is conducted in accordance with applicable USACE and federal guidance. Additionally, USACE coordinates and works with project team members to meet needs expressed by regulatory agencies and stakeholders to the extent possible within the programmatic guidelines.
- **Regulatory Agency:** Participates in planning of SI activities to ensure the project meets applicable state standards and requirements.
- **Property Owner(s)**: Provides available and pertinent information about the area, provides in sight on current and anticipated future land uses for the property, and participates in project team discussions.
- **Shaw**: As a contractor to the USACE, conducts work on behalf of the USACE, provides TPP materials, makes site information available to the project team through a web-based information portal, and conducts and reports SI activities.

Site Inspection Process

- Data review,
- TPP,
- Site-Specific Work Plan (SSWP),
- SI field activities – reconnaissance, sampling, and analysis, and
- SI Report.

Technical Project Planning Process

- Conduct TPP meeting(s)* with key organizations and stakeholders;
- Identify stakeholder(s) concerns;
- Identify all AOCs for this SI;
- Review site information;
- Verify current and anticipated future land use;
- Develop CSM;
- Identify data gaps;
- Plan how to address data gaps;
- Develop DQOs for meeting SI requirements; and
- Concur on SI field work approach.

* Second TPP meeting to be determined by team members during the 1st TPP meeting.

Background Information

Site Description and Regulatory History

Historical information (including references to interviews and historical documents) contained in this package was obtained from the *Archives Search Report* (ASR) (USACE, 1997) and *ASR Supplement* (USACE, 2004) for the Boardman AFR. In addition, information obtained from the *Boardman AFR FUDS Preliminary Assessment/Site Inspection Report* (2004) prepared by Weston Solutions for the USEPA was used in the preparation of this document.

Site Location

- The former Boardman AFR is located approximately 5.5 miles south Boardman, Oregon, in Morrow County (Figure 1). Boardman is in the north central portion of Oregon along the Columbia River.
- Originally Boardman AFR occupied 95,985 acres. In 1960, the Air Force declared the property surplus and portions of the site were transferred to the U. S. Department of Interior (DOI) (37,320.31 acres), USACE (290 acres), and Department of the Navy (Navy) (58,372.9 acres). The parcels transferred to the DOI and the Navy were aligned in a checkerboard pattern. 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 (290 acres) along the Columbia River. After the property redistribution, the FUDS Boardman AFR occupies an area of 48,975.51 acres.
- The former Boardman AFR has five AOCs: three bomb targets; one range complex consisting of a gunnery training range, demolition area, and a bomb target; and a separate demolition area.

Physical Setting

- Boardman AFR lies within the Columbia Basin Subprovince of the Columbia Intermontane Physiographic Province.
- The former Boardman AFR slopes gently 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 site is currently used for:
    - Irrigated agricultural and grazing purposes. The site is currently heavily used for farming of potatoes and onions.
    - A restricted antennae test range owned by the BAIC.
    - A fossil fuel power generating plant owned by Portland General Electric Company (PGE).
    - An airstrip at the site operated and maintained by the Morrow County Port Authority.
- Boardman, Oregon is the nearest incorporated community (approximately 5.5 miles north) with a population of 2,855 (2000 census).

- 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 minimum temperature is 27.0 in January. The average annual precipitation is 8.41 inches per year.
- The AOCs are located in fenced areas, however, access to most of them is unrestricted or uncontrolled. Access to other AOCs (INPR Site No. 1 and Demolition Area) is more restricted by access control to the BAIC Antennae Test Range.

Previous Investigations and Regulatory History

- The USACE prepared an Inventory Project Report (INPR) for Boardman AFR in September 1992, in which a potential hazard from unexploded ordnance (UXO) at the FUDS was identified.
- The USACE issued an ASR in 1997, which compiled available information for Boardman AFR with emphasis on types and areas of ordnance use and disposal.
- An ASR Supplement completed in 2004 identified specific AOCs. During 2006 TPP planning for the 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

- The USEPA completed a Preliminary Assessment/Site Inspection (PA/SI) for 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, surface water, and groundwater. Samples were analyzed for Target Analyte List metals, nitrogen-based explosives, and perchlorate. No samples contained significant concentrations of metals and no nitrogen-based explosive compounds were detected. Perchlorate was detected in all five surface water samples but not in an associated sediment sample. Surface water concentrations ranged from 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.

Operational History and MEC/MC Characteristics

Historic Military Operations

- Between 1941 and 1943, the United States Army Air Corps acquired 95,985.51 acres, through purchase of private land and transfer of DOI land, for a bombing and gunnery range. It was used by the Walla Walla Army Air Base for air-to-ground gunnery 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 57th Air Division, Fairchild Air Force Base, assumed the responsibility, control, and utilization of the Boardman AFR. A moving 20-mm target gunnery range with three mounted B-36 turrets were 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 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 it's 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.

MEC/MC Characteristics

- The MEC and MC used at the Boardman AFR are shown on Table 1. A disposal pit was used to destroy incendiary bombs (AN-50A2) and ammunition.

- The only hazardous substance found during the 2004 PA/SI was perchlorate in surface water and groundwater. Surface water concentrations ranged between 0.32 µg/L and 7.49 µg/L. Results from a surface water sample collected from Carty Reservoir indicated no perchlorate was detected. Perchlorate was detected in 18 of 25 groundwater samples; concentrations ranged between 0.46 µg/L and 20.7 µg/L. The DoD action level is 24.5 µg/L.

Groundwater

- The soils at 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 depth of the groundwater at the Boardman AFR is approximately 10 ft.
- There are no private irrigation wells and several monitoring wells located within the Boardman AFR.

Surface Water

- The Boardman AFR is located within the Middle Columbia-Lake Wallula Watershed.
- Carty Reservoir is located within 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 Six-mile Canyon Creek. There is no surface water outlet from the reservoir.
- Six-mile Canyon Creek traverses across the western portion of the Boardman AFR. The creek is not known to support fisheries. Six-mile Canyon Creek flows into the Columbia River, which is a major river that support both federally and state threatened and listed species.
- Surface water samples were collected at five locations along Six-mile Canyon Creek during the PA/SI (Weston, 2004). Samples were analyzed for perchlorate. Perchlorate was detected in all stream samples. Perchlorate concentrations decreased downstream.

Terrestrial Exposure

- There are no residences or schools/day care facilities within 200 ft of the Boardman AFR.
- The ASR identified eight species of endangered wildlife and three types of threatened vegetation that may be found within or near the former Boardman AFR area. The Oregon Department of Fish and Game and the U.S. Fish and Wildlife Service have been contacted to provide specific information about the site. The chart below lists the endangered or threatened species in the area based on the ASR.

Endangered Wildlife	Threatened Vegetation
Peregrine Falcon	Robinson's Onion
Bald Eagle	Laurence's Milk-vetch
Ferruginous Hawk	Little Mousetail
Swainson's Hawk	
Washington Ground Squirrel	
Painted Turtle	
Long-billed Curlew	
Northern Grasshopper Mouse	

- A 7-mile stretch of the Oregon Trail crosses the extreme southern portion of the Boardman AFR and has been labeled as "a high potential segment" for archeological resources. The State Historical Preservation Office (SHPO) is being contacted to provide up-to-date information on the site.

Air

- Boardman, Oregon is the nearest population center (approximately 5 miles).
- There are numerous farms and ranches located adjacent to and near the Boardman AFR.

Conceptual Site Model

Site Inspection
Boardman Air Force Range

Technical Project Planning Meeting
July 20, 2006

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,
- Range Complex No. 1, and
- Demolition Area No. 2.

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 has recently been reported (March 2006) at unspecified locations on the Boardman AFR. These reports were made following the discovery of six 250-pound (lb) practice bombs capable of detonating. The bombs were recovered from the recycler by a Navy Explosive Ordnance Disposal (EOD) team and were later detonated at the nearby Navy Bombing Range. The practice bombs were report to have been recovered from a farm on the Boardman AFR.

Conceptual Site Model – Target No. 1 AOC

Target No. 1 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 (2004). The southern one-third of the AOC overlaps with Carty Reservoir Target AOC. Figure 1 shows the general location of Target No.1, and Figure 2 shows a more detailed view of the AOC using a aerial photo overlay.

Current and Future Land Use

- The Target No. 1 AOC is located on PGE property adjacent to Carty Reservoir. Approximately 40 percent of the safety zone is inundated by Carty Reservoir.
- The terrain is flat with a gradual slope toward the shoreline of Carty Reservoir.
- The area north and east 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 west of the target is now used for irrigated farming.
- North of the earthen dam the land has been maintained as range land.
- One groundwater well at the PGE Power Generating Station is located approximately 650 ft northeast of the outer boundary of the AOC. Several groundwater monitoring wells are also located at the generating station.
- Carty Reservoir is the nearest surface water body to the AOC. Six-mile Canyon Creek flows through the northeast corner of the target.
- The source of water for Carty Reservoir is unknown and is a data gap. The water is used for cooling at the PGE Power Generating Station and the reservoir may be feed by a groundwater source. It is unlikely that normal stream flow could maintain reservoir levels in the summer.

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 debris were identified within the target footprint or safety zone. However, the contractor that conducted the INPR for the USACE identified several small items whose description matched that of a 31-lb practice bomb.

Potential Contaminant Sources – Target No. 1 AOC

- The ASR Supplement (USACE, 2004) 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 pyrotechnic 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 whose description matched that of a 31-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 livestock and 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 livestock and 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 2.

MEC Evaluation/Investigation Needed

- Visual 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.

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, nickel, and titanium.
- 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.

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: The source of water for Carty Reservoir is unknown at this time. Carty Reservoir may be potentially affected, although the MC from munitions used at this AOC may not pose a negative 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 it is approximately 10 feet below ground (bgs) surface at the site. Migration of MC directly to the groundwater from the soil is considered to be possible. However, the constituents of the MC may not pose a negative risk.
- Air: Air is a potential medium of concern because of the possibility of inhalation of contaminated soil particles. However, air is not an affected media under current land use, thus the pathway is incomplete.

Exposure media at the Boardman AFR include soil, surface water, sediment, and groundwater. A pathway evaluation for each media is discussed below and provided in Table 2.

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

Receptors

- Workers (PGE and agricultural workers).
- Livestock and wildlife.

MC Soil Evaluation/Investigation Needed

- One soil sample will be collected from this AOC if MEC or munitions debris is located during the visual reconnaissance survey. The sample will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc). This metals list is based on expected metals to be contained in the munitions. Only black powder

explosives and red or white phosphorous signals were used. No analysis for explosives will be completed.

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 livestock and 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 workers).
- Livestock and 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 USEPA's PA/SI (Weston, 2004) and analyzed for perchlorate. Analytical results indicated that no detectable concentrations of perchlorate were found in the surface water sample from Carty Reservoir. The samples were not analyzed for metals or explosives. 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 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 livestock and wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

Receptors

- Workers (PGE and agricultural workers).
- Livestock and 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. The potential routes for livestock exposure include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.

Receptors

- Workers (PGE and agricultural workers).
- Livestock and wildlife.

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for the Target No. 1 AOC. The PA/SI (Weston, 2004) 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 were not included in the PA/SI analytical suite. However, because of the types of metals contained in munitions used at Target No. 1, metals are not considered a concern for groundwater.

Conceptual Site Model – Target No. 2 AOC

Target No. 2 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 USEPA's PA/SI (Weston, 2004). The target name is consistent with the ASR Supplement (2004). Figure 1 shows the general location of Target No. 2 and 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.
- There are no groundwater wells located within the boundary of Target No 2.
- The nearest surface water is Six-mile Canyon Creek located approximated 1,800 ft west of the southwest boundary of the AOC.

Former Range Use

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

Potential Contaminant Sources – Target No. 2 AOC

- 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.
- The AN-M50 incendiary bombs were cased in a magnesium shell and contained a fuze and thermite. Thermite consists of a mixture of iron oxide, aluminum, and sulfur.
- 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 (ASR, 1997).

MEC Evaluation

Types of MEC

- The types of munitions used at Target No. 2 are listed above. Debris from these munitions were observed during the ASR site visit in 1997. 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 has been reported from this AOC as recently as March 2006.

- The potential for UXO to be present at this AOC is moderate. 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 livestock and 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 livestock and 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 2.

MEC Evaluation/Investigation Needed

- No MEC reconnaissance surveys will be conducted at this AOC. The potential for MEC is indicated by the presence of munitions debris as indicated in the ASR.

MC Evaluation

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, nickel, and titanium.
- 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.
- 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: Six-mile Canyon Creek may be potentially affected by runoff from the target area.

- Sediment: Sediment in Six-mile Canyon Creek may be potentially affected by surface water runoff from impacted soil areas. However, Six-mile 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 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 likely because of the shallow depth to groundwater. No known 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. However, air is not an affected media under current land use, thus the pathway is incomplete.

Exposure media at the Boardman AFR include soil, surface water, sediment, and groundwater. A pathway evaluation for each media is discussed below and provided in Table 2.

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

Receptors

- Agricultural workers.
- Livestock and wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples will be collected from Target No. 2 and analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc) and explosives including nitroglycerin. This metals list is based on expected metals to be contained in the munitions. Soil samples were collected from near the Target No. 2 AOC during the PA/SI (Weston, 2004). 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, and nitroglycerin 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 livestock and 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

- Agricultural workers.
- Livestock and wildlife.

MC Surface Water Evaluation/Investigation Needed

- No water samples will be collected from surface waters. Surface water samples were collected from Six-mile Canyon Creek during the PA/SI (Weston, 2004) in 2004. Samples were analyzed for perchlorate only. Perchlorate was detected in five surface water samples collected along the course of Six-mile Canyon Creek. The samples were collected from both up and downstream location of the Target No. 2 AOC.
- Sampling for metals and explosives 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. In addition, the types of metals contained in the munitions used at this target do not constitute a potential impact to the surface water. The primary explosive used at this target was black powder, whose constituents are nonhazardous. The use of the Mk 6 2.25 practice rocket is considered to be limited.

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 livestock and wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

Receptors

- Agricultural workers.
- Livestock and wildlife.

MC Sediment Evaluation/Investigation Needed

- No sediment samples will be collected from Six-mile Canyon Creek. A sediment sample was collected from a point near the AOC during the PA/SI (Weston, 2004). 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. The primary explosive used at the Target No. 2 AOC was black powder only. The use of the Mk 6 2.25 practice rocket is considered to be limited.

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

Receptors

- Agricultural workers.
- Livestock and wildlife.

MC Groundwater Evaluation/Investigation Needed

- No groundwater samples are planned for the Target No. 2 AOC. The PA/SI (Weston, 2004) 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, because of the types of metals contained in munitions used at Target No. 2, metals are not considered a concern for groundwater.

Conceptual Site Model – Carty Reservoir Bomb Target AOC

Carty Reservoir Bomb Target 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 USEPA's PA/SI (Weston, 2004). The target name is consistent with the ASR Supplement (2004). Figure 1 shows the general location of Carty Reservoir Bomb Target and Figure 5 shows a more detailed view. The configuration and current land uses in the vicinity of the target. This AOC overlaps with Target No. 1.

Current and Future Land Use

- The Carty Reservoir Bomb Target AOC is located on PGE and Three-mile Canyon Farms property. The western half of the AOC is currently used for irrigated farming and the eastern portion is native vegetation consisting of grasses. There is evidence of livestock grazing in the area.
- The terrain slopes toward Carty Reservoir.
- There are no groundwater wells 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 – Carty Reservoir Bomb Target AOC

- Likely range munitions used at this AOC was the Mk 23, M38A2, and M75 practice bombs and the 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 practice 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 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 moderate. 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 livestock and 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 livestock and 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 2.

MEC Evaluation/Investigation Needed

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

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 iron include aluminum, chromium, copper, lead, manganese, molybdenum, nickel, and titanium.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder that contains potassium nitrate, sulfur, and charcoal.

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 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. However, air is not an affected media under current land use, thus the pathway is incomplete.

Exposure media at the Boardman AFR include soil, surface water, sediment, and groundwater. A pathway evaluation for each media is discussed below and provided in Table 2.

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

Receptors

- PGE and agricultural workers.
- Livestock and wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples are planned for the Carty Reservoir Bomb Target. Soil samples will be located near the target center where a high density of munitions debris has been reported. Samples will be analyzed for selected metals. Black powder was the only explosive used. Because of its nonhazardous composition, no sampling for black powder is necessary.

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 livestock and 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

- PGE and agricultural workers.
- Livestock and 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 (Weston, 2004) in 2004 and analyzed for perchlorate only. Perchlorate was not detected in the surface water sample.
- Sampling for metals and explosives is not required. The metals contained in munitions used at this target do not constitute a potential impact to the sediment in Carty Reservoir. The only 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 livestock and wildlife exposure to contaminated sediment include ingestion of and direct contact with sediment.

Receptors

- Agricultural workers.
- Livestock and wildlife.

MC Sediment Evaluation/Investigation Needed

- One sediment sample will be collected from Carty Reservoir and analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, and zinc). Only black powder explosives and red or white phosphorous signals were used. Sampling for perchlorate is not required as no perchlorate was detected in the surface water sample collected during the PA/SI (Weston, 2004) 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. The potential routes for livestock exposure include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.

Receptors

- PGE and agricultural workers.
- Livestock and wildlife.

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for the Carty Reservoir Bomb Target AOC. The PA/SI (Weston, 2004) 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 an upgradient sample, but not in downgradient samples. Metals were not included in the PA/SI analytical suite. However, because of the types of metals contained in munitions used at this AOC, metals are not considered a concern for groundwater.

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. Figures 6 through 8 show greater detail of the Range Complex.

The INPR Site No. 1 is a bomb target that was in use between 1946 and 1960. The ASR Supplement (USACE, 2004) indicated that the target was configured with concentric circles of 100, 200, and 300 ft. However, recent aerial photos show faint concentric circles at 75, 500, and 1000 ft (see Figures 6 and 7). 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 No.1 during the PA/SI (Weston, 2004).

The Demolition Area was used for the demolition of munitions between 1945 and 1960. The area consists of two rows, approximately 200 ft apart. Each row has 20 pits (craters) spaced 50 ft apart. Munitions debris is embedding is the crater walls and munitions debris is 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. The range name is consistent with the ASR Supplement (2004).

Current and Future Land Use

- Range Complex No.1 is shown on Figure 6. Much of the northern half of the range complex is currently being used for irrigated crops or grazing. The southern portion of the range is used for the BAIC Antennae Test Range, for irrigated crops and grazing, and wildlife conservation area managed by the Nature Conservancy.
- There are no groundwater wells 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 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 – Range Complex No. 1 AOC

- The likely range munitions used were:
    - INPR No. 1 – Mk 23, Mk 76, Mk 89, Mk 106, M38A2, BDU 10, and BDU 33 practice bombs.

- 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.

- The Mk 23, Mk 76, Mk 89, and BDU 33 practice bombs were constructed from cast iron and contained black powder and a red phosphorus pyrotechnic signal charge.
- The M38A2 practice bombs are a sand-filled sheet metal cased 100-lb practice bomb and contained a black powder spotting charge.
- The Mk 106 practice bomb is cased in sheet metal and contains a fuze and a charge of red phosphorus that is used as a marker.
- The BDU 10 is a nuclear practice bomb that is concrete filled and contains inert material.
- C-4 explosive is a plastic explosive containing 91 percent RDX and 9 percent oily plasticizers. Detonation cord contains a central core of PETN high explosive. The time blasting fuze contains a core of black powder.
- The 20 mm Ball practice ammunition contains a 3.31-inch steel projectile with no explosive or tracer charge.

MEC Evaluation

Types of MEC

- The types of munitions used at Range Complex No. 1 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 No. 1 site are post Koran War vintage, particularly the BDU 10 practice nuclear bomb.
- The potential for UXO to be present at this AOC is moderate and primarily within INPR No.1 and the Demolition Area. 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 (BAIC and agricultural workers) to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling.
- The potential route of livestock and wildlife exposure to MEC or munitions debris would be by directly walking on them.

Subsurface Exposure Pathway

- The potential routes of human exposure (BAIC and 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 livestock and 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 2.

MEC Evaluation/Investigation Needed

- Visual reconnaissance of the will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer. Visual reconnaissance surveys will be near the location of the INPR No 1 target and the Demolition Area when selecting soil sampling locations.

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, nickel, and titanium.
- Spotting charges or signals used with practice bombs at this AOC primarily consist of a black powder that contains potassium nitrate, sulfur, and charcoal.
- 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 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. However, air is not an affected media under current land use, thus the pathway is incomplete.

Exposure media at Range Complex No. 1 include soil and groundwater. A pathway evaluation for each media is discussed below and provided in Table 2.

Figures 3 and 9 illustrate the CSMs for Range Complex No.1 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 livestock and wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by livestock and wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Agricultural workers.
- Livestock and wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples are planned for the Range Complex No. 1. The 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 reconnaissance UXO survey using a magnetometer. Samples will be analyzed for selected metals and explosives. A soil sample was collected from INPR No. 1 during the PA/SI (Weston, 2004) and 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. The potential routes for livestock exposure include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.

Receptors

- BAIC and agricultural workers.
- Livestock and wildlife.

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for Range Complex No.1. The PA/SI (Weston, 2004) 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, because of the types of metals contained in munitions used at this AOC, metals are not considered a concern for groundwater.

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 several 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 and research on the AOC is continuing.
- There are no groundwater wells 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 if this area is the demolition area that was reported to have been leased to the Umatilla Army Ordnance Depot for destruction of unusable munitions.

Potential Contaminant Sources – Demolition Area No. 2

- 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 are listed above. Debris from these munitions were identified by employees of the Nature Conservancy who manage a portion of land for critical wildlife habitat.

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 livestock and 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 livestock and 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 2.

MEC Evaluation/Investigation Needed

- No visual reconnaissance survey of Demolition Range No. 2 is necessary. MEC and munitions debris has been identified at the AOC. of the immediate target area will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer through portions of the range area. Visual reconnaissance surveys when selecting soil sampling locations will however be completed.

MC Evaluation

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.

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 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. However, air is not an affected media under current land use, thus the pathway is incomplete.

Exposure media at Range Complex No. 1 include soil and groundwater. A pathway evaluation for each media is discussed below and provided in Table 2. 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

- Agricultural workers.
- Wildlife.

MC Soil Evaluation/Investigation Needed

- Two soil samples are planned for 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 reconnaissance UXO survey utilizing a magnetometer. Samples will be analyzed for selected metals and explosives.

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.

MC Groundwater Evaluation/Investigation Needed

- No additional groundwater samples are planned for this AOC. The PA/SI (Weston, 2004) 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, because of the types of metals contained in munitions used at this AOC, metals are not considered a concern for groundwater.

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 Target No. 2.
- Some sampling for MC has been completed as part of the USEPA's PA/SI (Weston, 2004). Perchlorate has been detected in surface water and groundwater. Table 3 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 reconnaissance survey.
Target No. 2	Established	Unknown	Reconnaissance for sample locations. Soil sampling.
Carty Reservoir Bomb Target	Established	Unknown	Reconnaissance for sample locations. Soil and sediment sampling.
Range Complex No. 1	Established	Absent on INPR Site No.1, Unknown at Demolition pits. Only small arms used on Turret Gunnery Range	Reconnaissance for sample locations. Soil sampling in Demolition Area.
Demolition Area No. 2	Established	Unknown	Reconnaissance for sample locations. Soil 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 of this SI.

Proposed Sampling Scheme

Proposed Field Investigation

The proposed field investigation sampling to be conducted at the former Boardman AFR is detailed below. The investigation approach will be defined in more detail in an SSWP that will be submitted to ODEQ and other stakeholders for review. The SSWP will reference technical details including sampling and analytical methods that are described in the *Type I Work Plan, Site Inspections at Multiple Sites*, prepared by Shaw and submitted to USACE as final in February 2006.

Reconnaissance Survey

A visual reconnaissance survey will be completed at Target No.1 to locate MEC and munitions debris. The objective of the reconnaissance survey will be to determine whether MEC or munitions debris are present at the AOC. If MEC or munitions debris are located, then a soil sample will be collected. The magnetometer-assisted, visual reconnaissance survey will be conducted by a qualified UXO technician within the target area. A global positioning system will be used to record discovered MEC and munitions debris. 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.

Soils

Surface soil samples will be collected at a depth of approximately 0 to 6 inches bgs. Surface soil samples will be composite samples (7-point, wheel pattern with 2-ft radius). Subsurface samples if collected will be discrete samples collected from between a 6- to 12-inch depth. Sediment samples will be collected from a 0- to 6-inch depth but will be discrete samples in order to retrieve material from specific, localized, surface water drainage features.

One soil sample will be collected from the Target No. 1 AOC if MEC or munitions debris is located. The sample will be collected from one location and analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc) only. Use of this target is thought to be very limited if used at all, and the explosives contained in munitions used at this AOC were not hazardous (potassium nitrate, sulfur, and charcoal.

Two soil samples will be collected from Target No. 2 AOC and analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc) and explosives including nitroglycerin. The PA/SI (Weston, 2004) sample locations from this area were not within the AOC and are thus not representative of Target No. 2.

Two soil samples will be collected from the Carty Reservoir Bomb Target and analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc) only. Samples will not be

analyzed for explosives as the explosives contained in munitions were not hazardous (potassium nitrate, sulfur, and charcoal).

Two soil samples will be collected from the Demolition Area within Range Complex No. 1 to determine impacts to soil from explosive compounds used during demolition activities. Samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc) and explosives.

Two soil samples will be collected from the Demolition Area No. 2 and analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc) and explosives (including nitroglycerin and PETN). Samples will be collected from near disposal craters.

No soil samples will be collected from INPR No. 1 or the Turret Gunnery Range. INPR No. 1 was sampled previously for metals, nitrogen-based explosive compounds, and perchlorate. There were no metals detected that significantly exceeded background concentrations and no explosives or perchlorate were detected in the soils. The Turret Gunnery Range consists only of the downrange area and the firing positions were located on what is now Navy property and not part of this FUDS. In addition, the 20 mm munitions fired utilized a steel projectile, which contained only trace concentrations of hazardous metals (e.g., chromium).

Surface Water and Sediment

One sediment sample will be collected from Carty Reservoir Bomb Target. The sample will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc). The sample will not be analyzed for explosives. The only explosives used at this target were black powder. Surface water samples were collected from Carty Reservoir (one sample) and from Six-mile Canyon Creek (five samples) during the PA/SI (Weston, 2004). Samples were analyzed for perchlorate only.

Groundwater

No groundwater sampling is planned for this AOC. Groundwater sampling for the Boardman AFR was completed during the USEPA's PA/SI (Weston, 2004) sufficient to meet data objectives.

Background Sampling

Ten background soil samples will be collected from the Boardman AFR to evaluate background conditions. Sample locations will be chosen with the aid of Visual Sampling Plan (PNNL, 2005). Background concentrations will be evaluated by calculating the upper tolerance limit.

The background sediment sample collected for the PA/SI will be used to in this PA/SI to evaluate site background concentrations.

TPP Meeting Notes and Data Quality Objectives

Technical Project Planning and Development of Data Quality Objectives

- The USACE TPP process is a four-phase process:
  - Identify the current project,
  - Determine data needs,
  - Develop data collection options, and
  - Finalize data collection program.
- The purpose of TPP is to develop DQOs that document how the project makes decisions.
- DQOs are intended to capture project-specific information such as the intended data use(s), data needs, and how these items will be achieved.
- Information captured through DQOs will be used as a benchmark for determining whether identified objectives are met.

TPP Phases

Phase I: Identify the Current Project

1. Team members identified to date include: USACE – representatives from the Omaha Design Center and the Seattle District; Shaw Environmental, Inc. as a USACE contractor; ODEQ; USEPA Region 10; Portland General Electric; BAIC; and Three-Mile Farms.

   Question: Is there any person or organization missing from this Team?

2. The AOCs are identified as:

   - Target No. 1,
   - Target No. 2.
   - Carty Reservoir,
   - Range Complex No. 1
     - INPR site No. 1
     - Demolition Area
     - Turret Gunnery Training Range , and
   - Demolition Area No. 2.

   All areas, except the Demolition Area No. 2, were assigned a RAC of 4 during the ASR study. The Demolition Area No. 2 is a newly identified AOC and was not scored. A list of munitions used at Boardman AFR is provided on Table 1. Based on interviews with former personnel and site owners, MEC has been found on site.

Question: Are there any other AOCs to be identified?

3. Based on information available about the site and shared through discussions with USACE, concerns about this area have been expressed by the landowners.

   Question: Are there additional concerns or issues from landowners or other stakeholders regarding the Boardman AFR area?

   Question: Are there any administrative or stakeholder concerns or constraints that would prevent site inspection activities from going forward on the decision path for this site?

Phase II: Determine Data Needs

4. Existing site information includes an ASR and ASR Supplement both prepared by the USACE in 1997 and 2004, respectively and a PA/SI prepared for the USEPA by Weston in 2004.

   Question: Are there any other pertinent documents relating to the site available?

5. The site-specific approach for this SI involves collating and assessing available site information, to include site geology, hydrogeology, groundwater, surface water, ecological information, human use/access, and current and future land uses; as well as considering conduct of site inspection and sampling activities.

   Question: Are there any other site aspects/information that should be considered?

6. Based on prior site investigations, soil are the primary affected medium at the Boardman AFR. Surface water is a potential pathway of MC because of the existence of Carty Reservoir and Six-mile Canyon Creek within or near several AOCs. Groundwater is a potential pathway considering the shallow occurrence (10 ft bgs). Air is also a potential

pathway if soil particles become airborne. Considering current and future land use, primary receptors of any contaminants that may be present would most likely be agricultural workers and animals using the area for ranching and grazing.

Question: Do team members concur with the CSM?

- **MEC and MC are to be evaluated at Target No. 1.**
- **MC is to be evaluated at Target No. 2, Carty Reservoir Bomb Target, the Demolition Area, and Demolition Area No. 2.**
- **MC contaminants of concern are metals, explosives, and perchlorate.**
- **Exposure pathways are through soils, surface water, and potentially groundwater.**

7. Technical considerations and/or constraints need to be identified and addressed before conducting any additional sampling, and would depend on the approach and additional data needs decided upon by team members.

Questions:

- **Are any data missing?**
- **What is the nature of needed data?**
- **What data gaps would additional data meet for making a decision about the site?**
- **Are there any considerations/constraints that need to be addressed for collecting additional data?**

Phase III: Develop Data Collection Options

8. Proposed approach:

    1. Conduct surface reconnaissance in the Target No. 1 AOC to identify MEC and munitions debris.
    2. Collect composite soil samples from the identified AOCs to be analyzed as detailed on Table 4.

Question: Based on the desired decision endpoints and information known to date, what additional information is needed to reach a determination of No Department of Defense Action Indicated (NDAI) or further action?

Question: What evidence of MEC is necessary to result in recommendation for the site to proceed to the RI stage relative to MEC and what is required for NDAI?

Question: Are the stakeholders in agreement with the sampling approach program?

Question: Are the stakeholders in agreement that no background data are required to make a decision?

Phase IV: Finalize Data Collection Program

9. What concentrations of COCs lead to decision end-points?
   Note: Oregon state standards are provided in Tables 5 through 11.

   Question: Are these the correct standards to be applied as screening values for human health and ecological risk assessment?

   Question: Are there any additional sampling and analysis methodologies needed for all team members to arrive at a decision end-point?

   The ODEQ has commented in previous TPPs for Camp Abbot and Camp Adair that it prefers using Risk-Based Concentrations (RBCs) based on guidance for *Risk-based Decision Making Process for the Remediation of Petroleum-Contaminated Sites* for evaluation of human health risk. Where RBC values are not available, USEPA Region 9 residential Preliminary Remediation Goals (PRGs) may be used.

   Concentrations to be used for human health and screening concentrations for ecological receptors are provided in the Tables 4 and 5.

   Question: Given the additional sampling and analysis methodologies, are there impacts to the project schedule that need to be accommodated?

Data Quality Objectives

Upon agreement at the TPP meeting, the following decision rules will be applied with regard to MC sampling results:

- Below risk-based screening levels = NDAI;
- Above risk-based screening levels and background = RI/FS.

The following expanded project objectives have been developed.

Objective 1: Determine if the site requires additional investigation or can be recommended for NDAI based on the presence or absence of MEC.

DQO #1 – Utilizing trained UXO personnel and handheld magnetometers, a visual reconnaissance Survey of Target No. 1 will be conducted to identify physical evidence to indicate the presence of MEC (e.g., MEC on the surface and munitions debris). The visual search will consist of a meandering path within the primary target area. The following decision rules will apply:

- If no evidence of explosive MEC is found, the AOC will be recommended for NDAI relative to MEC.
- If evidence of explosive MEC is confirmed, the AOC will be recommended for additional investigation.
- If there is indication of an imminent MEC hazard, the site may be recommended for a time critical removal action (TCRA).

DQO #2 – Decision for recommending proceeding to RI with respect to MEC can be made for Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1, and Demolition Area No. 2.

Objective 2: Determine if the site requires additional investigation or can be recommended for NDAI based on the presence or absence of MC above screening values.

DQO #3 – Soil samples will be collected and analyzed as proposed in Table 4 at Target No. 1, Target No. 2, Carty Reservoir, Bomb Target, the Range Complex No. 1 Demolition Area, and Demolition Area No. 2. Analytical results will be compared to screening values for human health and ecological risk assessment and to background and ambient samples collected during the this SI and PA/SI (Weston, 2004) values for naturally occurring substances. The following decision rules will apply:

- 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 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.

Objective 3: Obtain data required for HRS scoring.

Data required for HRS scoring are identified in the HRS Data Gaps worksheet.

Objective 4: Obtain data required for MRSPP ranking.

Data required for MRSPP ranking are identified in the MRSPP worksheet.

Next Steps

- Scheduling of a 2nd TPP meeting will occur as agreed upon by team members.
- Shaw will prepare the TPP Memorandum and distribute for concurrence.
- Shaw will prepare the SSWP for review and comment.
- Shaw will collect samples.
- Shaw will prepare the SI Report.

Figures

DRAWING NUMBER: Boardman_001_fig01_siteLayout

DRAWN BY: K. Masterson 07/12/06

OFFICE: MNRVL

119°54'0"W 119°48'0"W 119°42'0"W 119°36'0"W

45°48'0"N

45°42'0"N

Crow Butte State Park
Columbia River
Alder Creek
Lake Umatilla
Boardman
Boardman Air Force Range Flight Strip
Airport Rd
Tower Rd
Kunze Ln
Canal Ln
Wilson Ln
Wilson Rd
Peters Rd
Skoubo Ln
Paul Smith Rd
Parkside Dr
Main St
Olson Rd
Miller Rd
Laurel Ln
Esteegard Rd
Ripple Rd
Root Ln
Boardman Canal Rd
Kunze Rd
Columbia Ave
Utility Ln
Shangri La Rd
Sim Tag Ln
Three Mile Canyon Rd
Taggares Ln
Six Mile Canyon
Bombing Range Rd
Homestead Ln
Immigrant Ln
Alpine Ln
Juniper Canyon
Well Spring Rd
Sixmile Canyon

T4N R23E
T4N R24E
T4N R25E
T3N R23E
T3N R24E
T3N R25E
T2N R23E
T2N R24E
T2N R25E

Turret Gunnery Training Range - Range Complex No. 1
Target No. 2
Demolition - Range Complex No. 1
Range Complex No. 1
INPR Site No. 1 - Range Complex No. 1
Demolition Area No. 2
Target No. 1
Carty Reservior Bomb Target

Legend

- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Dept. of Defense
- Oregon Dept. of Fish and Wildlife
- Oregon Dept. State Lands
- United States Corps of Engineers
- United States Fish and Wildlife Service
- Groundwater Well
- Reported MEC Find
- Proposed Soil Sample
- Proposed Sediment Sample

PA/SI Sample Location

- Groundwater Sample
- Sediment Sample
- Soil Sample
- Surface Water Sample

NOTES:
1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.

N

0 4,000 8,000 16,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 1

SITE LAYOUT

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

DRAWING NUMBER *Boardman_006_fig06_trg1*

DRAWN BY *K. Masterson* 07/12/06

OFFICE MNRVL

119°50'53"W 119°50'24"W 119°49'55"W 119°49'26"W 119°48'58"W 119°48'29"W

45°41'46"N

45°41'17"N

45°40'48"N

280,000

R09851

R06790

Target No. 1

R05255

R05258

R05253

Carty Reservior Bomb Target

R10096

Legend

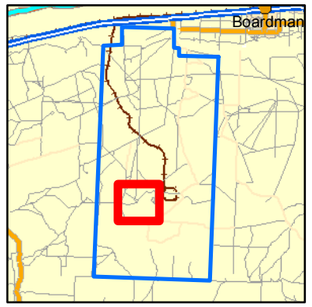
- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- Groundwater Well
- Proposed Soil Sample

PA/SI Sample Locations

- Groundwater Sample
- Surface Water Sample

NOTES:

1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
4) Aerial photo from TerraServer dated September 8, 2001.



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0 500 1,000 2,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

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FIGURE 2

TARGET NO. 1

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

XREF Files: IMAGE Files: airplane.jpg
File: O:\116188-FUDS-CAD\0300030\Rev-A\030003A02.dwg Layout: Layout1 User: Michael.Crawford Jul 11, 2006 - 11:11am

OFFICE	DRAWN BY		DRAWING NUMBER
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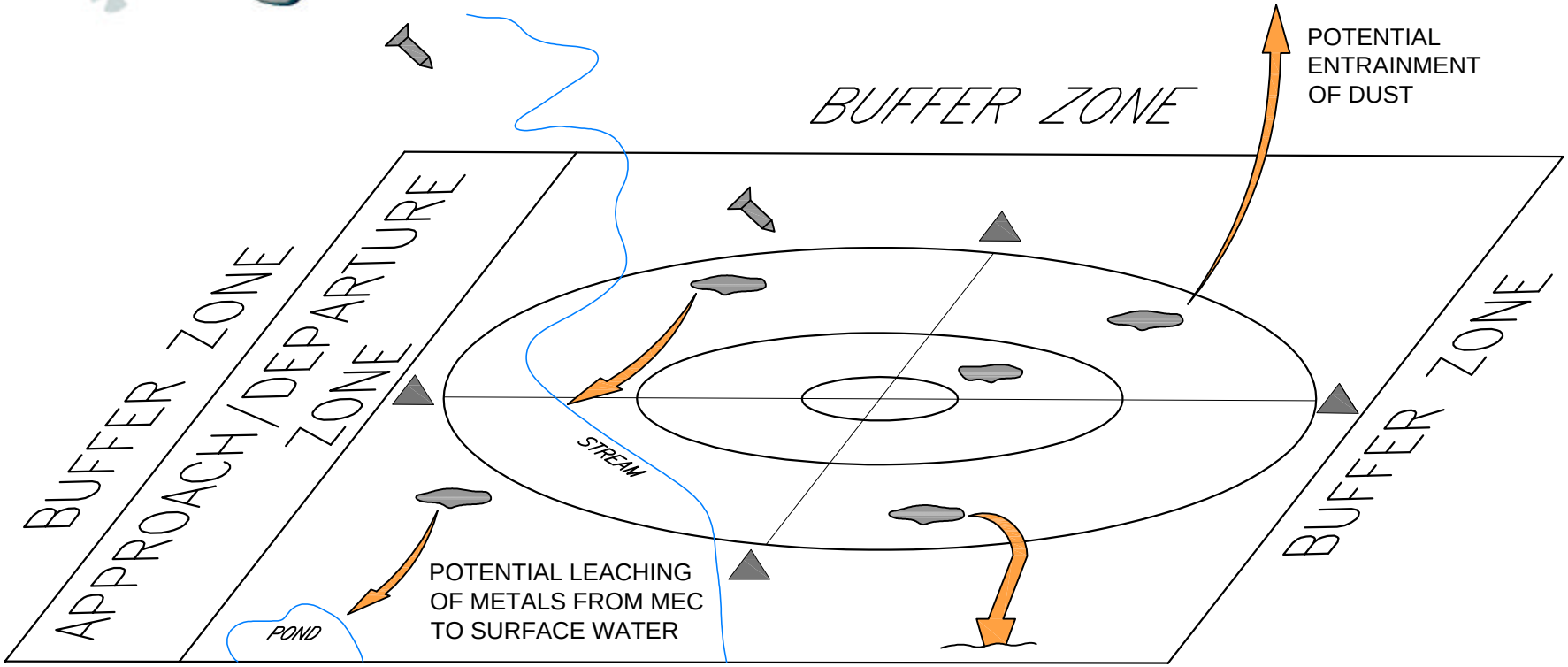


U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 3

CONCEPTUAL SITE MODEL
PRECISION BOMBING RANGE

BOARDMAN AIR FORCE RANGE

Shaw Environmental, Inc.

119°51'0"W 119°50'24"W 119°49'48"W 119°49'12"W 119°48'36"W

45°46'48"N

45°46'12"N

45°45'36"N

R04650

Target No. 2

R10103

R04650

R04665

Turret Gunnery Training Range
- Range Complex No. 1

R04650

DRAWING NUMBER *Boardman_003_fig03_trg2*

DRAWN BY *K. Masterson* *07/12/06*

OFFICE MNRVL

Legend

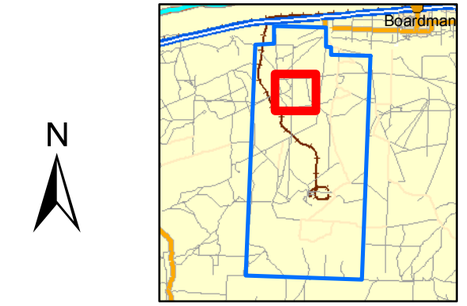
- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- Proposed Soil Sample

PA/SI Sample Locations

- Soil Sample

NOTES:

1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
4) Aerial photo from TerraServer dated September 8, 2001.



N

0 500 1,000 2,000
Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

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FIGURE 4

TARGET NO. 2

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

OFFICE: MNRVL
DRAWN BY: K. Masterson 07/12/06
DRAWING NUMBER: Boardman_007_fig07_crty_rsv

119°50'53"W 119°50'24"W 119°49'55"W 119°49'26"W 119°48'58"W

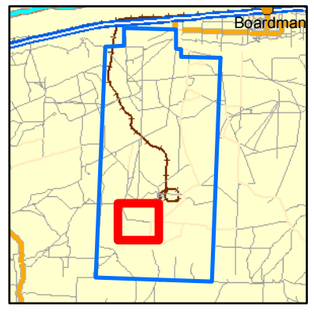
45°41'17"N
45°40'48"N
45°40'19"N
45°39'50"N

Target No. 1
R05255
R05258
Carty Reservior Bomb Target
R05253
R10096

Legend

- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- Proposed Soil Sample
- Proposed Sediment Sample

NOTES:
1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
4) Aerial photo from TerraServer dated September 8, 2001.



0 500 1,000 2,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

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FIGURE 5

CARTY RESERVOIR BOMB TARGET

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

119°46'34"W 119°46'5"W 119°45'36"W 119°45'7"W 119°44'38"W

45°44'38"N

45°44'10"N

45°43'41"N

Demolition - Range Complex No. 1

Turret Gunnery Training Range - Range Complex No. 1

R04665

INPR Site No. 1 - Range Complex No. 1

R04661

R04665

DRAWING NUMBER *Boardman_005_fig05_inpr*

DRAWN BY *K. Masterson* *07/12/06*

OFFICE *MNRVL*

Legend

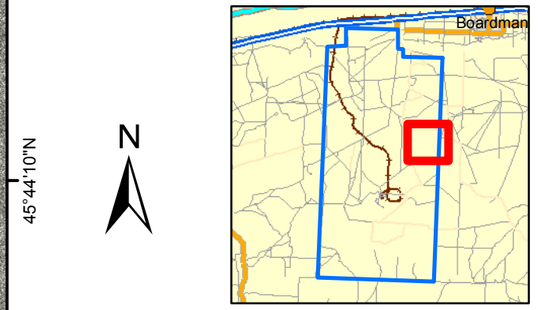
- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- Proposed Soil Sample

PA/SI Sample Locations

- Soil Sample

NOTES:

1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
4) Aerial photo from TerraServer dated September 8, 2001.



N

0 500 1,000 2,000

Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

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FIGURE 6

INPR SITE NO. 1
RANGE COMPLEX NO. 1

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

DRAWING NUMBER *Boardman_004_fig04_demo*

DRAWN BY *K. Masterson* *07/11/06*

OFFICE MNRVL

119°46'30"W 119°46'19"W 119°46'8"W 119°45'58"W 119°45'47"W 119°45'36"W

45°45'22"N

45°45'11"N

45°45'0"N

45°44'49"N

Turret Gunnery Training Range - Range Complex No. 1

Demolition - Range Complex No. 1

R04665

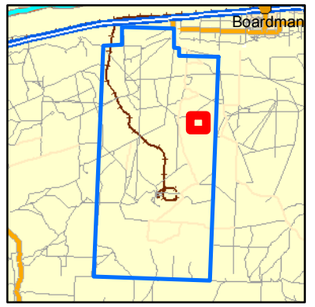
INPR Site No. 1 - Range Complex No. 1

Legend

- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- Proposed Soil Sample

NOTES:

1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
4) Aerial photo from TerraServer dated September 8, 2001.



N

0 200 400 800

Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

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FIGURE 7

DEMOLITION AREA
RANGE COMPLEX NO. 1

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

119°51'0"W
119°48'0"W
119°45'0"W
45°48'0"N
45°45'0"N

R09735
R04659
R04650
R10102
R10103
Tower Rd
Target No. 2
R10103
R04650
Turret Gunnery Training Range
- Range Complex No. 1
R04650
R04665
Demolition
- Range Complex No. 1
R04661
R09851
R04665
R04665
R04665
INPR Site No. 1
- Range Complex No. 1
R04665
R06790
Feedlot Rd

DRAWING NUMBER *Boardman_001_fig01_siteLayout*

DRAWN BY | *K. Masterson* | *07/12/06*

OFFICE | MNRVL

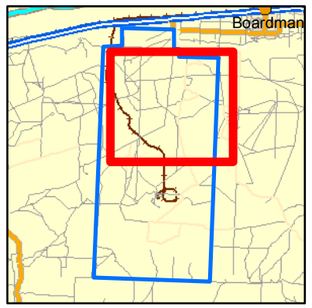
Legend

- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel

PA/SI Sample Locations

- Sediment Sample
- Soil Sample
- Surface Water Sample

NOTES:
1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
4) Aerial photo from TerraServer dated September 8, 2001.



N

0 1,500 3,000 6,000
Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

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FIGURE 8

TURRET GUNNERY TRAINING RANGE
RANGE COMPLEX NO. 1

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

XREF Files: IMAGE Files:
File: O:\116188-FUDS-CAD\0300030\Rev-A\030003A01.dwg Layout: Layout User: Michael.Crawford Jul 11, 2006 - 11:06am

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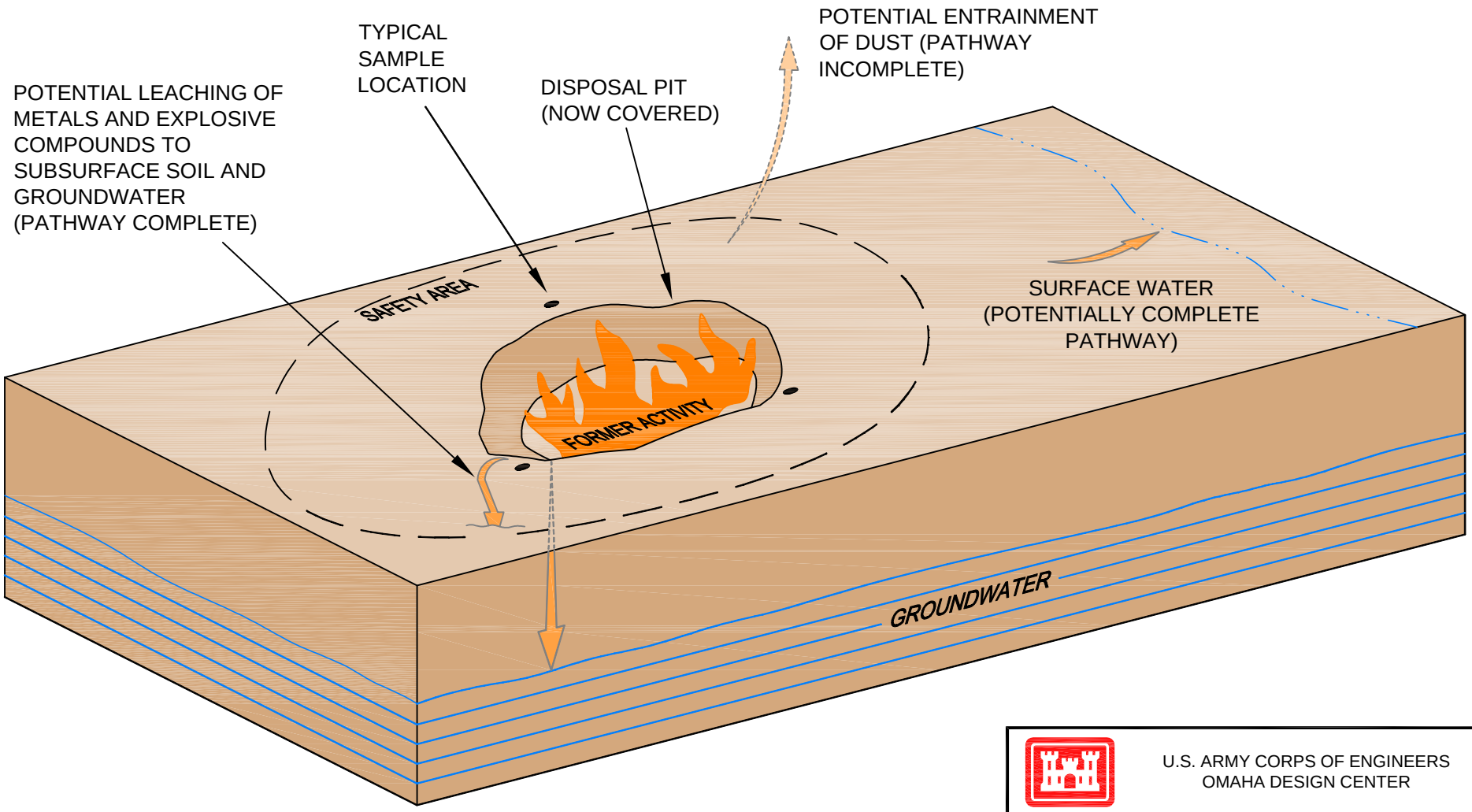

RECEPTORS:

- Site Users/Workers/Farmers
- Biota (deer)

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FIGURE 9

CONCEPTUAL SITE MODEL
DEMOLITION AREA

BOARDMAN AIR FORCE RANGE

Shaw Environmental, Inc.

119°46'41"W 119°46'19"W 119°45'58"W 119°45'36"W 119°45'14"W

45°42'50"N

45°42'29"N

45°42'7"N

R04652

R04665

R04661

R04666

Demolition Area No. 2

DRAWING NUMBER *Boardman_009_fig08_demo2*

DRAWN BY *K. Masterson* *07/11/06*

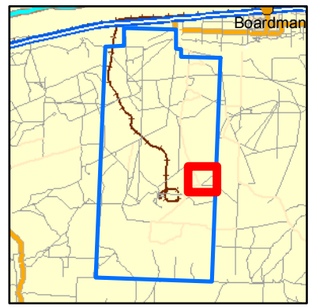
OFFICE MNRVL

Legend

- Boardman Air Force Range Boundary
- Boardman Air Force Range AOCs
- Taxlot Parcel
- Reported MEC Find
- Proposed Soil Sample

NOTES:

1) AOC boundaries were derived from the Boardman Air Force Range ASR Supplement.
2) Groundwater well data were obtained from Oregon Water Resource Department.
3) These ranges are located within the Middle Columbia-Lake Wallula Watershed.
4) Aerial photo from TerraServer dated September 8, 2001.



N

0 350 700 1,400 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 11N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 10

DEMOLITION AREA NO. 2

BOARDMAN AIR FORCE RANGE

Shaw® Shaw Environmental, Inc.

Tables

Table 1
Potential MEC and MC at Boardman AFR AOCs

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-M50 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)	
	2.25-inch Practice Rocket MK6	sheet metal, Ballistite (nitrocellulose and nitroglycerin)	
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	sheet metal, iron oxide	
	M89	sheet metal, black powder (potassium nitrate, sulfur, charcoal)	

Table 1 (Cont.)
Potential MEC and MC at Boardman AFR AOCs

AOC	Range Munitions	Munitions Constituents	Land Use Controls
Range Complex No. 1	Small Arms - 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)	None
	BDU-33, MK 76	Cast iron, 10 gauge shotgun shell	
	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)	TNT	None
	M66, M68 detonating fuzes		
	100 lb GP Bomb		
	Explosives C-4 blocks	RDX	
	Explosives Detonating Cord, M60 Igniter	PETN	
Suspected Use but no AOC Specified	Practice bomb BDU-10 series, 2,025 lb	Inert (hot gas generator in folding fins configuration)	None
	75 mm HEAT, M66 projectiles	1 lb TNT or 50/50 Pentolite	

Table 2
MEC and MC Exposure Pathway Analysis

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Target No. 1 – Practice Bombing Range	**MEC**	MEC in the form of ***unexploded*** practice bomb spotting charges may exist on land surface.	**Surface Soil** • MEC (unexploded practice bombs) are a hazard. • MEC reported on surface during INPR	• Potentially complete pathway. • Exposure routes: - Vehicle & foot traffic.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Foot traffic.	• No verified MEC found in the AOC.	A magnetometer-assisted, visual reconnaissance inspection will be conducted across the AOC.
			Subsurface Soil • MEC may be buried.	• Potentially complete pathway. • Exposure routes: - Intrusive activities - Agricultural tilling.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Burrowing activities - Agricultural tilling.	• No verified MEC found in the AOC.	A magnetometer-assisted, visual reconnaissance inspection will be conducted to attempt to locate buried MEC.
	MC	Black powder, sheet metal, cast iron, lead, red/white phosphorus	**Soil** • Directly affected media. • Potential metals contamination from munitions used. • Spotting charges do not contain hazardous components. • Fate & Transport: secondary source of potential surface water, sediment, and air contamination.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of soil particulates during intrusive work.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in soil for this AOC does not exist. • Field data for Screening Level Ecological Risk Assessment do not exist.	One soil sample will be collected if MEC/munitions debris is identified during the visual reconnaissance. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc). Samples will not be analyzed for explosives. Only explosives uses was black powder.
			Surface Water • Potentially affected media – Carty Reservoir and Six-mile Canyon Creek. • Potential metals contamination. • Spotting charges do not contain hazardous components. • Fate & Transport: via surface runoff from impacted soil.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of surface water.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, - Direct contact by area fauna and livestock, and - Direct contact by aquatic organisms.	• Analytical data for metals in surface water does not exist. • Field data for Screening Level Ecological Risk Assessment do not exist.	No surface water samples will be collected. Surface water will be evaluated through sediments.
			Sediment • Potentially affected media – Carty Reservoir and Six-mile Canyon Creek. • Potential metals contamination. • Spotting charges do not contain hazardous components. • Fate & Transport: via surface runoff from impacted soil.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, and - Dermal contact.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in sediments does not exist for Carty Reservoir. Metals data exists for Six-mile Canyon Creek. • Field data for Screening Level Ecological Risk Assessment do not exist.	No sediment samples will be collected from this AOC A sediment sample from Carty Reservoir Bomb Target will be collected.
			Groundwater • Potentially affected media. • Potential metals contamination. • Spotting charges do not contain hazardous components. • Fate & Transport: migration of metals directly to groundwater is possible because of mobility of some metals and depth of groundwater (~10 ft bgs).	• Potentially complete pathway. - local wells	• Incomplete pathway. - No local wells	• Incomplete pathway. - No local wells	• No groundwater analytical data exist metals.	• No groundwater samples planned. Perchlorate was detected in water sample collected during PA/SI by Weston. Existing data may be available at nearby PGE Power Plant groundwater monitoring well.
			Air • Not an affected media under current land use.	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 2 (Cont.)
MEC and MC Exposure Pathway Analysis

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Target No. 2 – Practice Bombing Range	**MEC**	MEC in the form of ***unexploded*** practice bomb spotting charges may exist on land surface.	**Surface Soil** • MEC (unexploded practice bombs) are a hazard. • Munitions debris reported on surface.	• Potentially complete pathway. • Exposure routes: - Vehicle & foot traffic.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Foot traffic.	None	No visual inspections will be completed, presence of munitions debris indicates high probability of MEC
			Subsurface Soil • MEC may be buried.	• Potentially complete pathway. • Exposure routes: - Intrusive activities - Agricultural tilling.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Burrowing activities - Agricultural tilling.	None	No magnetometer-assisted, visual inspection will be conducted to attempt to locate buried MEC. Presence of munitions debris indicates high probability of MEC.
	MC	Black powder, sheet metal, cast iron, red/white phosphorus, thermite, rocket propellant containing nitrocellulose and nitroglycerin.	**Soil** • Directly affected media. • Potential metals contamination from munitions used. • Spotting charges do not contain hazardous components • Potential explosives contamination (nitrocellulose and nitroglycerin) • Fate & Transport: secondary source of potential surface water, sediment, and air contamination.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of soil particulates during intrusive work.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in soil exists for this AOC. • Analytical Data for explosives in soil do not exist for this AOC. • Field data for Screening Level Ecological Risk Assessment do not exist.	Two soil samples will be collected. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc) and explosives including nitroglycerin.
			Surface Water • Potentially affected media – Six-mile Canyon Creek. • Potential metals contamination. • Spotting charges do not contain hazardous components • Potential explosives contamination (nitrocellulose and nitroglycerin) • Fate & Transport: via surface runoff from impacted soil.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of surface water.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, - Direct contact by area fauna and livestock, and - Direct contact by aquatic organisms.	• Analytical data for metals and explosives in surface water does not exist. • Field data for Screening Level Ecological Risk Assessment do not exist.	No surface water sample will be collected from this AOC. The travel distance from the target area to the surface water body is approximately 1,800 ft. and transport over that distance is not likely to cause a detections of MC.
			Sediment • Potentially affected media – Six-mile Canyon Creek. • Potential metals contamination. • Spotting charges do not contain hazardous components. • Potential explosives contamination (nitrocellulose and nitroglycerin) • Fate & Transport: via surface runoff from impacted soil.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, and - Dermal contact.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in sediments does exist for Six-mile Canyon Creek. However, sample location is upgradient of this AOC. • Analytical data for explosives in sediment does not exist. • Field data for Screening Level Ecological Risk Assessment do not exist.	No sediment sample will be collected from this AOC. The travel distance from the target area to the surface water body is approximately 1,800 ft. and transport over that distance is not likely to cause a detections of MC.
			Groundwater • Potentially affected media. • Potential metals contamination. • Spotting charges do not contain hazardous components. • Potential explosives contamination (nitrocellulose and nitroglycerin) • Fate & Transport: migration of metals directly to groundwater is possible because of mobility of some metals and depth of groundwater (~10 ft bgs).	• Potentially complete pathway. - local wells	• Incomplete pathway. - No local wells	• Incomplete pathway. - No local wells	• No groundwater analytical data exist for metals or explosives.	• No groundwater samples planned.
			Air • Not an affected media under current land use.	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 2 (Cont.)
MEC and MC Exposure Pathway Analysis

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Carty Reservoir Bomb Target – Practice Bombing Range	**MEC**	MEC in the form of ***unexploded*** practice bomb spotting charges may exist on land surface.	**Surface Soil** • MEC (unexploded practice bombs) are a hazard. • MEC reported on surface during ASR	• Potentially complete pathway. • Exposure routes: - Vehicle & foot traffic.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Foot traffic.	• None	No magnetometer-assisted, visual reconnaissance inspection will be conducted across AOC to assess MEC occurrence.
			Subsurface Soil • MEC may be buried.	• Potentially complete pathway. • Exposure routes: - Intrusive activities - Agricultural tilling.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Burrowing activities - Agricultural tilling.	• None	No magnetometer-assisted, visual reconnaissance inspection will be conducted across the AOC to assess MEC occurrence.
	MC	Black powder, sheet metal, cast iron, lead, red/white phosphorus.	**Soil** • Directly affected media. • Potential metals contamination from munitions used. • Spotting charges do not contain hazardous components • Fate & Transport: secondary source of potential surface water, sediment, and air contamination.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of soil particulates during intrusive work.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in soil for this AOC does not exist. • Field data for Screening Level Ecological Risk Assessment do not exist.	Two soil samples will be collected from target area. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc). Samples will not be analyzed for explosives. Only explosives uses was black powder.
			Surface Water • Potentially affected media – Carty Reservoir and Six-mile Canyon Creek. • Potential metals contamination. • Spotting charges do not contain hazardous components • Fate & Transport: via surface runoff from impacted soil.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of surface water.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, - Direct contact by area fauna and livestock, and - Direct contact by aquatic organisms.	• Analytical data for metals in surface water does not exist. • Field data for Screening Level Ecological Risk Assessment do not exist.	No surface water samples will be collected. Surface water will be evaluated through sediments.
			Sediment • Potentially affected media – Carty Reservoir and Six-mile Canyon Creek. • Potential metals contamination. • Spotting charges do not contain hazardous components • Fate & Transport: via surface runoff from impacted soil.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, and - Dermal contact.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in sediments does not exist for Carty Reservoir. Metals data exists for Six-mile Canyon Creek • Field data for Screening Level Ecological Risk Assessment do not exist.	A sediment sample from Carty Reservoir will be collected. The sediment sample will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc). Samples will not be analyzed for explosives. Only explosives uses was black powder.
			Groundwater • Potentially affected media. • Potential metals contamination. • Spotting charges do not contain hazardous components • Fate & Transport: migration of metals directly to groundwater is possible because of mobility of some metals and depth of groundwater (~10 ft bgs).	• Potentially complete pathway. - local wells	• Incomplete pathway. - No local wells	• Incomplete pathway. - No local wells	• No groundwater analytical data exist metals.	• No groundwater samples planned. Perchlorate was detected in water sample collected during PA/SI by Weston. Existing data for metals may be available at nearby PGE Power Plant groundwater monitoring well.
			Air • Not an affected media under current land use.	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 2 (Cont.)
MEC and MC Exposure Pathway Analysis

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Range Complex No. 1 – INPR Site No. 1 (Practice Bombing Range), Demolition Area, Turret Gunnery Range	MEC	MEC in the form of ***unexploded*** practice bomb spotting charges may exist on land surface, kickouts from Demolition crater may exist.	**Surface Soil** • MEC (unexploded practice bombs) are a hazard. • Munitions debris reported on surface.	• Potentially complete pathway. • Exposure routes: - Vehicle & foot traffic.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Foot traffic.	None	No visual inspections will be completed, presence of munitions debris indicates high probability of MEC
			Subsurface Soil • MEC may be buried.	• Potentially complete pathway. • Exposure routes: - Intrusive activities - Agricultural tilling.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Burrowing activities - Agricultural tilling.	None	No magnetometer-assisted, visual inspection will be conducted to attempt to locate buried MEC. Presence of munitions debris indicates high probability of MEC.
	MC	Black powder, sheet metal, cast iron, red/white phosphorus, thermite, rocket propellant (nitrocellulose and nitroglycerin), C-4 (RDX), Detonation cord (PETN.)	**Soil** • Directly affected media. • Potential metals contamination from munitions used. • Potential explosives contamination (nitrocellulose, nitroglycerin, RDX, PETN) • Fate & Transport: secondary source of potential surface water, sediment, and air contamination.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of soil particulates during intrusive work.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in soil exists for this AOC. • Analytical Data for explosives in soil do not exist for this AOC. • Field data for Screening Level Ecological Risk Assessment do not exist.	No soil samples will be collected from INPR No.1. AOC was sampled during PA/SI. Two soil samples will be collected near detonation craters at the Demolition Area. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc), and explosives including nitroglycerin and PETN. No soil samples will be collected from the Turret Gunnery Training Range. MC is only steel
			Surface Water • Not a potentially affected media because of the distance from surface water.	• Incomplete pathway.	• Incomplete pathway.	• Incomplete pathway.	None	No sampling
			Sediment • Not a potentially affected media because of the distance from surface water.	• Incomplete pathway.	• Incomplete pathway.	• Incomplete pathway	• None	No sampling
			Groundwater • Potentially affected media. • Potential metals contamination. • Potential explosives contamination (nitroglycerin, PETN, RDX) • Fate & Transport: migration of metals directly to groundwater is possible because of mobility of some metals and depth of groundwater (~10 ft bgs).	• Incomplete pathway. - No local wells	• Incomplete pathway. - No local wells	• Incomplete pathway. - No local wells	• None	• No groundwater samples planned.
			Air • Not an affected media under current land use.	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 2 (Cont.)
MEC and MC Exposure Pathway Analysis

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
				Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Demolition Area No 2	**MEC**	MEC in the form of ***unexploded*** munitions may exist on land surface, kickouts from demolition craters may exist.	**Surface Soil** • MEC (unexploded munitions) are a hazard. • Munitions debris reported on surface.	• Potentially complete pathway. • Exposure routes: - Vehicle & foot traffic.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Foot traffic.	None	No visual inspections will be completed, presence of munitions debris indicates high probability of MEC
			Subsurface Soil • MEC may be buried.	• Potentially complete pathway. • Exposure routes: - Intrusive activities - Agricultural tilling.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Burrowing activities - Agricultural tilling.	None	No magnetometer-assisted, visual inspection will be conducted to attempt to locate buried MEC. Presence of munitions debris indicates high probability of MEC.
	MC	Black powder, sheet metal, cast iron, explosives (nitroglycerin, TNT, RDX, PETN)	**Soil** • Directly affected media. • Potential metals contamination from munitions used. • Potential explosives contamination (nitroglycerin, TNT, RDX, PETN) • Fate & Transport: secondary source of potential surface water, sediment, and air contamination.	• Potentially complete pathway. • Exposure routes: - Incidental ingestion, - Dermal contact, and - Inhalation of soil particulates during intrusive work.	• Incomplete pathway.	• Potentially complete pathway. • Exposure routes: - Ingestion, and - Direct contact by area fauna and livestock.	• Analytical data for metals in soil exists for this AOC. • Analytical Data for explosives in soil do not exist for this AOC. • Field data for Screening Level Ecological Risk Assessment do not exist.	Two soil samples will be collected near detonation craters. Soil samples will be analyzed for select metals (aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc), and explosives including nitroglycerin and PETN.
			Surface Water • Not a potentially affected media because of the distance from surface water.	• Incomplete pathway.	• Incomplete pathway.	• Incomplete pathway.	None	No sampling
			Sediment • Not a potentially affected media because of the distance from surface water.	• Incomplete pathway.	• Incomplete pathway.	• Incomplete pathway	• None	No sampling
			Groundwater • Potentially affected media. • Potential metals contamination. • Potential explosives contamination (nitroglycerin, PETN, RDX) • Fate & Transport: migration of metals directly to groundwater is possible because of mobility of some metals and depth of groundwater (~10 ft bgs).	• Incomplete pathway. - No local wells	• Incomplete pathway. - No local wells	• Incomplete pathway. - No local wells	• None	• No groundwater samples planned.
			Air • Not an affected media under current land use.	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 3
Summary of EPA PA/SI Sampling and Resulting Data Gaps

AOC	EPA PA/SI Designation	Soil Sampling	Sediment Sampling	Surface Water Sampling	Groundwater Sampling	Data Gaps	Comments
Target No. 1	Areas A & B	Not Sampled	Not Sampled	Perchlorate	Not Sampled	Metals	No significant metal conc., perchlorate not detected.
Target No. 2	Areas C & D	2 SS & 2 SB samples TAL metals & perchlorate	Not Sampled	Not Sampled	Not Sampled	Explosives	No significant metal conc., perchlorate not detected.
Carty Reservoir Bomb Target	Areas G & H	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Metals	
Range Complex No. 1 - INPR Site No 1.	Areas E & F	2 SS & 2 SB samples TAL metals, 1 SS & 1 SB - NBEC, 2 SS & 2 SB - perchlorate	Not Sampled	Not Sampled	Not Sampled	None	No significant metal conc., explosives and perchlorate not detected.
- Demolition Area	Area I	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Metals, explosives	
- Turret Gunnery Range	Area J	Not Sampled	Not Sampled	Not Sampled	Not Sampled	None	
Demolition Area No. 2	Not Identified	Not Sampled	Not Sampled	Not Sampled	Not Sampled	Metals, explosives	
Not applicable	Site wide and offsite	Not Sampled	1 Sample - Metals	5 Samples - Perchlorate	24 wells, all but one NBEC and perchlorate	None	No explosives detected. No significant metals detected in surface water sample Perchlorate detected in all 5 surface water samples, all 3 domestic wells, 15 of 19 monitoring wells. Perchlorate not detected in water supply wells.
Background Samples	BK	Metals	Metals	Not sampled	Not sampled	None	

AOC – Area of Concern
EPA PA/SI – *U.S. Environmental Protection Agency Preliminary Assessment/Site Inspection* (Weston, 2004)
SS – surface soil sample
SB – Subsurface soil sample
NBEC – Nitrogen based explosive compounds
BK - Background

Table 4
Proposed Sampling Approach
Boardman Air Force Range

AOC	Media	Contaminants of Concern		Comments
		Metals*	Explosives	
Target No. 1	Soil	1	--	Actual sample numbers and locations based on site reconnaissance. Soil samples will be composite.
	Sediment	--	--	Sediment sample will be collected as part of the Carty Reservoir Bomb Target.
Target No. 2	Soil	2	2	Actual sample locations based on site reconnaissance. Soil samples will be composite.
	Sediment	--	--	No sediment pathway.
Carty Reservoir Bomb Target	Soil	2	--	Actual sample locations based on site reconnaissance. Soil samples will be composite.
	Sediment	1	--	Actual sample location based on site reconnaissance. Sediment samples will be discrete.
Range Complex No. 1	Soil	2	2	Samples to be collected from the Demolition Area. Sample location based on site reconnaissance.
	Sediment	--	--	No sediment pathway.
Demolition Area No. 2	Soil	2	2	Sample location based on site reconnaissance.
	Sediment	--	--	No sediment pathway.
Background Samples	Soil	10	--	Sample locations will be selected with the aid of Visual Sampling Plan in locations not impacted by Boardman AFR activities.
	Sediment	--	--	Sediment sample from PA/SI will serve as ambient sample.
Sample Totals		20	6	

Notes:
Quality control samples will be addressed in the SSWP.
* Metals to be analyzed include aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, titanium, and zinc.

Table 5
Human Health Screening Criteria for Soil/Sediment at Oregon Sites

Analyte	Abbreviation	CAS No.	Region 9 Human Health Screening Values[a]				Laboratory Method Detection Limit (mg/kg)
			Residential PRG[b] (mg/kg)[b]		SSLs[c] DAF=1 (mg/kg)	SSLs[c] DAF=20 (mg/kg)	
Aluminum	Al	7429-90-5	76,000				20.0
Antimony	Sb	7440-36-0	31		0.30	5	0.5
Barium	Ba	7440-38-2	5,400		82	1,600	0.5
Cadmium	Cd	7440-43-9	37		0.4	8	0.5
Chromium[e]	Cr	7440-47-3	210		2	38	1.0
Cobalt	Co	7440-48-4	900				0.5
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
Manganese	Mn	7439-96-5	1,800				25.0
Magnesium	Mg	7439-95-4					0.5
Mercury	Hg	7439-97-6	23				0.5
Molybdenum	Mo	7439-98-7	390				0.06
Nickel	Ni	7440-02-0	1,600		7	130	1.0
Zinc	Zn	7440-66-6	23,000		620	12,000	2.0
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	10	35			
PETN	PETN	78-11-5	0.50	NVA	NVA	NVA	
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	610				0.065

DAF = Dilution Attenuation Factor.
PRG = Preliminary Remediation Goal.
SSL = Soil Screening Level.
mg/kg = milligrams per kilogram.
mg/L = milligrams per liter.

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 6
Human Health Screening Criteria for Groundwater at Oregon Sites [a]

Analyte	Abbreviation	CAS No.	Laboratory Method Detection Limit (µg/L)	Region 9 Tap Water PRG [b] (µg/L)	Federal Drinking Water Criteria MCLs [c] (mg/L)
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		
PETN	PETN	78-11-5	1.3		
Aluminum	Al	7429-90-5	60	36,000	50 [e]
Antimony	Sb	7440-36-0	1.0		
Barium	Ba	7440-38-2	5.0	2,600	2,000
Cadmium	Cd	7440-43-9	0.5	18	5
Chromium [f]	Cr	7440-47-3	2.0	110	100
Cobalt	Co	7440-48-4	1.0	730	
Copper	Cu	7440-50-8	3.0	1,500	1,000 [e] 1,300 [g]
Iron	Fe	7439-89-6	5.0	11,000	300 [e]
Lead	Pb	7439-92-1	1.0		15 [g]
Magnesium	Mg	7439-95-4	100		
Manganese	Mn	7439-96-5	2.0	880	50 [e]
Mercury	Hg	7439-97-6	0.3		
Molybdenum	Mo	7439-98-7	5.0	180	
Nickel	Ni	7440-02-0	1.0	730	
Zinc	Zn	7440-66-6	0.1	11,000	5,000 [e]

Table 6 (Cont.)
Human Health Screening Criteria for Groundwater at Oregon Sites

MCL = Maximum Contaminant Level
PRG = Preliminary Remediation Goal
µg/L = micrograms per liter

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.
Note that no surface water samples are planned at this time. If surface water is collected, additional human health screening criteria will be compiled.
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 7
Human Health Screening Criteria for Surface Water at Oregon Sites [a]

Analyte	Abbreviation	CAS Number	Region 9 Tap Water PRG[b] (µg/L)	Oregon DEQ Water Quality Criteria[c]	
				Water and Fish Ingestion[d] (mg/L)	Fish Consumption Only[e] (mg/L)
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			
Aluminum	Al	7429-90-5	36,000		
Antimony	Sb	7440-36-0	15	146	45,000
Arsenic	As	7440-38-2	0.045	0.0022[h]	0.0175[h]
Barium	Ba	7440-38-2	2,600	1,000	
Beryllium	Be	7440-41-7	73	0.0068[h]	0.117[h]
Cadmium	Cd	7440-43-9	18	10	
Calcium	Ca	7440-70-2			
Chromium[i]	Cr	7440-47-3	110	50	
Cobalt	Co	7440-48-4	730		
Copper	Cu	7440-50-8	1,500		
Iron	Fe	7439-89-6	11,000	300	
Lead	Pb	7439-92-1		50	
Magnesium	Mg	7439-95-4			
Manganese	Mn	7439-96-5	880	50	100
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
Potassium	K	7440-09-7			

Table 7
Human Health Screening Criteria for Surface Water at Oregon Sites [a]

Analyte	Abbreviation	CAS Number	Region 9 Tap Water PRG[b] (µg/L)	Oregon DEQ Water Quality Criteria[c]	
				Water and Fish Ingestion[d] (mg/L)	Fish Consumption Only[e] (mg/L)
Selenium	Se	7782-49-2	180	10	
Silver	Ag	7440-22-4	180	50	
Sodium	Na	7440-23-5			
Strontium	Sr	7440-24-6	22,000		
Thallium	Tl	7440-28-0	2.4	13	48
Titanium	Ti	7440-32-6	150,000		
Vanadium	V	7440-62-2	36		
Zinc	Zn	7440-66-6	11,000		
Zirconium	Zr	7440-67-7			
Phosphorus (white)	WP or P_4	7723-14-0	0.73		
Perchlorate	$C1O_4$	7601-90-3	24[j]		

MCL = Maximum Contaminant Level
PRG = Preliminary Remediation Goal
µg/L = micrograms per liter

[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 1.0×10^{-6}.
[i] Because the form of chromium has not yet been determined, the values for Chromium VI are used as a conservative measure.
j Value based on memorandum from Department of Defense entitled "Policy on DoD Required Actions Related to Perchlorate." Dated 26 January 2006.

Table 8
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Level II Screening Level [a]	Proposed Benchmarks									Potential Bio accumulative Constituent? [h]	Final Ecological Screening Value Soil [i]	Practical Quantitation Limit
	Lowest Value for Plants/Inverts./ Birds/Mammals (mg/kg)	Region 5 ESLs [b] (2003) (mg/kg)	Region 7 [c] (mg/kg)		Region 8 [d] (mg/kg)		Region 10 [e] (mg/kg)		Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg)			(mg/kg)	(mg/kg)
Metals/Inorganics													
Aluminum	50	NVA	50	EPA-R4	NVA		50	EPA-R4	5.5	LANL		50	20.0
Antimony	5	0.142	0.27	SSL	0.27	SSL	0.27	SSL	0.05	LANL	Yes	5	0.5
Barium	85	1.04	330	SSL	330	SSL	330	SSL	110	LANL		85	0.5
Cadmium	4	0.00222	0.36	SSL	0.36	SSL	0.36	SSL	0.27	LANL	Yes	4	0.5
Chromium (total)	0.4	0.4	26	SSL	26	SSL	26	SSL	2.3	LANL	Yes	0.4	1.0
Cobalt	20	0.14	13	SSL	13	SSL	13	SSL	13	LANL		20	0.5
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
Magnesium	NVA	NVA	440000	EPA-R4	NVA		440000	EPA-R4	NVA			NVA/Nutrient	25.0
Manganese	100	NVA	100	EPA-R4	NVA		100	EPA-R4	50	LANL		100	0.5
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
Zinc	50	6.62	8.5	ORNL	8.5	ORNL	8.5	ORNL	10	LANL	Yes	50	2.0

Table 8 (Cont.)
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Level II Screening Level [a]	Proposed Benchmarks									Potential Bio accumulative Constituent? [h]	Final Ecological Screening Value Soil [i]	Practical Quantitation Limit
	Lowest Value for Plants/Inverts./ Birds/Mammals (mg/kg)	Region 5 ESLs [b] (2003) (mg/kg)	Region 7 [c] (mg/kg)		Region 8 [d] (mg/kg)		Region 10 [e] (mg/kg)		Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg)			(mg/kg)	(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

NVA: No value available

Table 8 (Cont.)
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (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.

EPA-R4=USEPA Region 4
LANL= Los Alamos National Laboratory
SSL=USEPA Eco Soil Screening Levels
Dutch=Dutch Intervention Values
ORNL= Oak Ridge National Laboratory Ecological PRGs (Efroymson et al)

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 9
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values[a] (mg/L) Freshwater	Region 5 Ecological Screening Levels[b] (mg/L)	EPA Region 7 [c] (mg/L)		EPA Region 8 [d] (mg/L)		EPA Region 10 [e] (mg/L)		Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/L)		Potential Bioaccumulative Constituent? [g]	Final Ecological Value Surface Water [h] (mg/L)	Practical Quantitation Limit (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
Antimony	1.00E+00	8.00E-02	3.00E-02	EPRG	3.00E-02	Tier II	3.00E-02	EPRG	1.00E-01	LANL	Yes	1.00E+00	1.0E-03
Barium	4.00E-03	2.20E-01	4.00E-03	EPRG	4.00E-03	Tier II	4.00E-03	EPRG	3.80E-03	LANL		4.00E-03	5.0E-03
Cadmium	2.20E-03	1.50E-04	2.50E-04	AWQC	2.50E-04	AWQC	2.50E-04	AWQC	1.50E-04	LANL	Yes	2.20E-03	5.0E-04
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
Cobalt	2.30E-02	2.40E-02	2.30E-02	EPRG	2.30E-02	Tier II	2.30E-02	EPRG	3.00E-03	LANL		2.30E-02	1.0E-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
Magnesium	8.20E+01	NVA	NVA		NVA		NVA		NVA			8.20E+01	1.0E-01
Manganese	1.20E-01	NVA	1.20E-01	EPRG	1.20E-01	Tier II	1.20E-01	EPRG	8.00E-02	LANL		1.20E-01	2.0E-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
Zinc	1.20E-01	6.57E-02	1.20E-01	AWQC	1.20E-01	AWQC	1.20E-01	AWQC	6.60E-02	LANL	Yes	1.20E-01	1.0E-02

Table 9 (Cont.)
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values[a] (mg/L) Freshwater	Region 5 Ecological Screening Levels[b] (mg/L)	EPA Region 7 [c] (mg/L)		EPA Region 8 [d] (mg/L)		EPA Region 10 [e] (mg/L)		Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/L)		Potential Bioaccumulative Constituent? [g]	Final Ecological Value Surface Water [h] (mg/L)	Practical Quantitation Limit (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

NVA = No Value Available

Table 9 (Cont.)
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (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.

AWQC=National Ambient Water Quality Criteria
LANL= Los Alamos National Laboratory
Tier II=Great Lakes Tier II Water Quality Criteria
EPRGs=Oak Ridge National Laboratory Ecological PRGs
TAL=Talmage et al (1999)
CCME=Canadian Council of Ministers of the Environment, Environmental Quality Guidelines

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 10
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values [a] (mg/kg) Freshwater	Region 5 Ecological Screening Levels[b] (mg/kg)	EPA Region 7 [c] (mg/kg)		EPA Region 8 [d] (mg/kg)		EPA Region 10 [e] (mg/kg)		Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg)		Potential Bioaccumulative Constituent? [g]	Final Ecological Screening Value Sediment [h] (mg/kg)	Practical Quantitation Limit (mg/kg)
Metals/Inorganics													
Aluminum	NVA	NVA	NVA		NVA		NVA		2.80E+02	LANL		2.80E+02	20.0
Antimony	3.00E+00	NVA	NVA		NVA		NVA		3.60E-01	LANL	Yes	3.00E+00	0.5
Barium	NVA	NVA	NVA		NVA		NVA		4.80E+01	LANL		4.80E+01	0.5
Cadmium	3.00E-03	9.90E-01	9.90E-01	MAC	9.90E-01	MAC	9.90E-01	MAC	3.30E-01	LANL	Yes	3.00E-03	0.5
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
Cobalt	NVA	5.00E+01	NVA		NVA		NVA		2.30E+02	LANL		2.30E+02	0.5
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
Magnesium	NVA	NVA	NVA		NVA		NVA		NVA			NVA	25.0
Manganese	1.10E+03	NVA	NVA		NVA		NVA		7.20E+02	LANL		1.10E+03	0.5
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
Zinc	3.00E+00	1.21E+02	1.21E+02	MAC	1.21E+02	MAC	1.21E+02	MAC	3.70E+01	LANL	Yes	3.00E+00	2.0

Table 10 (Cont.)
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values [a] (mg/kg) Freshwater	Region 5 Ecological Screening Levels [b] (mg/kg)	EPA Region 7 [c] (mg/kg)		EPA Region 8 [d] (mg/kg)		EPA Region 10 [e] (mg/kg)		Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg)		Potential Bioaccumulative Constituent? [h]	Final Ecological Screening Value Sediment [i] (mg/kg)	Practical Quantitation Limit (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

NVA = No Value Available

Table 10 (Cont.)
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (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.

Note: The Talmage [TAL] screening values assume 10% organic carbon in the sediment.

MAC=MacDonald Consensus Values
EPRGs=Oak Ridge National Laboratory Ecological PRGs
ISQGs=Canadian Interim Sediment Quality Guidelines
LALN=Los Alamos National Laboratory
TAL=Talmage et al (1999)

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.

Draft Worksheets

Site Information Worksheet
MRSPP Data Gaps
HRS Data Gaps

Site Inspection ***Technical Project Planning Meeting***
Boardman Air ForceRange ***July 20, 2006***

Site Information Worksheet

Site: Boardman Air Force Range

Project: Boardman Air Force Range

	Site Information Needed[a]	Suggested Means to Obtain Site Information	Potential Source(s) of Site Information	Responsible for Obtaining	Deadline for Obtaining Site Information
1	Background sampling requirements for metals	ODEQ protocol	ODEQ guidance document	Shaw	For inclusion in TPP Memo
2	Background metals data	Sampling	Add more samples to field program	Shaw	For inclusion in TPP Memo
3	Identify user of Demolition Area	Research Army records	Historical aerial photos/review historical documents	Shaw	For inclusion in TPP Memo
4	Identify type of munitions destroyed at Demolition Area	Research Army records	Review historical documents	Shaw	For inclusion in TPP Memo
5	Schedule for sampling	Consultation	ODEQ and landowners	Shaw	Prior to field work
6	Lat/Long and x,y on all maps	GIS	Add to maps	Shaw	For inclusion in TPP Memo
7	Point of contact for community	Not applicable	USACE	USACE	Before start of field work
8	Access agreements	Letters, call, or visit stakeholders	Letters/conversations with stakeholders	USACE	Before start of field work
9	Threatened or endangered species within AOC	Phone	OR Fish and Wildlife, U.S. Fish and Wildlife	Shaw	For inclusion in TPP Memo
10	Areas of cultural significance within AOC	SHPO	Phone SHPO	Shaw	For inclusion in TPP Memo

[a] Refer to EM 200-1-2, Paragraphs 1.1.3 and 2.2.

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179

Installation: Boardman Air Force Range
AOC: Target No. 1
RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Explosives, propellant, pyrotechnic
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions	x	Reconnaissance survey		
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	**EHE Module Score**				**60 to 70 EHE Rating D (Preliminary)**
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	**CHE Module Score**				**< 38 CHE Rating G (Preliminary)**
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	**HHE Module Score**	**x**	**Module Score Pending**		
MRS Priority	**29**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Final Score Pending**		
	A	**MRS Background Information**	**x**	**Pending**		

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179

Installation: Boardman Air Force Range
AOC: Target No. 2
RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Pyrotechnic, explosives, propellants
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	**EHE Module Score**				**60 to 70 EHE Rating D (Preliminary)**
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	**CHE Module Score**				**< 38 CHE Rating G (Preliminary)**
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	**HHE Module Score**	**x**	**Module Score Pending**		
MRS Priority	**29**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Final Score Pending**		
	A	**MRS Background Information**	**x**	**Pending**		

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179

Installation: Boardman Air Force Range
AOC: Carty Reservoir
RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Pyrotechnic, explosives, propellants
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	**EHE Module Score**				**60 to 70 EHE Rating D (Preliminary)**
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	**CHE Module Score**				**< 38 CHE Rating G (Preliminary)**
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	**HHE Module Score**	**x**	**Module Score Pending**		
MRS Priority	**29**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Final Score Pending**		
	A	**MRS Background Information**	**x**	**Pending**		

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179

Installation: Boardman Air Force Range
AOC: Range Complex No. 1
RMIS Range ID: F10OR0160

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Pyrotechnic, explosives, propellants
	2	Source of Hazard			x	Practice bombing range
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	Agricultural - crops, livestock grazing
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	**EHE Module Score**				**60 to 70 EHE Rating D (Preliminary)**
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	**CHE Module Score**				**< 38 CHE Rating G (Preliminary)**
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	**HHE Module Score**	**x**	**Module Score Pending**		
MRS Priority	**29**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Final Score Pending**		
	A	**MRS Background Information**	**x**	**Pending**		

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CFR Part 179

Installation: **Boardman Air Force Range**
AOC: **Demolition Area No. 2**
RMIS Range ID: **F10OR0160**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Explosives, propellants
	2	Source of Hazard			x	Burning/open detonation
	3	Location of Munitions			x	Confirmed surface
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	8	Activities/Structures			x	wildlife area
	9	Ecological and/or Cultural Resources	x	Inquire USFW and Oregon F&W		
	10	**EHE Module Score**				**60 to 70 EHE Rating D (Preliminary)**
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard			x	0 inhabited structures w/in 2 miles
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources			x	Ecological resources present
	20	**CHE Module Score**				**< 38 CHE Rating G (Preliminary)**
Health Hazard Evaluation (HHE)	21	Groundwater Data Element			x	PA/SI data show perchlorate impacts
	22	Surface Water (Human Endpoint) Data Element			x	PA/SI data show perchlorate impacts
	23	Sediment (Human Endpoint) Data Element Table			x	PA/SI data show no impacts to sediments
	24	Surface Water (Ecological Endpoint) Data Element	x	Evaluation Pending		
	25	Sediment (Ecological Endpoint) Data Element	x	Evaluation Pending		
	26	Surface Soil Data Element	x	Evaluation Pending		
	27	Supplemental Contaminant Hazard Factor	x	Evaluation Pending		
	28	**HHE Module Score**	**x**	**Module Score Pending**		
MRS Priority	**29**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Final Score Pending**		
	A	**MRS Background Information**	**x**	**Pending**		

Boardman Air Force Range HRS Data Gaps

Information required to complete the MEC-HRS data collection form:

Item	Number	Comment – Missing Data Element
1	1.8	Confirm the latitude / longitude of potential source(s) and the accuracy of the information (in meters)
2		Source scale (i.e., 1:24,000, etc.)
3	1.12	Site Permits
4	2.3	Confirm no tribal lands within 4 miles or surface water within 15 miles
5	2.4	Confirm if there are other NPL sites within 1 mile of the site
6	2.5	Confirm property owners
7	5.3	Population within 1 mile, within 4 miles
8	6	Water use (GW within 4 miles, SW within 15 miles)
9	6.1	Total drinking water population served
10	6.2	Type of drinking water supply system (GW or SW?)
11	6.3	Other water uses of GW within 4 miles
12	6.4	Depth to aquifer within 4 miles
13	7.1	Confirm existence of sensitive or potentially vulnerable environment