Omaha District

FINAL SITE INSPECTION REPORT

Boardman Air Force Range

Morrow County, OR

FUDS Property No. F10OR0160

Site Inspections at Multiple Sit
Formerly Used Defense Sites
Military Munitions Response P

Contract No. W912DY-04-D-0
Delivery Order No. 003

September 2007

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Formerly Used Defense Sites
Military Munitions Response Program

September 2007

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Table of Contents

List of Figures v
List of Tables vi
List of Appendices vii
List of Acronyms viii
Glossary of Terms xi

Executive Summary ES-1
1.0 Introduction 1-1
1.1 Project Authorization 1-1
1.2 Site Name and Location 1-1
1.3 Purpose, Scope, and Objectives of the Site Inspection 1-2
1.4 Munitions Response Site Prioritization Protocol 1-3
2.0 Property Description and History 2-1
2.1 Historical Military Use 2-1
2.2 Munitions Information 2-2
2.3 Ownership History 2-2
2.4 Physical Setting 2-2
2.4.1 Topography and Vegetation 2-2
2.4.2 Land Use 2-2
2.4.3 Nearby Population 2-3
2.4.4 Climate 2-3
2.4.5 Area Water Supply 2-3
2.4.6 Surface Water 2-3
2.4.7 Geologic and Hydrogeologic Setting 2-4
2.4.7.1 Bedrock Geology 2-4
2.4.7.2 Overburden Soils 2-4
2.4.7.3 Hydrogeology 2-4
2.4.8 Sensitive Environments 2-4
2.5 Previous Investigations for MC and MEC 2-5
2.5.1 Archives Search Report 2-5
2.5.2 ASR Supplement 2-5
2.5.3 Other Investigations 2-6
2.6 Other Land Uses that May Have Contributed to Contamination 2-8
2.7 Past Regulatory Activities 2-8
2.8 Previous MEC Finds 2-8
3.0 SI Tasks and Findings 3-1
3.1 Technical Project Planning 3-1
3.2 Additional Records Research 3-4
3.2.1 Coordination with State Historic Preservation Office 3-4
3.2.2 Coordination with Natural Resources Offices 3-4
3.2.3 Historical Aerial Photographs 3-4
3.2.4 Environmental Database Search 3-5
3.2.5 Rights of Entry 3-5

Table of Contents(Cont.)

3.3 Field Work 3-5
3.4 Sampling and Analysis 3-5
3.5 Laboratory Analysis and Data Quality Review 3-6
3.6 Screening Values 3-6
3.6.1 Background Data 3-6
3.6.2 Human Health Screening 3-8
3.6.3 Ecological Screening 3-8
3.7 Variances from the SSWP 3-8
3.8 Second TPP Meeting 3-8
4.0 Target No. 1 4-1
4.1 History and Land Use 4-1
4.2 Previous Investigations 4-1
4.3 MEC Evaluation 4-2
4.3.1 Field Observations and Historical Evidence of MEC 4-2
4.3.2 MEC Risk Assessment 4-2
4.4 Munitions Constituents Evaluation 4-3
4.4.1 Terrestrial Pathway 4-3
4.4.1.1 Comparison to Background Data 4-3
4.4.1.2 Comparison to Human Health Screening Values 4-4
4.4.1.3 Comparison to Ecological Screening Values 4-4
4.4.2 Surface Water Pathway 4-4
4.4.3 Groundwater Pathway 4-4
4.4.3.1 Comparison to Background 4-5
4.4.3.2 Comparison to Human Health Screening Values 4-5
4.4.4 Air Pathway 4-5
5.0 Target No. 2 5-1
5.1 History and Land Use 5-1
5.2 Previous Investigations 5-1
5.3 MEC Evaluation 5-1
5.3.1 Field Observations and Historical Evidence of MEC 5-2
5.3.2 MEC Risk Assessment 5-2
5.4 Munitions Constituents Evaluation 5-3
5.4.1 Terrestrial Pathway 5-3
5.4.1.1 Comparison to Background Data 5-3
5.4.1.2 Comparison to Human Health Screening Values 5-3
5.4.1.3 Comparison to Ecological Screening Values 5-4
5.4.2 Surface Water Pathway 5-4
5.4.2.1 Comparison to Background Data 5-4
5.4.2.2 Comparison to Human Health Screening Values 5-4
5.4.2.3 Comparison to Ecological Screening Values 5-5
5.4.3 Groundwater Pathway 5-5
5.5 Air Pathway 5-5

Table of Contents(Cont.)

6.0 Carty Reservoir Bomb Target 6-1
6.1 History and Land Use 6-1
6.2 Previous Investigations 6-1
6.3 MEC Evaluation 6-1
6.3.1 Field Observations and Historical Evidence of MEC 6-2
6.3.2 MEC Risk Assessment 6-2
6.4 Munitions Constituents Evaluation 6-2
6.4.1 Terrestrial Pathway 6-3
6.4.1.1 Comparison to Background Data 6-3
6.4.1.2 Comparison to Human Health Screening Values 6-3
6.4.1.3 Comparison to Ecological Screening Values 6-3
6.4.2 Surface Water Pathway 6-3
6.4.2.1 Comparison to Background Data 6-4
6.4.2.2 Comparison to Human Health Screening Values 6-4
6.4.2.3 Comparison to Ecological Screening Values 6-4
6.4.3 Groundwater Pathway 6-4
6.4.4 Air Pathway 6-4
7.0 Range Complex No. 1 7-1
7.1 History and Land Use 7-1
7.2 Previous Investigations 7-1
7.3 MEC Evaluation 7-2
7.3.1 Field Observations and Historical Evidence of MEC 7-2
7.3.2 MEC Risk Assessment 7-3
7.4 Munitions Constituents Evaluation 7-3
7.4.1 Terrestrial Pathway 7-3
7.4.1.1 Comparison to Background Data 7-4
7.4.1.2 Comparison to Human Health Screening Values 7-4
7.4.1.3 Comparison to Ecological Screening Values 7-4
7.4.2 Surface Water Pathway 7-4
7.4.3 Groundwater Pathway 7-5
7.4.3.1 Comparison to Background 7-5
7.4.3.2 Comparison to Human Health Screening Values 7-5
7.4.4 Air Pathway 7-5
8.0 Demolition Area No. 2 8-1
8.1 History and Land Use 8-1
8.2 Previous Investigations 8-1
8.3 MEC Evaluation 8-1
8.3.1 Field Observations and Historical Evidence of MEC 8-1
8.3.2 MEC Risk Assessment 8-1
8.4 Munitions Constituents Evaluation 8-2
8.4.1 Terrestrial Pathway 8-2
8.4.1.1 Comparison to Background Data 8-2
8.4.1.2 Comparison to Human Health Screening Values 8-2

8.4.1.3 Comparison to Ecological Screening Values 8-3
8.4.2 Surface Water Pathway 8-3
8.4.3 Groundwater Pathway 8-3
8.4.3.1 Comparison to Background 8-3
8.4.3.2 Comparison to Human Health Screening Values 8-4
8.4.4 Air Pathway 8-4
9.0 Impact Area 9-1
9.1 History and Land Use 9-1
9.2 Previous Investigations 9-1
9.3 MEC Evaluation 9-1
9.3.1 Field Observations and Historical Evidence of MEC 9-1
9.3.2 MEC Risk Assessment 9-1
9.4 Munitions Constituents Evaluation 9-2
9.4.1 Terrestrial Pathway 9-2
9.4.1.1 Comparison to Background Data 9-2
9.4.1.2 Comparison to Human Health Screening Values 9-2
9.4.1.3 Comparison to Ecological Screening Values 9-2
9.4.2 Surface Water Pathway 9-3
9.4.2.1 Comparison to Background Data 9-3
9.4.2.2 Comparison to Human Health Screening Values 9-3
9.4.2.3 Comparison to Ecological Screening Values 9-3
9.4.3 Groundwater Pathway 9-3
9.4.3.1 Comparison to Background 9-4
9.4.3.2 Comparison to Human Health Screening Values 9-4
9.4.4 Air Pathway 9-4
10.0 Summary and Conclusions 10-1
10.1 Target No. 1 10-1
10.2 Target No. 2 10-2
10.3 Carty Reservoir Bomb Target 10-3
10.4 Range Complex No. 1 10-4
10.5 Demolition Area No. 2 10-5
10.6 Impact Area 10-5
11.0 Recommendations 11-1
11.1 Target No. 1 11-1
11.2 Target No. 2 11-1
11.3 Carty Reservoir Bomb Target 11-1
11.4 Range Complex No. 1 11-2
11.5 Removal Actions 11-2
11.6 Munitions Response Areas 11-2
11.7 MRSPP Scoring 11-3
12.0 References 12-1

List of Figures

Figure 1-1 Site Location

Figure 2-1 Original Site Layout
Figure 2-2 Current Aerial Photograph
Figure 2-3 Parcel Ownership
Figure 2-4 Current Topographic Map
Figure 2-5 Census Data within 4-Mile Radius
Figure 2-6 Sensitive Receptor Locations
Figure 2-7 Groundwater Well Locations
Figure 2-8 Regional Surface Water Drainage
Figure 2-9 PA/SI Sample Locations
Figure 2-10 Reported MEC Finds

Figure 3-1 Site Inspection Areas of Concern
Figure 3-2 Background Sample Locations and Reconnaissance

Figure 4-1 Target No. 1 and Carty Reservoir Bomb Target Reconnaissance
Figure 4-2 Target No. 1 and Carty Reservoir Bomb Target Sample Locations and Metals Results
Figure 4-3 Target No. 1 and Carty Reservoir Bomb Target Sample Locations and Explosives Results
Figure 4-4 Target No. 1 and Carty Reservoir Bomb Target PA/SI Groundwater Sample Results

Figure 5-1 Target No. 2 Reconnaissance
Figure 5-2 Target No. 2 Sample Locations and Metals Results
Figure 5-3 Target No. 2 Sample Locations and Explosives Results
Figure 5-4 Target No. 2 PA/SI Surface Water Perchlorate and Sediment Metals Sampling Results

Figure 7-1 Range Complex No. 1 Reconnaissance
Figure 7-2 INPR Site No. 1 Range Complex No. 1 Sample Locations and Metals Results
Figure 7-3 INPR Site No. 1 Range Complex No. 1 Sample Locations and Explosives Results
Figure 7-4 Demolition Area Range Complex No. 1 Sample Locations and Metals Results
Figure 7-5 Demolition Area Range Complex No. 1 Sample Locations and Explosives Results
Figure 7-6 Demolition Area Range Complex No. 1 Reconnaissance
Figure 7-7 Turret Gunnery Range Complex No. 1 Sample Locations and Metals Results

Figure 8-1 Demolition Area No. 2 Reconnaissance
Figure 8-2 Demolition Area No. 2 Sample Locations and Metals Results
Figure 8-3 Demolition Area No. 2 Sample Locations and Explosives Results

Figure 9-1 Impact Area Reconnaissance
Figure 9-2 Impact Area Sample Locations and Metals Results
Figure 9-3 Impact Area Sample Locations and Explosives Results

Figure 11-1 Munitions Response Sites

List of Tables

Table 2-1 Munitions Information
Table 2-2 Army Checklist for Important Ecological Places
Table 2-3 Summary of Weston 2004 PA/SI Sampling
Table 2-4 Locations of Confirmed MEC Finds

Table 3-1 Summary of Samples Collected for Site Inspection
Table 3-2 Background Screening Values Soil, Sediment and Groundwater
Table 3-3 Human Health Screening Values for Soil/Sediment and Groundwater
Table 3-4 Ecological Screening Values for Soil and Sediment

Table 4-1 Comparison of Target No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 4-2 Comparison of Target No. 1 Groundwater Analytical Detections to Background, Human Health and Ecological Screening Values

Table 5-1 Comparison of Target No. 2 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 5-2 Comparison of Target No. 2 Sediment Analytical Detections to Background, Human Health and Ecological Screening Values

Table 6-1 Comparison of Carty Reservoir Bomb Target Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 6-2 Comparison of Carty Reservoir Bomb Target Sediment Analytical Detections to Background, Human Health and Ecological Screening Values

Table 7-1 Comparison of INPR Site No. 1 – Range Complex No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 7-2 Comparison of Demolition Area – Range Complex No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 7-3 Comparison of Turret Gunnery Range – Range Complex No. 1 Soil Analytical Detections to Background, Human Health and Ecological Screening Values

Table 8-1 Comparison of Demolition Area No. 2 Soil Analytical Detections to Background, Human Health and Ecological Screening Values

Table 9-1 Comparison of Impact Area Soil Analytical Detections to Background, Human Health and Ecological Screening Values
Table 9-2 Comparison of Impact Area Sediment Analytical Detections to Background, Human Health and Ecological Screening Values

List of Appendices

Appendix A Performance Work Statement (*Electronic Only*)
Appendix B Technical Project Planning Session Documentation/Meeting Minutes (*Electronic Only*)
Appendix C Interview Documentation
Appendix D Field Notes and Field Forms
Appendix E Photodocumentation Log
Appendix F Analytical Data (*Electronic Only*)
Appendix G Analytical Data QA/QC Report
Appendix H Geographical Information Systems Data
Appendix I Geophysical Data (*Not Used*)
Appendix J Conceptual Site Model
Appendix K Munitions Response Site Prioritization Protocol Evaluations
Appendix L Reference Copies

List of Acronyms

°F	degrees Fahrenheit
og/L	micrograms per liter
ADR	Automated Data Review
AFR	Air Force Range
AOC	area of concern
ARC	Annual Report to Congress
ASR	Archives Search Report
BAIC, Inc.	Boardman Agri-Industrial Complex, Inc.
bgs	below ground surface
CCB	continuing calibration blank
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Material Hazard Evaluation
CLP	Contract Laboratory Program
CSM	conceptual site model
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DERP	Defense Environmental Restoration Program
DMM	discarded military munitions
DoD	Department of Defense
DOI	Department of Interior
DQO	data quality objective
EDR	Environmental Data Resources, Inc.
EHE	Explosive Hazard Evaluation
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ER	Engineering Regulation
FR	Federal Register
FS	feasibility study
ft	foot or feet
FUDS	Formerly Used Defense Sites
GP	General Purpose
GPL	GPL Laboratories, LLLP
GPS	Global Positioning System
HE	high explosive
HHE	Health Hazard Evaluation
HRS	Hazard Ranking System
HTRW	hazardous, toxic, or radioactive wastes
IC	Ion Chromatography
ICB	initial calibration blank
IEP	Important Ecological Place
INPR	Inventory Project Report
lb	pound
MC	munitions constituents

MD	munitions debris
MEC	munitions and explosives of concern
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NAD	North American Datum
Navy	U.S. Navy
NCP	National Oil and Hazardous Pollution Contingency Plan
NDAI	No Department of Defense Action Indicated
NGVD	National Geodetic Vertical Datum
NWO	Northwest Region (Omaha District Military Munitions Design Center)
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OPRD	Oregon Parks and Recreation Department
OR	Oregon
PA/SI	Preliminary Assessment/Site Inspection
PETN	pentaerythritol tetranitrate
PGE	Portland General Electric
QA/QC	Quality Control/Quality Assurance
RAC	Risk Assessment Code
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROE	rights of entry
RPD	relative percent difference
SDG	sample delivery group
SEDD	Stage Electronic Data Deliverables
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SOP	standard operating procedure
SOW	statement of work
SQAP	Sampling and Quality Assurance Plan
SSWP	Site-Specific Work Plan
TAL	Target Analyte List
TNT	2,4,6-trinitrotoluene
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USC	United States Code
UTL	upper tolerance limit

UTM	Universal Transverse Mercator
UXO	unexploded ordnance
VSP	Visual Sampling Plan
Weston	Weston Solutions Inc.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) – Also known as "Superfund," this congressionally enacted legislation provides the methodology for the removal of hazardous substances resultant from past / former operations. Response actions must be performed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (USACE, 2003). CERCLA was codified as 42 USC 9601 et seq., on December 11, 1980, and amended by the Superfund Amendments and Reauthorization Act (SARA) on October 17, 1986.

Defense Sites – Locations that are or were owned by, leased to, or otherwise possessed or used by the Department of Defense (DoD). The term does not include any operational range, operating storage, or manufacturing facility, or facility that is used for or was permitted for the treatment or disposal of military munitions (10 USC 2710(e)(1)).

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed consistent with applicable environmental laws and regulations (10 USC 2710(e)(2)).

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration (10 USC 2710(e)(2)).

Formerly Used Defense Site (FUDS) – Real property that was formerly owned by, leased by, possessed by or otherwise under the jurisdiction of the Secretary of Defense or the components, including organizations that predate DoD. Some FUDS properties include areas formerly used as military ranges (10 USC 2710(e)(2)).

Military Munitions – Ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy (DOE), and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunitions, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components of the above.

The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices

that are managed under the nuclear weapons program of the DOE after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed (10 USC 101(e)(4)(A) through (C)).

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

Munitions Debris (MD) – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal (10 USC 2710(e)(2)).

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded ordnance as defined in 10 USC 101(e)(5); (B) Discarded military munitions, as defined in 10 USC 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard (10 USC 2710(e)(2)).

Munitions Response Site (MRS) – A discrete location within a munitions response area that is known to require a munitions response (32 CFR§179.3).

Munitions Response Site Prioritization Protocol (MRSPP) – The MRSPP was published as a rule on October 5, 2005. This rule implements the requirement established in section 311(b) of the National Defense Authorization Act for Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each location in the inventory of DOD defense sites known or suspected of containing UXO, DMM, or MC. The DoD adopted the MRSPP under the authority of 10 USC 2710(b). Provisions of 10 USC 2710(b) require that the Department assign to each defense site in the inventory required by 10 USC 2710(a) a relative priority for response activities based on the overall conditions at each location and taking into consideration various factors related to safety and environmental hazards (70 FR 58016).

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

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

Risk Assessment Code (RAC) – An interim risk assessment procedure developed by the U.S. Army Engineering and Support Center, Huntsville (USAESCH), Ordnance and Explosives Directorate (CEHNC-OE) to address explosives safety hazards related to munitions. The RAC score was formerly used by the USACE to prioritize response actions at FUDS. The RAC procedure, which does not address environmental hazards associated with MC, has been superseded by the MRSPP.

Unexploded Ordnance – Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded either by malfunction, design, or any other cause (10 USC 101(e)(5)(A) through (C)).

Executive Summary

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address DoD sites suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the U.S. Army Corps of Engineers (USACE) is conducting environmental response activities at Formerly Used Defense Sites (FUDS) for the Army, the DoD Executive Agent for the FUDS program. Shaw Environmental, Inc. (Shaw) is responsible for conducting Site Inspections (SIs) at FUDS in the northwest region managed by the Omaha District Military Munitions Design Center (NWO).

SI Objectives and Scope

The primary objective of the MMRP SI is to determine whether a FUDS project warrants further response action related to risks posed by MEC or MC. The SI collects the minimum amount of information necessary to make this determination, as well as it (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System (HRS) scoring by the Environmental Protection Agency (EPA); and (iii) collects data, as appropriate, to characterize the release for effective and rapid initiation of the Remedial Investigation (RI) and Feasibility Study (FS). An additional objective of the MMRP SI is to collect the additional data necessary to complete the Munitions Response Site Prioritization Protocol (MRSPP).

The scope of the SI reported herein is restricted to evaluation of the presence of MEC and MC related to historical use of the FUDS prior to transfer. Potential releases of hazardous, toxic, or radioactive wastes (HTRW) are not addressed within the current scope. The intent of the SI is to confirm the presence or absence of MEC and/or associated MC contamination.

Boardman Air Force Range

This report presents the results of an SI conducted at Boardman Air Force Range (AFR), FUDS property number F10OR0160, located approximately 5.5 miles southwest of Boardman, Oregon, in Morrow County. Boardman AFR was commissioned in 1941 and was used primarily as a practice bombing and gunnery range. A small portion was also reported to be used for the demolition of unserviceable/surplus munitions and small arms tracer testing. Boardman AFR was decommissioned in 1963, following discussions between the Navy, the Department of the Interior (DOI), and the State of Oregon, whereupon an agreement was reached where the Navy would consolidate its needs to the eastern half of the original range and release the western half. The land in the western half was transferred to the State of Oregon, Portland General Electric (PGE), and Morrow County.

Technical Project Planning

The approach for the SI was developed by Shaw in consultation with site stakeholders. A Technical Project Planning (TPP) meeting conducted in July 2006 was attended by representatives from the USACE Omaha Design Center, USACE Seattle District, Oregon Department of Environmental Quality (ODEQ), Oregon State Police, Portland General Electric, Boardman Agri-Industrial Complex, Inc. (BAIC, Inc.), Threemile Canyon Farms, Inland Land Company, The Nature Conservancy, the Boeing Company, and Shaw. The EPA Region 10 was invited to attend but did not respond. The stakeholders agreed to the approach and identified six areas of concern (AOCs) for further evaluation in the SI as follows: Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1, Demolition Area No. 2, and Impact Area. Note that Demolition Area No. 2 and the Impact Area were identified during the TPP. The other four AOCs were previously identified in the Archive Search Report (ASR), ASR Supplement, and the DoD Annual Report to Congress.

It was also agreed to utilize existing analytical data collected during the *Boardman AFR FUDS Preliminary Assessment/Site Inspection Report* (PA/SI) (Weston, 2004) in the evaluation of Boardman AFR.

SI Field Activities

SI field activities, conducted in February 2007, included a visual reconnaissance at Target No. 1 and the Impact Area to look for evidence of MEC. At the other AOCs, fieldwork was limited to sampling for MC because evidence of MEC was available from previous investigations. Prior to sampling, a limited visual reconnaissance, aided by an all-metal detector, was completed for anomaly avoidance during sampling. The objective of the visual reconnaissance was to observe general conditions and to select sampling locations. Samples were collected from surface soil and sediment.

SI Recommendations

Results of the SI provide the basis for conclusions and recommendations for further actions at each of the AOCs.

Target No. 1

Based on historical evidence and results from the SI field activities, there is potential for MEC at Target No. 1. Analytical results indicate that all soil metals results are below Boardman AFR background values and no explosives were detected. Groundwater analytical results indicate that metals concentrations are similar to background, with the exception of iron, which was above the background value but below the human health screening value. Perchlorate was not detected in the groundwater sample collected from within the AOC. Based on the potential for MEC, a recommendation for a Remedial Investigation/Feasibility Study (RI/FS) limited to further evaluation of the MEC hazard is made for Target No. 1. Additionally, because all analytical results from samples collected in and around this munitions response site (MRS) were either

below background concentrations or screening values, Target No. 1 is recommended for No DoD Action Indicated (NDAI) relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

Target No. 2

Based on historical evidence and recent MEC finds, there is potential for MEC at Target No. 2. Analytical results indicate that all soil metals results are below Boardman AFR background values and no explosives were detected. While surface water analytical results indicate that perchlorate is present, the upstream sampling locations have the highest perchlorate concentrations, which indicate that the perchlorate is not from Target No. 2 or any other known FUDS AOC. Based on the potential for MEC, a recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Target No. 2. Additionally, because all analytical results from samples collected in and around this MRS were either below background concentrations or screening values, Target No. 2 is recommended for NDAI relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

Carty Reservoir Bomb Target

Based on historical evidence, there is potential for MEC at Carty Reservoir Bombing Target. Analytical results indicate that all soil and sediment metals analytical results are below Boardman AFR background values and no explosives were detected. Surface water was analyzed for perchlorate only and there was no detection. Based on the potential for MEC, a recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Carty Reservoir Bomb Target. Additionally, because all analytical results from samples collected in and around this MRS were either below background concentrations or screening values, Carty Reservoir Bomb Target is recommended for NDAI relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

Range Complex No. 1

Based on historical evidence and results from the SI field activities, there is potential for MEC at Range Complex No. 1. Analytical results indicate that all soil metals results are below Boardman AFR background values and no explosives or perchlorate were detected, indicating no observed adverse impacts from MC at Range Complex No. 1. Based on the potential for MEC, a recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Range Complex No. 1. Additionally, because all analytical results from samples collected in and around this MRS were either below background concentrations or screening values, Range Complex No. 1 is recommended for NDAI relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

Additional Recommendations

Based on historical evidence and conditions observed in the SI, a removal action is not recommended prior to additional investigation.

It is recommended that the two AOCs identified during the TPP process, the Demolition Area No. 2 and the Impact Area, be designated as MRSs. If the Demolition Area No. 2 and the Impact Area are identified as MRSs, it is recommended that additional investigations for MEC be completed. Additional investigations for MC are not recommended, as concentrations of MC in samples collected from these two AOCs did not exceed site background or screening values.

It is also recommended that areas where MEC has been reported, but are not included in the four MRSs presented above or the two AOCs recommended for as additional MRSs, be further investigated to determine whether additional MEC is present in the vicinity.

MRSPP Scoring

Draft MRSPP scoring was completed for the four identified MRSs. The priority scoring ranges from 1 to 8 (highest to lowest). The draft priority scores for the four MRSs are:

MRS	MRSPP Priority Score
Target No. 1	6
Target No. 2	4
Carty Reservoir Bomb Target	3
Range Complex No. 1	4

With the exception of Target No. 1, none of the MRSs presented sufficient risk to human health or the environment from MC to merit valuation under the Health Hazard Evaluation (HHE) MRSPP module. Thus, in all but Target No. 1, the MRSs received the HHE rating of "No Known or Suspected MC Hazard." Target No. 1 was assigned value under the HHE module due to the presence of iron concentrations above the background values in a groundwater sample collected onsite. Overall, the MRSPP priority scores for the Boardman AFR MRSs reflect the risk of explosive hazards, not chemical contamination at the sites. Note that these MRSPP priority scores are draft and additional review by DoD will be completed.

1.0 Introduction

This Site Inspection (SI) Report presents the results of an SI conducted at the Boardman Air Force Range (AFR) Formerly Used Defense Site (FUDS) located near Boardman, Oregon (OR). Shaw Environmental, Inc. (Shaw) has prepared this report for the U.S. Army Corps of Engineers (USACE) in accordance with Task Order 003, issued under USACE Contract No. W912DY-04-D-0010. Shaw is responsible for conducting SIs at FUDS in the Northwest Region managed by the Omaha District Military Munitions Design Center (NWO) as directed by the Performance Work Statement (Appendix A).

The technical approach is based on the *Type I Work Plan, Site Inspections at Multiple Sites, NWO Region* (Shaw, 2006a) and the *Formerly Used Defense Sites, Military Munitions Response Program, Site Inspections, Program Management Plan* (USACE, 2005).

1.1 Project Authorization

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) to address DoD sites suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the USACE is conducting environmental response activities at FUDS for the Army, the DoD Executive Agent for the FUDS program.

Pursuant to USACE Engineer Regulation (ER) 200-3-1 (USACE, 2004a) and the *Management Guidance for the Defense Environmental Restoration Program* (DERP) (Office of the Deputy Under Secretary of Defense [Installations and Environment], September 2001), USACE is conducting FUDS response activities in accordance with the DERP statute (10 USC 2701 et seq.), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC 9601), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). As such, USACE is conducting remedial SIs, as set forth in the NCP, to evaluate hazardous substance releases or threatened releases from eligible FUDS.

While not all MEC/MC constitute CERCLA hazardous substances, pollutants, or contaminants, the DERP statute provides DoD the authority to respond to releases of MEC and MC, and DoD policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

1.2 Site Name and Location

Boardman AFR, property number F10OR0160, is located approximately 5.5 miles southwest of Boardman, OR, in Morrow County (Figure 1-1). The Boardman AFR is included in the MMRP Inventory in the *Defense Environmental Programs Annual Report to Congress* (ARC) *Fiscal Year 2006* (DoD, 2006), and in the *Archive Search Report* (ASR) *Supplement, Former*

Boardman Air Force Range, Boardman, Oregon (USACE, 2004b), with four identified ranges and three sub-ranges as follows:

Range Name	Range ID	Approximate Area (acres)	UTM Coordinates* (meters)
Target No. 1	F10OR016001R01	649	N 5063404; E 279733
Target No. 2	F10OR016001R02	649	N 5072555; E 280149
Carty Reservoir Bomb Target	F10OR016001R03	649	N 5061866; E 279539
Range Complex No. 1	F10OR016001R03	9,505	N 5072555; E 280149
INPR Site No. 1	F10OR016001R03-SR01	536	N 5072555; E 280149
Demolition Area	F10OR016001R03-SR02	157	N 5072555; E 280149
Turret Gunnery Training Range	F10OR016001R03-SR03	9,443	N 5072555; E 280149

*Coordinates for the ranges are in Universal Transverse Mercator (UTM) Zone 11N, NAD 1983.

Of the 649 total acres reported for the Carty Reservoir Bomb Target, the ASR Supplement indicates 325 acres were on land and 324 acres were water acres. In addition to the four ranges and three sub-ranges, two other areas that were not identified in the range inventory, are evaluated in this SI. The two areas including coordinates are as follows:

- Demolition Area No. 2 N 5065433; E 284894
- Impact Area N 5059240; E 282333

These two additional areas were added in the *Technical Project Planning* (TPP) *Memorandum, Boardman Air Force Base* (Shaw, 2006b) following discussions with stakeholders who indicated the presence of munitions debris (MD) at these locations.

1.3 Purpose, Scope, and Objectives of the Site Inspection

The primary objective of the MMRP SI is to determine whether a FUDS project warrants further response action related to risks posed by MEC or MC. The SI collects the minimum amount of information necessary to make this determination, as well as it (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System (HRS) scoring by Environmental Protection Agency (EPA); and (iii) collects data, as appropriate, to characterize the release for effective and rapid initiation of the Remedial Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to

collect the additional data necessary to complete the Munitions Response Site Prioritization Protocol (MRSPP).

The scope of the SI reported herein is restricted to evaluation of the presence of MEC or MC related to historical use of the FUDS prior to transfer. Potential releases of hazardous, toxic, or radioactive wastes (HTRW) are not addressed within the current scope. The intent of the SI is to confirm the presence or absence of contamination from MEC and/or MC. The general approach for each SI is to conduct records review and site reconnaissance to evaluate the presence or absence of MEC, and to collect samples at locations where MC might be expected based on the conceptual site model (CSM). The following decision rules are used to evaluate the results of the SI:

Is No DoD Action Indicated (NDAI)? An NDAI recommendation may be made if:

- There is no indication of MEC;
  and
- MC contamination does not exceed screening levels determined from TPP.

Is an RI/FS warranted? An RI/FS may be recommended if:

- There is evidence of MEC hazard. MEC hazard may be indicated by direct observation of MEC during the SI, by indirect evidence (e.g., a crater potentially caused by impact of unexploded ordnance [UXO]), or by a report of MEC being found in the past without record that the area was subsequently cleared;
  or
- MC contamination exceeds screening levels determined from TPP.

Is a removal action warranted? A removal action may be needed if:

- High MEC hazard is identified. Shaw will immediately report any MEC findings so that USACE can determine the hazard in accordance with the MRSPP. An example of a high hazard would be finding sensitive MEC at the surface in a populated area with no barriers to restrict access;
  or
- Elevated MC risk is identified. Identification of a complete exposure pathway (e.g., confirming MC concentrations above health-based risk standards in a water supply well) would trigger notification of affected stakeholders. Data would be presented at a second TPP meeting regarding the possible need for a removal.

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

1.4 Munitions Response Site Prioritization Protocol

The MRSPP was published as a rule on October 5, 2005 (70 FR 58028). This rule implements the requirement established in section 311(b) of the National Defense Authorization Act for

Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each location in the DoD inventory of defense sites known or suspected of containing UXO, discarded military munitions, or MC (70 FR 58016).

The MRSPP uses three modules to evaluate the hazards on these sites. The modules include the:

1. Explosive Hazard Evaluation (EHE) module, that evaluates relative risks of explosive hazards;
2. Chemical Warfare Material Hazard Evaluation (CHE) module, that evaluates hazards related to the physiological effects of chemical warfare material; and
3. Health Hazard Evaluation (HHE) module, that evaluates relative risk to human health and the environment from MC and any incidental non-munitions related contaminants.

A munitions response site (MRS) receives a separate numerical score and priority ranking under each module. There are three alternative scoring outcomes for each module, including: 1) "Evaluation Pending"; 2) "No Longer Required" (e.g. a response action was already taken); and 3) "No Known or Suspected Hazard." Ultimately, the MRS is assigned one site-wide priority derived from the module specific scores and priorities.

Draft MRSPP scoring sheets for the MRSs identified in this SI Report are included in Appendix K. The MRSPP scoring will be updated on an annual basis to incorporate new information.

2.0 Property Description and History

The setting, history, and use of Boardman AFR are described in the following sections. Unless otherwise referenced, this information is taken from the ASR (USACE, 1997).

2.1 Historical Military Use

Boardman AFR (Figure 2-1) was used primarily as a practice bombing and gunnery range. According to the ASR, beginning in 1941 and continuing through 1943, the United States Army Air Corps acquired 95,985.51 acres through purchase of private land and transfer of Department of the Interior (DOI) land for a practice bombing and gunnery range. Throughout the World War II years, it was used for bombing practice by the Walla Walla Army Air Base. After World War II, the Army Air Corps categorized the bombing range as surplus land and by 1946 discussions were held concerning authorizing livestock grazing on the inactive range. However, in 1948, the lands were withdrawn from surplus and the Air Force used the range until to 1960. Renamed the Boardman Precision Bombing Range, the range was configured with five targets and exclusion areas.

The 57th Air Division, Fairchild Air Force Base, assumed responsibility, control, and utilization of the former Boardman AFR between 1952 to 1957. Records indicate that a "moving 20-millimeter (mm) target gunnery range, with three mounted B-36 turrets, was added in 1952. The gunners fired at remote controlled aerial target drones (OC aircraft) under daylight and night conditions. Practice bombing was also occurring during this time. Target No. 2 was the principal bomb target during this time."

The historical records do not indicate how the area was used between 1956 and 1958. However, in December 1958, the Air Force granted the Department of the Navy permission to use the bombing range site as a high altitude bombing range. Also, in 1960, the Umatilla Army Ordnance Depot was granted a permit to use two small areas for the destruction of unusable munitions and small arms ammunition tracer testing.

In 1960, once again the Air Force placed the former Boardman AFR in an excess category and transferred 37,320.31 acres to the DOI, 58,372.9 acres to the Navy, and 290 acres to the USACE.

In 1963, following discussions between the Navy, the DOI, and the State of Oregon, an agreement was reached where the Navy would consolidate its needs to the eastern half of the original range and release the western half. This allowed for single contiguous land use by the Navy and DOI. The Air Force then passed ownership on to the State of Oregon and other entities.

2.2 Munitions Information

The types of munitions used at Boardman AFR would have included 100-pound (lb) practice bombs, 2- and 4-lb incendiary bombs, 2.25-inch practice rockets, fragmentation bombs, and conventional small arms (.50-caliber or less) and 20-mm ball ammunition. Table 2-1 contains a list of the munitions and associated MC reportedly used at the Areas of Concern (AOCs). Metals and explosives comprise the principle MC that could come from the types of munitions used at Boardman AFR.

2.3 Ownership History

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

Following closure of the Boardman AFR, the land was transferred from the Air Force to the State of Oregon, Portland General Electric, and Morrow County. Currently the property within the former Boardman AFR FUDS is owned by the City of Boardman, Morrow County, Boardman Agri-Industrial Complex, Inc. (BAIC, Inc.), and Portland General Electric (PGE). Presently BAIC, Inc. leases land to PGE, the Boeing Company, Inland Land Company, and The Nature Conservancy. Figure 2-2 shows the area surrounding Boardman AFR from an aerial photograph perspective. Parcel ownership within the identified range areas is shown on Figure 2-3. The property owners are identified by an index number rather than a name on the figures. The property owner name is available on request from the USACE Seattle District office.

2.4 Physical Setting

2.4.1 Topography and Vegetation

The topography of the former Boardman AFR slopes gently up from the Columbia River (approximately 310 feet [ft] elevation) near the northern boundary of the FUDS to the southern boundary at about 1,000 ft elevation (Figure 2-4).

The native vegetation of the Boardman AFR is shrub-steppe, with wild grasses and small brush including sage and grey rabbit bush.

2.4.2 Land Use

The FUDS is currently used for irrigated agricultural and grazing purposes; for farming of potatoes, onions, and other vegetables; as a restricted antennae test range operated by the Boeing Company; as a fossil fuel power generating plant owned by PGE; as a habitat management area

for the protection of the Washington Ground Squirrel managed by The Nature Conservancy; and as an airstrip operated and maintained by the Morrow County Port Authority.

2.4.3 Nearby Population

The community nearest the former Boardman AFR is Boardman, OR, with an estimated population of 2,855 (U.S. Census, 2000) (Figure 2-5). Morrow County has an estimated population of 10,995 or 5.4 people per square mile (U.S. Census, 2000). Several hundred residences and numerous farms are located within a two mile radius of the FUDS. Two schools are located approximately 2 miles northeast of the FUDS (Figure 2-6). Based on the 2000 U.S. Census, the estimated population within a 4-mile radius of the Boardman AFR FUDS property boundary is 3,432 persons. The estimated numbers of housing units and households within a 4-mile radius are 1,162 and 1,049, respectively.

The estimated population within a 2-mile radius for each of the four ranges listed in the 2006 ARC (DoD, 2006) are: Target No 1 – 0 persons, Target No. 2 – 0 persons, Carty Reservoir Bomb Target – 0 persons, and Range Complex No. 1 – 63. There are no schools or other critical assets located within a 2-mile radius of any of these four ranges.

2.4.4 Climate

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 and with the driest month is July. The highest monthly average maximum temperature is 89.7 degrees Fahrenheit (ºF) in July and the lowest monthly average maximum temperature is 27 ºF in January. The average annual precipitation is 8.41 inches per year.

2.4.5 Area Water Supply

Local drinking water is obtained from individual domestic water wells at residences. Well depths range from 80 to 300 ft., and are typically completed in the basalt aquifer. The City of Boardman obtains water from a well located adjacent to the Columbia River. Within the Boardman AFR FUDS there is one water supply well for the PGE fossil fuel power generating plant. This well serves both industrial and drinking water needs for the power plant. Irrigation water is obtained either from groundwater wells or the Columbia River. Figure 2-7 shows groundwater wells in the vicinity of Boardman AFR.

2.4.6 Surface Water

The former Boardman AFR is located within the Middle Columbia-Lake Wallula Watershed. Figure 2-8 shows the regional surface water drainages. Carty Reservoir is located within the former Boardman AFR and portions of the Target No. 1 and Carty Reservoir AOCs are submerged under the reservoir. Carty Reservoir was created when PGE dammed a portion of Sixmile Canyon Creek in 1977. The reservoir level is maintained using water pumped from the Columbia River. There is no surface water outlet from the reservoir. Sixmile Canyon Creek

traverses across the western portion of the former Boardman AFR. The creek is not known to support fisheries. Historically the creek was dry except during periods of heavy rain and snow melt. With the creation of Carty Reservoir and the resulting groundwater mound, water now is present in Sixmile Canyon Creek. The creek flows into the Columbia River, which is a major river that supports both federally and state threatened and listed species.

2.4.7 Geologic and Hydrogeologic Setting

The former Boardman AFR lies within the Columbia Basin Subprovince of the Columbia Intermontane Physiographic Province.

2.4.7.1 Bedrock Geology

The bedrock beneath the Boardman AFR consists of basalt flows of the Columbia River Basalt Group. Individual basalt flows range in thickness from a few tens of feet to several hundred feet. Interflow zones between individual flows may contain fine-grained sediments and are productive water-bearing zones, frequently producing high volumes of water for irrigation purposes. A layer of alluvium overlies the basalt flows and ranges in thickness from absent up to 70 feet.

2.4.7.2 Overburden Soils

The soils at the former Boardman AFR are composed of four different soil groups: the Quincy loamy fine sand, the Koehler loamy fine sand, the Hezel loamy fine sand, and the Tauton fine sandy loam.

2.4.7.3 Hydrogeology

Groundwater occurs within two distinct aquifers, the alluvial aquifer and the Columbia River Basalt aquifer system. Based on documentation received from PGE and included in *Hydrogeology, Groundwater Chemistry, and Land Use in the Lower Umatilla Basin Groundwater Management Area* (ODEQ, 1995), prior to construction of Carty Reservoir by PGE in 1977 only thin occurrences of groundwater within the alluvium were reported and Sixmile Canyon Creek was dry. Leakage from Carty Reservoir has resulted in a perched groundwater zone above the uppermost basalt flow. Water levels in the alluvium were observed to rise up to 30 ft (40 ft below ground surface [bgs]) in wells constructed near Carty Reservoir. The water levels have now stabilized. There appears to be a groundwater mound beneath Carty Reservoir. Groundwater flow direction for both the alluvial aquifer and the Columbia River Basalt aquifer system is to the north toward the Columbia River.

There are no private irrigation wells, two industrial water source wells and several monitoring wells located within the former Boardman AFR (mostly associated with the PGE fossil fuel power plant).

2.4.8 Sensitive Environments

The ranges and other areas do qualify as Important Ecological Places (IEPs) or sensitive environments as defined by USACE (2006) or EPA (1997) and shown in Table 2-2. An

exception to this is Target No. 2 which is used entirely for agricultural purposes and does not fit the definition of an IEP. Portions of the ranges and other areas of interest at the Boardman AFR addressed by this SI are used for agricultural and industrial purposes as well as a wildlife management area for the protection of the Washington Ground Squirrel by The Nature Conservancy under a multi-species candidate conservation agreement (Figure 2-6). The Washington Ground squirrel is a state listed endangered species and a federal candidate species.

Portions of Boardman AFR are within the Threemile Canyon Farms Multi-Species Candidate Conservation Agreement with Assurances area created by the U.S. Fish and Wildlife Service in cooperation with the Oregon Department of Fish and Wildlife, The Nature Conservancy, and PGE. The agreement contains a strategy for managing lands used by the Washington Ground Squirrel and to preclude the need to federally list the species as threatened or endangered. These lands are managed by The Nature Conservancy and are shown on Figure 2-6.

2.5 Previous Investigations for MC and MEC

During the ASR site visit, MD was reported within Target No. 2, Carty Reservoir Bomb Target, and INPR Site No. 1. A range clearance was reportedly completed in the 1954-1955 timeframe (USACE, 1997, Appendix I).

MEC has been reported recently as March 2006 at Target No. 2 AOC. These reports were made following the discovery of six AN-M57 General Purpose (GP) practice bombs (capable of detonating) at a local recycler. These six bombs and fifteen additional AN-M57 GP practice bombs recovered from a pile accumulated from Target No. 2 were detonated by a Navy explosive ordnance disposal (EOD) team at the nearby Navy Bombing Range. According to reports from the Navy EOD the bombs were training bombs. The bombs had been gathered from agricultural fields and placed in a pile by the agricultural workers.

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

2.5.1 Archives Search Report

The USACE completed an ASR in 1997, which compiled available information for the former Boardman AFR with emphasis on types and areas of ordnance use and disposal (USACE, 1997).

2.5.2 ASR Supplement

The USACE completed an ASR Supplement in 2004 identified specific ranges (Target No. 1, Target No. 2, Carty Reservoir Bomb Target, and Range Complex No. 1 [INPR Site No. 1, Demolition Area, and Turret Gunnery Training Range]) (USACE, 2004b).

2.5.3 Other Investigations

The USACE prepared an Inventory Project Report (INPR) for the former Boardman AFR in September 1992, in which a potential hazard from UXO at the FUDS was identified.

A Risk Assessment Code (RAC) scoring was conducted by the USACE in 2004 for the ranges identified in the ASR Supplement. Possible scores range from 5 (low risk) to 1 (high risk). The following table summarizes the RAC determinations for the ranges 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

Weston Solutions, Inc. (Weston) conducted a Preliminary Assessment/Site Inspection (PA/SI) for the EPA at the former the former Boardman AFR in 2004. The results of the investigation are presented in *Boardman AFR FUDS Preliminary Assessment/Site Inspection Report* (Weston, 2004). The scope of the PA/SI largely paralleled the scope of this SI. However, a greater emphasis was placed on determining the presence of perchlorate in soil and groundwater within and around the Boardman AFR FUDS. To the extent possible, this MMRP SI used data previously collected for the PA/SI. Additional reconnaissance and sampling activities were planned only to address specific data needs identified during the TPP. The PA/SI collected samples from soil, sediment, surface water, and groundwater. Table 2-3 lists the samples collected and analyses completed. Samples were analyzed for Target Analyte List (TAL) metals, explosives, and perchlorate. The PA/SI sample locations are shown on Figure 2-9. Note that many of the groundwater samples were collected off FUDS property.

The collection and analysis of environmental samples for perchlorate during the PA/SI were performed in accordance with an EPA Region 10 approved Sampling and Quality Assurance Plan (SQAP) prepared by Weston. Environmental samples analyzed for perchlorate employed EPA Method 314.0 (Ion Chromatography) (IC). Additionally, several surface water and groundwater samples employed a combination of EPA Method 314.0 and SW-846 Method 8321A Modified (Liquid Chromatography/Mass Spectroscopy). Perchlorate analyses by EPA Method 314.0 are susceptible to false positives because of the non-specificity of the conductivity detector. Therefore, all perchlorate "hits" (detects) reported by EPA Method 314.0 may be

biased high because of positive matrix interference. In cases where the sample was analyzed by both EPA Method 314.0 and SW-846 Method 8321A Modified, Shaw reported the perchlorate result from the EPA SW-846 Method 8321A Modified analysis. This is because EPA SW-846 Method 8321A Modified provides greater method sensitivity and minimizes the possibility of false positives. The table below summarizes perchlorate results reported by both EPA Method 314.0 and SW-846 Method 8321A Modified, and Weston's calculated relative percent difference (RPD) values. A low RPD value indicates good reproducibility or precision between perchlorate results analyzed by both EPA Method 314.0 and SW-846 Method 8321A Modified.

Sample ID	EPA Method 314.0 Result (µg/L)	EPA SW-846 Method 8321A Modified Result (µg/L)	Relative Percent Difference (RPD)
GW-DW002	< 1.0	0.46	NC
GW-MW007	3.84	4.2	9
GW-MW012	<1.0	1.1	NC
GW-MW017	20.7	18	14
GW-MW20	9.73	9.8	1
GW-MW022	5.85	5.9	1
GW-MW0023	2	2.5	22
SW-SC001	<1.0	0.32	NC

µg/L = micrograms per liter
< = concentration less than indicated quantity
EPA = U.S. Environmental Protection Agency
NC = not calculated
= shaded samples indicate samples from locations off-site of Boardman AFR FUDS

Although perchlorate results analyzed by EPA Method 314.0 may be biased high, the data were collected and reported in accordance with EPA guidance and are assumed to be of acceptable quality. The reported analyte "detections" may be used for the purpose of comparing analyte concentrations against screening levels. All perchlorate results reported above the laboratory's EPA Method 314.0 detection limit for the PA/SI are below Shaw's SI human health screening value of 24.0 micrograms per liter (µg/L) (DoD Perchlorate Screening Value) and ecological screening values of 35,000 µg/L (Los Alamos National Laboratory [LANL], 2005) and 9,300 µg/L (Dean et al., 2004).

The PA/SI report concluded that no samples contained significant (three times the PA/SI background concentration) concentrations of metals and no explosive compounds were detected. Perchlorate was detected in all five surface water samples from Sixmile Canyon Creek, with concentrations ranging between 0.32 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 collected from within and surrounding Boardman AFR and ranged in concentration between 0.46 µg/L and 20.7 µg/L. Perchlorate was detected in two of the four

samples collected from wells located on the Boardman AFR at concentrations of 2.5 µg/L and 3.56 µg/L. None of the perchlorate concentrations detected in samples collected during the PA/SI from within and surrounding Boardman AFR exceed the DoD action level for perchlorate of 24 µg/L or the ecological screening values of 35,000 µg/L (LANL, 2005) and 9,300 µg/L (Dean et al., 2004).

Additional groundwater and surface water sampling has been completed in the lower Umatilla Basin by the EPA, ODEQ, and the Navy confirming the presence of perchlorate in groundwater and surface water throughout the Lower Umatilla Basin, within which the former Boardman AFR FUDS resides (ODEQ, 2005). Locations with perchlorate detections occur both cross (up to tens of miles) and down gradient of the former Boardman AFR. The source or sources of the perchlorate have not been identified and the ODEQ and EPA are continuing investigations of perchlorate impacts in the Lower Umatilla Basin.

2.6 Other Land Uses that May Have Contributed to Contamination

Agricultural use of pesticides and herbicides could have also contributed to media contamination in particular relative to perchlorate. Perchlorate containing compounds have been documented in historical uses of fertilizers and herbicides. In addition, arid climate soils have been found to contain naturally occurring perchlorate (ITRC, 2005)

2.7 Past Regulatory Activities

There have been no regulatory actions with respect to MEC or MC reported for the site.

2.8 Previous MEC Finds

MEC finds, cited in the 1997 Boardman ASR and other more recent finds, are listed on Table 2-4 and shown on Figure 2-10. Several of the MEC finds are not located within defined AOCs. These finds may be the result of errant bomb releases or the MEC may have been moved to the location from another within a known AOC.

3.0 SI Tasks and Findings

SI tasks conducted for this FUDS property involved compiling and reviewing historical reports and information, using this information in the subsequent TPP and overall SI process. Following the TPP meeting, the *Final Site-Specific Work Plan, Boardman Air Force Range* (SSWP) (Shaw, 2007) was prepared to define the SI field activities necessary to collect the information needed to address the data gaps and data quality objectives (DQOs). Field work was conducted at the Boardman AFR between February 26 and 28, 2007.

3.1 Technical Project Planning

TPP involved compiling and reviewing historical reports and information to identify data gaps and develop a path forward. The TPP meeting for the former Boardman AFR was held at the Port of Morrow Riverfront Center in Boardman, Oregon on July 20, 2006. Representatives from the USACE – Omaha Design Center and Seattle District, ODEQ, Oregon State Police, PGE, BAIC Inc., Threemile Canyon Farms, Inland Land Company, The Nature Conservancy, the Boeing Company, and Shaw were in attendance. EPA Region 10 was invited to attend but did not respond.

Shaw reviewed the Boardman AFR information and presented a summary of the FUDS and the proposed approach for the SI, addressing MEC and MC sampling. All parties were in general agreement with the approach, but reserved judgment until the draft TPP Memorandum was issued. The property owners and lessees agreed to act on the requests for rights of entry (ROE) after they received the draft TPP Memorandum.

Based on the TPP meeting and subsequent evaluation of data obtained at the meeting, six AOCs are identified and addressed in the TPP Memorandum (Shaw, 2006b) and this report. The six AOCs are Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1 (includes INPR Site No. 1, Demolition Area, and Turret Gunnery Training Range), Demolition Area No. 2, and the Impact Area. Note that the Impact Area was identified after the TPP meeting, following evaluation of aerial photos.

TPP meeting results were documented in the TPP Memorandum (Shaw, 2006b), which was issued final on November 27, 2006 after incorporating comments from the stakeholders. The proposed technical approach was defined in the SSWP (Shaw, 2007), which was issued final on February 8, 2007 after incorporating comments from the stakeholders. A more complete discussion of the TPP meeting is contained in TPP Memorandum provided as Appendix B.

Specific discussions during the meeting included:

AOCs: There was agreement on the AOCs presented: Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1 (INPR Site No.1, Demolition Area, and Turret Gunnery Training Range). Demolition Area No. 2 was identified during the meeting. The SI AOCs are shown on Figure 3-1. Note that the boundary for Demolition Area No. 2 is dashed because the extent of the AOC has not been verified. The dashed boundary does include the known extent of demolition craters observed on aerial photography.

Potential AOC(s) were discussed based on information provided by The Nature Conservancy where MEC or MD have been located in areas within the FUDS boundary south of Demolition Area No. 2. Additional air photo review of this area is warranted along with evaluation of materials (topographic maps with MEC and MD locations) provided by The Nature Conservancy on lands they manage. Following review of data obtained at the TPP Meeting from The Nature Conservancy, an additional AOC, the Impact Area, was added. The extent of the Impact Area is not known and therefore no boundary is placed on Figure 3-1 or other figures presented in this report.

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

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

Air Photo Imagery: ODEQ has 2006 imagery available, which they provided following the meeting.

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

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

As discussed during the TPP meeting and documented in the TPP Memorandum (Shaw, 2006b), the following project objectives and DQOs were 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 all-metal detectors, a visual reconnaissance survey of Target No. 1 and the Impact Area, consisting of four transects each, will be conducted to identify physical evidence to indicate the presence of MEC (e.g., MEC on the surface and MD). The visual search will consist of a meandering path within the primary target area. The following decision rules will apply:

- If no evidence of MEC (non-small arms, MD, or magnetic anomalies was found during prior investigations and none is observed during SI visual reconnaissance, the site will be considered a potential candidate for NDAI with respect to MEC hazard.
- If MEC is not found, but isolated MD or magnetic anomalies were identified during prior investigations or are identified during SI visual reconnaissance, the site will be considered a potential candidate for NDAI with respect to MEC hazard.
- If MEC was found and/or if abundant or concentrated areas of MD or magnetic anomalies were observed during prior investigations or during SI visual reconnaissance, the site will be considered a potential candidate for further investigation with respect to MEC hazard.
- If any evidence is identified that is inconsistent with the CSM for the site (e.g., if MD indicating the potential use of high explosive [HE] munitions at a site for which the CSM was based on practice munitions), the above decision rules will be revised appropriately.
- If there is indication of an imminent MEC hazard, the site may be recommended for a removal action.

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 the SSWP (Shaw, 2007) at Target No. 1, Target No. 2, Carty Reservoir Bomb Target, the Range Complex No. 1, Demolition Area, Demolition Area No. 2, and the Impact Area. Analytical results will be compared to screening values for human health and ecological risk assessment and to background and ambient samples collected during the PA/SI and ODEQ supplied soil background data set for naturally occurring substances (note that additional samples were identified for the Turret Gunnery Training Range following a reviewer comment). The following decision rules will apply:

- If sample results are less than background, or greater than background and less than human health and ecological screening values, the site will be recommended for NDAI relative to MC.

- If sample results exceed both human health screening values and background values, the site will be recommended for additional investigation.
- If sample results do not exceed human health screening values but do exceed both ecological screening values and background values, additional evaluation of the data will be conducted in conjunction with the stakeholders to determine if additional investigation is warranted.

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.

3.2 Additional Records Research

3.2.1 Coordination with State Historic Preservation Office

The Oregon State Historic Preservation Office (SHPO) was contacted to determine if there are any areas of cultural or archaeological significance on FUDS property that could be impacted by field activities or future activities. The SHPO responded that while known archeological sites are located within the project boundaries, none of the sites is within an area proposed for sampling. Two general areas were identified to be within two of the sections contained in Target No. 1 and Carty Reservoir Bomb Target AOCs. In addition, a 7-mile stretch of the Oregon Trail crosses the extreme southern portion of the former Boardman AFR and is considered a high potential segment for archeological resources (Oregon Parks and Recreation Department [OPRD], 2006; Appendix C).

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

3.2.2 Coordination with Natural Resources Offices

The Oregon Department of Fish and Wildlife (ODFW) was contacted to determine if there are threatened or endangered species that could be impacted by field activities or future activities at the former Boardman AFR. The ODFW indicated that only the Washington Ground Squirrel would be potentially impacted. They recommended that the field team work closely with The Nature Conservancy, who manages the wildlife recovery area on the FUDS, to avoid impacts (ODFW, 2007; Appendix C).

3.2.3 Historical Aerial Photographs

Historical aerial photographs from 1958 and1965 were reviewed prior to preparation of this SI. The review confirmed the locations of AOCs addressed in this SI. Copies of historical aerial photographs are provided in Appendix L.

The most recent aerial photography is from 2006. Based on a review of the most recent aerial photography coverage, the estimated numbers of buildings within a 2-mile radius of the ranges listed in the 2006 ARC are: Target No. 1 – 54 buildings, Target No. 2 – 11 buildings, Carty Reservoir Bomb Target – 54 buildings, and Range Complex No. 1 – 79 buildings (DoD, 2006).

3.2.4 Environmental Database Search

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR) (2006). The government records search met the requirements of ASTM Standard Practice for Environmental Site Assessments (ASTM, 2006). Search results indicated the Boardman AFR was included in several databases including:

- Formerly Used Defense Sites
- Oregon Environmental Cleanup Site information System
- Facility Index System/Facility Registry System

The AOCs did not appear on mapped sites in known federal, state, or local ASTM or ASTM Supplemental databases (Appendix L). There are 12 Resource Conservation and Recovery Act-Small Quantity Generators in the vicinity of the AOCs (not within the AOC acreages). Additional information on the databases searched and the results for surrounding properties is included in the EDR report found in Appendix L.

3.2.5 Rights of Entry

Prior to mobilizing to the site, the Project Manager for the USACE Seattle District office obtained the ROE for the property where the SI field activities were performed.

3.3 Field Work

SI field activities, conducted the week of February 26, 2007, included visual reconnaissance, collection of surface soil and sediment samples. The following conditions were recorded in the field log book (Appendix D) and/or by digital photographs (Appendix E):

- Presence or absence of evidence of MEC,
- Changes, if any, in sample location because of field constraints,
- Vegetative cover, and
- Presence or absence of water for sediment samples, and other conditions encountered that impacted sample collection.

3.4 Sampling and Analysis

Samples were collected and analyzed in accordance with the SSWP (Shaw, 2007) using the standard operating procedures (SOPs) from the *Type I Work Plan* (Shaw, 2006a). Table 3-1 summarizes the soil and sediment sampling completed at Boardman AFR. Laboratory analysis was performed by GPL Laboratories of Frederick, Maryland using methods defined in the

SSWP. Analytical results are provided in Appendix F. Samples were analyzed for metals using EPA SW-846 Method 6020A and explosives using EPA SW-846 Method 8330A.

3.5 Laboratory Analysis and Data Quality Review

Laboratory analysis was performed by GPL Laboratories of Frederick, Maryland, using methods defined in the SSWP. Analytical results are provided in Appendix F.

The data review process presented in this report compares sample results to pre-established criteria referenced in the Sampling and Analysis Plan (Shaw, 2006a, Appendix E) to confirm that the data are of acceptable technical quality. GPL Laboratories, LLLP (GPL) provided Shaw with a Level 4 data package including "CLP-Like" summary forms, Staged Electronic Data Deliverables (SEDD) Stage 2b (version Draft 5.0), and Automated Data Review (ADR) compatible A1, A2, & A3 files for all sample delivery groups (SDGs).

Shaw conducted a data assessment on all samples collected in support of this SI. One-hundred percent of the analytical data have been reviewed and validation qualifiers assigned based on EPA *Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review, October 1999* and *EPA CLP National Functional Guidelines for Inorganic Data Review, October 2004*. ADR software Version 8.1 was used to assist in the data validation process for all areas with the exception of initial calibration blanks (ICB) / continuing calibration blanks (CCB), interference check standards, internal standards, serial dilutions, and second-column confirmation which were assessed manually. Data were evaluated against specific criteria to verify the achievement of all precision, accuracy, representativeness, completeness, comparability, and sensitivity goals established to meet the project DQOs.

The overall quality of the data collected is discussed in the Analytical Data QA/QC Report (Appendix G). Results of the analyses as discussed in the Analytical Data QA/QC Report are indicative of the media analyzed with the exception of some molybdenum and mercury analyses. A number of the soil and sediment samples were qualified as "U" not detected due to continuing calibration blank contamination and a number of the mercury analyses in the soil background samples were qualified as "U" not detected due to method blank contamination. No data were qualified "R" as unusable. Overall, the data reflect expected conditions and they are fully usable for their intended purpose.

3.6 Screening Values

The following subsections describe development of background and screening values for this SI.

3.6.1 Background Data

Ten background soil samples were collected from the Boardman AFR area during the SI and analyzed for metals. Background sample locations are shown on Figure 3-2. The selection of the soil background locations was aided by Visual Sampling Plan (VSP) (PNNL, 2005). VSP is

a computer software program that allows for an independent sampling location selection across a designated area. The area provided to the VSP software was all areas within the FUDS boundary not included in a known AOC. After VSP identified potential sampling locations, the locations were adjusted by hand to place the background sample location on a property for which the USACE had a signed ROE. Background sediment sampling locations were collected from a location upstream of the Boardman AFR AOCs.

The background soil sample analytical results were used to calculate background metal soil concentrations using published EPA Guidance (1989, 1992, 1994, 1995, and 2006). The background concentrations are either a 95^{th} upper tolerance limit (UTL) for normally and lognormally distributed analytes or the 95^{th} percentile for nonparametric distributed analytes. The background soil sample analytical results are provided in Appendix G. Table 3-2 lists the soil, sediment and groundwater metals background concentrations used in this report. Table 3-2 also includes the background concentration for perchlorate in groundwater that was obtained during the PA/SI (Weston, 2004). A summary of the soil background calculations is presented in Appendix L.

One sediment background sample (NWO-030-5011) was collected in the vicinity of Boardman AFR (Figure 3-2) during the SI and analyzed for metals. The analytical results are presented in Appendix G.

Groundwater background concentrations were from samples collected from PGE well "120" located upgradient of the Target No. 1 and Carty Reservoir AOCs. The well location is shown on Figure 3-2. Metal background concentrations were obtained from the PGE Boardman Plant 2005 Water Quality Monitoring Report. A copy of the report is provided in Appendix L. PGE monitors for all metal analytes of concern except mercury and perchlorate. The perchlorate background concentration was obtained from the PA/SI report (Weston, 2004). Note that the PA/SI identified the sample location as GW-MW025, which is the same well as PGE well "120. The groundwater background concentrations are listed on Table 3-2.

The method for comparing sediment and groundwater results to background was not defined in the TPP process. For purposes of comparison in this SI, the background concentrations for sediments and groundwater are taken to be the background sample value. The approach for determining if a release has occurred is consistent with the EPA's HRS (40 CFR Part 300: Appendix A): "The minimum standard to establish an observed release by chemical analysis is analytical evidence of a hazardous substance in the media significantly above the background level." Table 2-3, "Observed Release Criteria for Chemical Analysis" in the above referenced regulation has the following criteria:

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

In the discussions that follow in Sections 4 through 9, these criteria are used to determine whether a release of MC has occurred in sediment and groundwater regardless of whether the analyte is considered a hazardous substance. However, these criteria are not applied for soils because a statistically based determination of background has been established, and an exceedance of the 95th UTL or 95th percentile, depending on the individual analyte, is used to establish a release of MC.

3.6.2 Human Health Screening

Human health screening values for soil and sediment analytical results were established using the EPA Region 9 Preliminary Remediation Goals for Residential Soil. Note that in recent meetings with ODEQ for other FUDS, they indicated that EPA Region 6 Preliminary Remediation Goals should be used for all new sites in Oregon. Table 3-3 lists the human health screening values that were agreed to during the TPP process. Selection of screening levels is shown in the TPP Memorandum included as Appendix B in this SI Report.

3.6.3 Ecological Screening

According to the *Screening-Level Ecological Risk Assessment* (SLERA) *Guidance for FUDS MMRP Site Inspections* (USACE, 2006), only sites that are considered to be IEP or are to be managed for ecological purposes, require a SLERA. As shown in Table 2-2, the Boardman AFR does meet some of the 33 criteria for designation as an IEP. Table 3-4 lists the ecological screening values that were agreed to during the TPP process. Shaw developed a SLERA (Appendix L) using ecological screening values obtained from ODEQ (2001) and other appropriate sources as described in the TPP Memorandum included as Appendix B in this SI Report.

3.7 Variances from the SSWP

There were no variances to the SSWP.

3.8 Second TPP Meeting

A second TPP meeting was held via conference call on September 5, 2007. The meeting was held with stakeholders to present and discuss the SI findings and to reach consensus regarding

conclusions and recommendations. All stakeholders participating in the meeting concurred with the SI conclusions and recommendations. However, ODEQ does not concur with the recommendation of NDAI relative to MC at Range Complex No. 1. ODEQ indicated that there are several potential non-DoD related activity sources for perchlorate in groundwater in the Lower Umatilla Basin and until the other source(s) for perchlorate are determined they cannot agree to a determination of NDAI relative to MC at Range Complex No. 1. ODEQ did agree with the findings in the SI Report for a NDAI recommendation with respect to MC for Target No. 1, Target No. 2, and Carty Reservoir Bomb Target. The meeting agenda and minutes are provided in Appendix B.

4.0 Target No. 1

4.1 History and Land Use

The Target No. 1 AOC consists of a single target configured with concentric circles with radii of 100, 200, and 300 ft, which was standard range layout for the time of use. The target name is consistent with the ASR Supplement. The southern one-third of the AOC overlaps with Carty Reservoir Target AOC. The location of the AOC is shown on Figures 3-1 and 4-1.

The Target No. 1 AOC is located on BAIC, Inc. and PGE property adjacent to Carty Reservoir. Approximately 40 percent of the target drop area safety zone is flooded by Carty Reservoir. The safety zone is an area surrounding a target where the potential for bomb impacts exists.

The terrain is flat with a gradual slope toward the shoreline of Carty Reservoir. The area northeast of the safety zone has been extensively reworked during power plant construction and the building of an earthen dam for Carty Reservoir. The property to the north and west of the target is now used for irrigated farming. Portions of land near Carty Reservoir are uncultivated and near the reservoir shore, brush and trees have grown.

One groundwater monitoring well installed by the PGE Power Generating Station is located within the AOC. An industrial water supply well is located approximately 650 ft northeast of the outer boundary of the AOC. Carty Reservoir is the nearest surface water body to the AOC. Sixmile Canyon Creek flows through the northeast corner of the target. The source of water for Carty Reservoir is via pump from the Columbia River. The reservoir water is used for cooling at the PGE Power Generating Station. Future land use is expected to remain the same.

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 MD were identified within the target footprint or safety zone. The contractor that conducted the INPR for the USACE identified several small items and according to the ASR, “the description matched that of a 31-lb practice bomb.” This MD is thought to be from a MK-76 25-lb practice bomb. During the SI field activities MD was identified within the footprint of Target No. 1.

4.2 Previous Investigations

Other than the ASR and INPR, no previous investigations have been completed at Target No. 1. The PA/SI completed by Weston for the EPA in 2004 did not investigate this AOC. However, the PA/SI collected a surface water sample from Carty Reservoir. The analytical results from this sample are discussed in Section 4.4.2.

4.3 MEC Evaluation

The ASR Supplement identified the likely range munitions used at this AOC as being AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs. These practice bombs contained a black powder spotting charges which are relatively insensitive explosive components.

No MEC or MD were identified during the ASR site visit in 1997. However, the contractor that conducted the INPR for the USACE identified several small items and according to the ASR, "the description matched that of a 31-lb practice bomb." This MD is thought to be from a MK-76 25-lb practice bomb.

4.3.1 Field Observations and Historical Evidence of MEC

A visual reconnaissance of Target No. 1 was conducted prior to collection of samples to identify evidence of former range activities (e.g., surface debris, or stressed vegetation). The visual reconnaissance was supplemented with a Fisher all-metal detector in order to identify any metallic items that may be present. The Fisher all-metal detector was used due to the high iron content in the bedrock. The path walked during the visual reconnaissance was recorded using a hand-held Global Positioning System (GPS) unit (Figure 4-1). During the reconnaissance, MD likely from a M38A2 practice bomb was identified. No other evidence of military activity was observed.

4.3.2 MEC Risk Assessment

The following section presents a qualitative assessment of the risk associated with potential MEC at the Target No. 1 AOC. This assessment is based on historical documentation, prior investigation, and visual inspection conducted during this SI. A MEC assessment is provided to convey relative risk on a scale from low to high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

Shaw completed an all-metal detector assisted visual reconnaissance of the Target No. 1 AOC the week of February 26, 2007. During the reconnaissance MD likely from a M38A2 practice bomb was identified. No other MD was identified. Figure 4-1 shows the reconnaissance pathways for this AOC.

Access to portions of Target No. 1 is restricted by locked gates and fences. Access is allowed only with an escort from PGE management. Other portions of the AOC are used for irrigated agriculture and access is not controlled.

MEC has not been reported historically at Target No. 1. MD was reported in the INPR and observed during the SI field reconnaissance. The ASR nor the PA/SI (Weston, 2004) did not identify any MEC or MD from this AOC. The MEC risk for this area is considered to be low based on the following:

- Only MD has been reported for this AOC;

- The reported munitions used at this AOC are practice munitions only;
- The munitions used at this target used relatively insensitive explosive components;
- The area is used for farming, undergoing yearly tillage to depths of approximately 18 inches without MEC discovery;
- The unfenced area is not frequented by the public and only farm workers or PGE workers have access to the area; and
- No MEC has ever been reported or found.

4.4 Munitions Constituents Evaluation

Potential MC include metals associated with steel, sheet metal, paint, and other components of munitions (chromium, copper, iron, lead, molybdenum, and nickel), and black powder (potassium nitrate, sulfur, and charcoal). Perchlorate was not identified as a potential MC at Target No. 1. Nonetheless, discussion of perchlorate analytical results from surface water and groundwater samples collected from Target No. 1 during the PA/SI is included in the following evaluation for completeness.

4.4.1 Terrestrial Pathway

Terrestrial receptors may be exposed to MC because soil may have been directly affected by the corrosion of metals from the bomb bodies or explosives used. One surface soil sample (NWO-030-0001) was proposed and collected at Target No. 1. The location was near the center of the former target. The sample location is shown in Figure 4-2. The samples were analyzed for select metals (chromium, copper, iron, lead, molybdenum, and nickel) by EPA Method 6020. In addition, samples were analyzed for aluminum and manganese for potential use in evaluating naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen (2004). The sample was also analyzed for explosives including nitroglycerin by EPA Method 8330A. The explosives were added at the request of the ODEQ to confirm than no explosives were present.

Detected soil analytical results and comparison to soil background and human health and ecological screening values are shown in Table 4-1. The results of the comparison to soil background and human health and ecological screening values are shown pictorially on Figures 4-2 (metals) and 4-3 (explosives).

4.4.1.1 Comparison to Background Data

The analytical results were compared to the Boardman AFR site specific background values. There were no background exceedances for metals and no detections of explosives.

4.4.1.2 Comparison to Human Health Screening Values

Soil analytical results are only compared to human health screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

4.4.1.3 Comparison to Ecological Screening Values

Soil analytical results are only compared to ecological screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

4.4.2 Surface Water Pathway

The surface water pathway at Boardman AFR is evaluated through surface water and sediments. The potential receptors for surface water and sediments are agricultural and PGE workers and wildlife. One surface water sample (SW-CR001) was collected from Carty Reservoir during the PA/SI (Weston, 2004) and analyzed for perchlorate using EPA method *CLP Statement of Work (SOW) for Inorganics Analysis* 314.0 (EPA, 2000). Perchlorate was not detected in the PA/SI surface water sample. The detection limit was 1 µg/L. A sediment sample was proposed and collected for the SI as part of the adjacent Carty Reservoir Bombing Target evaluation (see Section 6.4.2)

4.4.3 Groundwater Pathway

The groundwater pathway at Boardman AFR was considered during the TPP discussions. Groundwater was sampled during the PA/SI and analyzed for explosives and perchlorate. Analysis for metals in groundwater was not included in the PA/SI. Metals analyses are available for some of the nearby monitoring wells by used by PGE.

Two groundwater monitoring wells owned by PGE ("008" and "120") in the vicinity of Target No. 1 were sampled and analyzed for perchlorate and explosives in the PA/SI. These same two wells are also sampled annually for metals by PGE. Both wells are completed in the upper most water bearing zone at the top of the Columbia River Basalt. The depth to water in well "008 is approximately 23 ft bgs and in well "120" approximately 46 ft bgs. Note that the PA/SI identifies well "008" as GW-MW024 and well "120" as GW-MW025. Well "008" is located within the Target No. 1 AOC (Figure 4-4), north of the Carty Reservoir earthen dam. The second well "120" is located southeast and upgradient of well "008" and Target No. 1 (see Figure 3-2). The most recent metals data are from 2005. Data are only available for chromium, copper, iron, mercury, and lead. Molybdenum and nickel are not included in the annual PGE groundwater monitoring analytical suite. Table 4-2 compares downgradient well "008" to well "120" (background) and to groundwater human health screening criteria.

4.4.3.1 Comparison to Background

Comparison of metals analytical results from well "008" to the local background (well "120") from 2005, indicates that the iron concentration from well "008" of 50 µg/L exceeded the three times background criteria of less than 10 µg/L. This indicates that a significant exceedance of background has occurred. Note that PGE does not monitor for molybdenum and nickel and no evaluation of these two analytes of concern can be completed.

During the PA/SI, groundwater samples were collected in the vicinity of Target No. 1 (wells 008 and 120) and analyzed for explosives and perchlorate. No explosive compounds were detected. Perchlorate was detected in the local upgradient well "120" at a concentration of 3.56 µg/L. This concentration is far lower than the DoD action level of 24 µg/L. Perchlorate was not detected in the downgradient well "008".

4.4.3.2 Comparison to Human Health Screening Values

Comparison to human health screening levels is only completed for those analytes that significantly exceed the background concentration. Iron was the only metal to be significantly detected (greater than three times background) above background at a concentration of 50 µg/L. This concentration is below the human health screening value of 11,000 µg/L.

4.4.4 Air Pathway

Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The potential inhalation of soil particles is included in the development of health-based screening values for soil.

5.0 Target No. 2

5.1 History and Land Use

The Target No. 2 AOC consists of a single target configured with concentric circles in 200- and 400-yard radii. In addition, there were three scoring towers 120 degrees apart near the target. This range was previously assessed during the PA/SI (Weston, 2004). The target name is consistent with the ASR Supplement. Figure 3-1 shows the general location of the Target No. 2 and Figure 5-1 shows the location with respect to the current land use in the vicinity of the target. Figure 5-2 is a historical aerial photograph showing the concentric circles of the target center. Note that the AOC boundary, obtained from the ASR Supplement (USACE, 2004b and the 2006 ARC (DoD, 2006) is not centered on the target center.

The Target No. 2 AOC is located on agricultural property owned by Threemile Canyon Farms. The area is currently used for irrigated farming. No groundwater wells are located within the boundary of Target No 2 AOC. The nearest surface water is Sixmile Canyon Creek located approximately 1,800 ft west of the southwest boundary of the AOC. The future land use is not expected to change from the present use. The target was used between 1942 and 1960 for practice bombing. As discussed in Section 2.4.8, Target No. 2 is used entirely for agricultural purposes and does not contain any sensitive environments and does not fit the definition of an IEP.

5.2 Previous Investigations

The ASR evaluated Target Area No. 2. The team encountered MD up to 325 yards from the target center. Items observed by the ASR team included M38A2 practice bombs, AN-M52 and AN-M50A2 incendiary bombs, and Mk 6 2.25-inch practice rockets.

The PA/SI collected two surface soil samples (0 to 0.5 ft bgs) and two subsurface soil samples (0.5 to 2.0 ft bgs) from a location north of the target area (Figure 5-2). Samples were analyzed for metals and perchlorate. As previously indicated, the PA/SI also sampled surface and groundwater in and around the Boardman AFR for perchlorate.

5.3 MEC Evaluation

Likely range munitions used at this AOC are listed as AN-M50 incendiary bombs, M38A2 practice bombs and Mk 6 2.25-inch practice rockets. Recent MEC finds at Target No. 2 included AN-M57 GP practice bomb. MD from AN-47, and Mk-15 Mod 3 100 lb practice bombs has also been reported (Weston, 2004). The AN-M50 and AN-M52 incendiary bombs were cased in a magnesium shell and contained a fuze and thermite. Thermite consists of a mixture of powdered aluminum metal and ferric oxide. The M38A2 practice bombs were a sand-filled, sheet metal cased, 100-lb practice bomb and contained a black powder spotting charge. The

Mk 6 2.25-inch practice rockets were constructed from sheet metal. The propellant used in the rocket was ballistite, which consists of nitrocellulose and nitroglycerin. There were no spotting charges in the Mk 6 rockets. The use of the Mk 6 practice rocket is thought to be limited at this target as evidenced by the scarcity of spent rocket motors. The reported AN-M57 GP practice bombs contained a spotting charge only. The AN-47 practice bombs were reported in the PA/SI (Weston, 2004) and may have been sand filled or were smoke or incendiary munitions. All of the above munitions contained relatively insensitive explosive components, except the AN-M47 which may have contained a sensitive fuze.

5.3.1 Field Observations and Historical Evidence of MEC

The types of munitions used at the Target No. 2 AOC are listed above. Debris from these munitions was observed during the ASR site visit in 1997, during the 2004 PA/SI investigation, and in 2006 during a Navy EOD recovery. The ASR indicated that 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 AOC for disposal and not used at the site. MEC was reported from this AOC as recently as March 2006.

No field reconnaissance was conducted at this AOC during the SI because MEC and MD were reported as recently as March 2006. However, prior to collecting soil samples, the path from the vehicle to the sampling point was visually surveyed and the path recorded using a GPS unit by a UXO technician with the aid of an all-metal detector. No MEC or MD was noted during sampling activities. The path is shown on Figure 5-1.

5.3.2 MEC Risk Assessment

The following section presents a qualitative assessment of the risk associated with potential MEC, as based on historical documentation, prior investigation, and visual inspection conducted during this SI. A MEC assessment is provided to convey relative risk on a scale from low to high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

Access to Target No. 2 is unrestricted. The area is used for irrigated agriculture and physical barriers are not present.

MEC has been reported historically at Target No. 2 as recently as March 2006. The MEC risk for this area is considered to be moderate based on the following:

- MEC has been reported as recently as March 2006, recent finds were AN-M57 GP practice bombs;
- All munitions contained relatively insensitive explosive components except for the AN-M47, which may have had a sensitive fuze;
- The area is used for farming, undergoing yearly tillage to depths of approximately 18 inches and MEC and MD is periodically unearthed;

- The unfenced area is frequented by farm workers; the general public does not have routine access to the AOC.

5.4 Munitions Constituents Evaluation

Potential MC include metals associated with steel, sheet metal, paint, and other components of munitions (chromium, copper, iron, lead, molybdenum, and nickel), black powder (potassium nitrate, sulfur, and charcoal), thermite (powdered aluminum and ferric oxide), ballistite (nitrocellulose and nitroglycerine), and Amatol (ammonium nitrate and 2,4,6-trinitrotoluene [TNT]), and tetryl. Perchlorate was not identified as a potential MC at Target No. 2. Nonetheless, discussion of perchlorate analytical results from surface water samples collected from Target No. 2 during the PA/SI is included in the following evaluation for completeness.

5.4.1 Terrestrial Pathway

Terrestrial receptors may be exposed to MC because soil may have been directly affected by the corrosion of metals from the bomb bodies or explosives used. Two surface soil samples (NWO-030-0002 and NWO-030-0003) were proposed and collected at Target No. 2. The sample locations are shown on Figures 5-2 and 5-3. The samples were analyzed for select metals (aluminum, chromium, copper, iron, lead, molybdenum, and nickel) by EPA Method 6020A. In addition, samples were analyzed for aluminum and manganese for potential use in evaluating naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen (2004). The samples were also analyzed for explosives including nitroglycerin by EPA Method 8330A.

Two surface soil samples (0 to 0.5 ft bgs) (SS-PS003 and SS-PS005) and two subsurface soil samples (0.5 to 2.0 ft bgs) (SB-PS003 and SB-PS005) were collected during the PA/SI (Weston, 2004). Samples were analyzed for TAL metals using CLP SOW ILM05.3 (EPA, 2004) and perchlorate using EPA Method 314.0 (EPA, 2000) (Table 2-3). The PA/SI sample locations were located north of the Target No. 2 AOC boundary, but are included in this evaluation for completeness.

5.4.1.1 Comparison to Background Data

The detected metals concentrations in soil for both the SI samples and the PA/SI samples are listed on Table 5-1. There were no exceedances of the SI background soil concentrations in any sample. There were no explosive or perchlorate detections in either the SI or PA/SI samples.

5.4.1.2 Comparison to Human Health Screening Values

Soil analytical results are only compared to human health screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

5.4.1.3 Comparison to Ecological Screening Values

Soil analytical results are only compared to ecological screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

5.4.2 Surface Water Pathway

As agreed to during the TPP process, no surface water or sediment samples were identified to be collected in the vicinity of the Target No. 2. Five surface water samples and one sediment sample were collected from the Sixmile Canyon Creek drainage during the PA/SI at locations greater than one mile from the center of the AOC. The locations of the surface water samples are shown on Figure 5-4. The surface water samples were analyzed for perchlorate using EPA Method 314.0 (EPA, 2000) and one sample was also analyzed for perchlorate using EPA SW-846 Method 8321-modified (STL, 2003). The sediment sample was analyzed for TAL metals using EPA method CLP SOW ILM05.3 (EPA, 2004). The potential receptors for MC in surface water and sediments are agricultural and PGE workers and wildlife.

Detected sediment analytical results and comparison to background and human health and ecological screening values are provided on Table 5-2. The surface water perchlorate analytical results are shown on Figure 5-4.

5.4.2.1 Comparison to Background Data

A background surface water sample was not collected for the PA/SI. Perchlorate was detected in all five surface water samples at concentrations ranging from 0.32 µg/L to 7.49 µg/L. The highest surface water concentration was detected in the sample (SW-SC006) collected the farthest upstream near the western boundary of the FUDS. This location (SW-SC006) is approximately 1.5 miles northwest of Target No. 1 and well away from any bombing activity at Boardman AFR (Figure 2-9). The lowest concentration was detected in the sample (SW-SC001) collected the farthest downstream (Figure 5-4).

The concentrations of metals detected in the PA/SI sediment are listed on Table 5-2. There were no significant exceedances (greater than three times the background concentration) of the SI background sediment soil concentration in the sample.

5.4.2.2 Comparison to Human Health Screening Values

The maximum detected concentration of perchlorate was 7.49 µg/L which is below the DoD action level of 24 µg/L.

The sediment sample analytical results are only compared to human health screening values if background concentrations are significantly exceeded. Because there were no significant exceedances of background concentrations, no comparison has been completed for this SI.

5.4.2.3 Comparison to Ecological Screening Values

Perchlorate ecological screening values of 35,000 µg/L (LANL, 2005) and 9,300 µg/L (Dean et al., 2004) were not exceeded by the detected surface water concentration. Sediment analytical results are only compared to ecological screening values if background concentrations are significantly exceeded. Because there were no significant exceedances of background concentrations, no comparison has been completed for this SI.

5.4.3 Groundwater Pathway

As agreed to in the TPP Memorandum, no groundwater samples were collected from Target No. 2 as part of the SI field activities (Shaw, 2006b). Groundwater samples were collected from within the Boardman AFR FUDS and surrounding property during the PA/SI (see Section 2.5.3).

5.5 Air Pathway

Air is considered to be a potential pathway due to inhalation of MC in blowing dust. The potential inhalation of soil particles is included in the development of health-based screening values for soil.

6.0 Carty Reservoir Bomb Target

6.1 History and Land Use

The Carty Reservoir Bomb Target AOC consists of a single target configured with concentric circles (spacing not identified). This target is located on the western side of Carty Reservoir (Figure 4-1). 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 target is thought to have been used between 1942 and 1945 for practice bombing; however, the actual date of use is not known.

The Carty Reservoir Bomb Target was located in a depression which made scoring difficult. The new Target No. 1 location (discussed in Section 4.0) is much flatter and at a higher elevation. The target name is consistent with the ASR Supplement. Figure 3-1 shows the general location of Carty Reservoir Bomb Target AOC. Figure 4-1 shows a more detailed view of the AOC. Figure 4-2 is a photograph from 1965 and the concentric target circles can be observed. This AOC overlaps Target No. 1 AOC.

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

6.2 Previous Investigations

The ASR team visited the Carty Reservoir Bomb Target and identified live practice bombs near the target center. The Army EOD was notified by PGE and disposed of five suspected live practice bombs (USACE, 1997, Appendix M2). MEC and MD identified by the ASR team included Mk-23, M38A2 practice bombs, and M75 and M84 target marker bombs.

One surface water sample was collected from Carty Reservoir during the PA/SI and analyzed for perchlorate. Note that the water for Carty Reservoir is pumped from the Columbia River.

6.3 MEC Evaluation

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

contained a burster and fuze and a charge of red iron ore (hematite) that was used as a marker. The M75/M84 target marker bombs contained sensitive fuzing.

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.

6.3.1 Field Observations and Historical Evidence of MEC

As agreed to at the TPP meeting, no visual reconnaissance was completed at the Carty Reservoir Bomb Target, because sufficient historical evidence of MEC and munitions debris present at this AOC. A visual reconnaissance was completed at Target No. 1 located immediately north. The northern portion of the Carty Reservoir Bomb Target safety circle overlaps the reconnaissance route completed on Target No. 1, on a portion of property. The route is shown on Figure 4-1.

6.3.2 MEC Risk Assessment

The following section presents a qualitative assessment of the risk associated with potential MEC, as based on historical documentation, prior investigation, and visual inspection conducted during this SI. A MEC assessment is provided to convey relative risk on a scale from low to high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

Access to portions of Carty Reservoir Bomb Target is restricted by locked gates and fences. Access is available only by escort by PGE management or The Nature Conservancy. Other portions of the AOC are used for irrigated agriculture and access is not controlled.

Munitions used at Carty Reservoir Bomb Target were primarily practice rounds including AN-Mk23 and M38A2 practice bombs. The M75/M84 target identification bombs may have contained sensitive fuzing. The potential for MEC at the Carty Reservoir Bomb Target is moderate. This is based on the following:

- MEC was reported during the 1995 visual site inspection conducted as part of the ASR;
- The M75/M84 target marker bombs may have contained sensitive fuzing;
- The unfenced area is used for farming, undergoing yearly tillage to depths of approximately 18 inches.

The area is frequented by farm workers; the general public does not have routine access to the AOC.

6.4 Munitions Constituents Evaluation

Based on historical information and reports of MEC and MD in the ASR, munitions used at Carty Reservoir Bomb Target were practice munitions. Potential MC include metals associated with sheet metal, cast iron, paint, and other components of munitions (iron and lead). Chromium, copper, molybdenum, and nickel were included as potential metal MC during the TPP planning, although no identified source is known at the Carty Reservoir AOC. The only

explosive documented as being used was black powder. Perchlorate was not identified as a potential MC at Carty Reservoir Bomb Target. Nonetheless, discussion of perchlorate analytical results from a surface water sample collected from Carty Reservoir Bomb Target during the PA/SI is included in the following evaluation for completeness.

6.4.1 Terrestrial Pathway

Terrestrial receptors may be exposed to MC because soil may have been directly affected by the corrosion of metals from the bomb bodies or explosives used. Two surface soil samples (NWO-030-0004 and NWO-030-0005) were proposed and collected at Carty Reservoir Bomb Target. The samples were analyzed for select metals (chromium, copper, iron, lead, molybdenum, and nickel) by EPA Method 6020A. Chromium, copper, molybdenum, and nickel were included in the analytical suite for this AOC to be consistent with other AOCs at Boardman AFR. In addition, samples were analyzed for aluminum and manganese for potential use in evaluating naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen (2004). One sample NWO-030-0005 was also analyzed for explosives including nitroglycerin by EPA Method 8330A. The explosives were added at the request of the ODEQ to confirm than no explosives were present. The sample locations and results are shown in Figures 4-2 and 4-3. No soil samples were collected from this AOC during the PA/SI.

6.4.1.1 Comparison to Background Data

The detected metals concentrations in soil are listed on Table 6-1. There were no exceedances of the SI background soil concentrations in any sample. There were no explosives detected in the one sample analyzed for explosives.

6.4.1.2 Comparison to Human Health Screening Values

Soil analytical results are only compared to human health screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

6.4.1.3 Comparison to Ecological Screening Values

Soil analytical results are only compared to ecological screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

6.4.2 Surface Water Pathway

Primary exposure to surface water is through direct contact of PGE workers and wildlife. One surface water sample was collected from Carty Reservoir during the PA/SI (SW-CR001) and analyzed for perchlorate using EPA method CLP-SOW 314.0 (EPA, 2000). One sediment sample (NWO-030-1001) and field duplicate (NWO-030-1003) were collected from the shore of Carty Reservoir (Figure 4-2). The samples were analyzed for select metals using EPA SW-846 Method 6020A, and explosives including nitroglycerin using EPA SW-846 Method 8330A.

6.4.2.1 Comparison to Background Data

The detected metals concentrations in sediment are listed on Table 6-2. There were no significant exceedances of the SI background sediment concentrations in any sample. There were no explosive detections in the sediment samples. Perchlorate was not detected in the PA/SI surface water sample (detection limit 1 µg/L).

6.4.2.2 Comparison to Human Health Screening Values

Sediment and surface water analytical results are only compared to human health screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

6.4.2.3 Comparison to Ecological Screening Values

Sediment and surface water analytical results are only compared to ecological screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

6.4.3 Groundwater Pathway

As agreed to in the TPP Memorandum (Shaw, 2006b), no groundwater samples were collected from Carty Reservoir Bomb Target as part of the SI field activities. Groundwater samples were collected from within the Boardman AFR FUDS and surrounding property (see Section 2.5.3) during the PA/SI. None of the PA/SI groundwater samples were collected from Carty Reservoir Bomb Target. The perchlorate concentrations detected in the PA/SI groundwater samples do not exceed the DoD action level of 24 µg/L for perchlorate.

6.4.4 Air Pathway

Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The potential inhalation of soil particles is included in the development of health-based screening values for soil.

7.0 Range Complex No. 1

7.1 History and Land Use

The Range Complex No. 1 AOC consists of three areas: INPR Site No. 1, the Demolition Area, and the Turret Gunnery Training Range. Figure 3-1 shows the general location of the Range No. 1 Complex AOC. Figure 7-1 shows a general overview of the AOC.

The INPR Site No. 1 is a bomb target that was in use between 1946 and 1960. The ASR Supplement indicated that the target was configured with concentric circles of 100, 200, and 300 ft. However, analysis of historical aerial photos (1965) shows faint concentric circles at 75, 500, and 1000 ft (Figures 7-2 and 7-3). A portion of the safety zone for INPR Site No. 1 lies within the non-FUDS property currently used by the Navy Bombing Range. Soil samples were collected from INPR Site No.1 during the PA/SI.

The Demolition Area was used for the demolition of munitions between 1952 and 1960 and may be the area used by the Umatilla Ordnance Depot for demolition of unserviceable munitions. The area consists of two rows, approximately 200 ft apart (Figures 7-4, 7-5 and 7-6). Each row has approximately 20 pits (craters) spaced approximately 50 ft apart. MD was reported as embedded in the crater walls and scattered in a wide radius from the craters (USACE, 1997), and MD was found during the 2007 field activities.

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

Much of the northern and eastern portions of Range Complex No.1 are currently being used for irrigated crops (Figure 7-1). The southern portion of the range is used for the Boeing Antennae Test Range, and wildlife conservation area managed by The Nature Conservancy. No groundwater wells are located within the boundary of this AOC. Future land use is expected to remain the same as current land use.

7.2 Previous Investigations

The ASR visited the Range Complex No. 1 area. The area of INPR Site No. 1 was reported to be "littered with bomb bodies in sizes ranging from the 3-lb Mk 23 up to the 2,000 lb BDU-10." In addition, the ASR reported finding "pieces of heavy metal fragments from high explosive ordnance" (USACE, 1997).

The Demolition Area was also visited by the ASR team, which reported finding two rows of demolition craters, each row consisting of approximately twenty craters. The craters were used for demolition of munitions. MD was reported within and surrounding the craters. The ASR team performed a random inspection of the Turret Gunnery Training Range safety fan and did not find any MD.

The PA/SI collected two surface soil samples (0 to 0.5 ft bgs) and two subsurface soil samples (0.5 to 2.0 ft) from within INPR Site No. 1 and shown on Figures 7-2 and 7-3. Samples were analyzed for metals, explosives and perchlorate.

7.3 MEC Evaluation

The likely range munitions used were:

- INPR Site No. 1 – Mk 23, Mk 76, Mk 84, Mk 89, Mk 106, M38A2, BDU 10, and BDU 33 practice bombs. In addition Weston (2004) reported finding a Mark-12 practice nuclear bomb (inert training bomb filled with concrete) and a Fuel-Air-Explosive BLU-95 bomb. The Mark-12 and BLU-95 were likely bombs that drifted over from the adjacent Navy Bomb Range. The Mark-12 has a parachute that is deployed during decent from the aircraft. The Shaw UXO safety expert reviewed the photograph of the reported BLU-95 and identified the bomb as a BLU-73. The BLU-73 contains extremely sensitive explosive components. All others contain relatively insensitive explosive components.
- 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. The detonation cord has a moderate explosive sensitivity risk.
- Turret Gunnery Training Range – 20-mm Ball practice ammunition. The projectile is machined from bar steel. The ammunition has a relatively insensitive explosive risk.

The types of munitions used at the Range Complex No. 1 AOC are listed above. Debris from these munitions was observed during the ASR site visit in 1997. The ASR noted that other than the Mk 23 practice bomb, the remaining bombs on INPR Site No. 1 are post Korean War vintage, particularly the BDU-10 practice nuclear bomb.

7.3.1 Field Observations and Historical Evidence of MEC

The Demolition Area and Turret Gunnery Training Range were visited during the SI field investigation. No visual reconnaissance was completed in either area as the presence of MEC and munitions debris has been previously observed. However, prior to collecting soil samples at both areas, the path from the vehicle to the sampling point was visually surveyed by a UXO technician with the aid of an all-metal detector. The paths are shown on Figures 7-1 and 7-6. MD was observed in the Demolition Area (Figure 7-6), but no debris was observed at the sampling locations for the Turret Gunnery Training Range.

The ASR identified MD in both INPR Site No. 1 and the Demolition Area. None was observed in the Turret Gunnery Training Range. The PA/SI reported observing at the INPR Site No. 1 Mk-76, Mk-89, Mk-84, and Mark 12 practice bombs and a BLU-95 (BLU-75) fuel air explosive bomb.

7.3.2 MEC Risk Assessment

The following section presents a qualitative assessment of the risk associated with potential MEC, as based on historical documentation and SI field observations. A MEC assessment is provided to convey relative risk on a scale from low to high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

Access to portions of Range Complex No. 1 is restricted by the Boeing Company through locked gates and fences and access is only through security personnel. Areas with restricted access include all of the Demolition Area and portions INPR Site No. 1 and the Turret Gunnery Range. Access to the remainder of INPR Site No. 1 is through locked gates. Access to those areas used for irrigated agriculture is not restricted.

The overall MEC risk for Range Complex No. 1 is moderate, with the risk concentrated at INPR Site No. 1 and the Demolition Area. This assessment is based on the following:

- Munitions debris has been reported at INPR Site No. 1 and the Demolition area;
- The BLU-73 that was located at INPR Site No. 1 contains extremely sensitive explosive components. The munitions likely drifted over from the adjacent Navy Range;
- Detonation cord used at the Demolition area contains sensitive explosive components;
- A portion of the area is used for farming, undergoing yearly tillage to depths of approximately 18 inches.
- Access to portions of INPR Site No. 1 and all of the Demolition area are controlled by security personnel. The remainder of the area of INPR Site No. 1 is controlled by locked gates. All irrigated agricultural areas are frequented by farm workers: the general public does not have routine access to the AOC.

7.4 Munitions Constituents Evaluation

Potential MC include metals associated with steel, sheet metal, paint, and other components of munitions (chromium, copper, iron, lead, mercury, molybdenum, and nickel), and explosives including nitroglycerin and pentaerythritol tetranitrate (PETN).

7.4.1 Terrestrial Pathway

Terrestrial receptors may be exposed to MC because soil may have been directly affected by the corrosion of metals from the bomb bodies or explosives used. As discussed in Section 7.2 above, two surface soil samples (0 to 0.5 ft bgs) and two subsurface soil samples (0.5 to 2.0 ft bgs) were collected during the PA/SI (Figures 7-2 and 7-3). The samples were analyzed for TAL

metals using EPA method CLP SOW ILM05.3 (EPA, 2004), explosives using EPA SW-846 Method 8330, and perchlorate using EPA Method 314.0 (EPA, 2000) (Table 2-3).

Two surface soil samples (NWO-030-0006 and NWO-030-0007) and one field duplicate (NWO-030-0013) were proposed and collected from the Demolition Area (Figures 7-4, 7-5, and 7-6). One sample location was from within a detonation crater and the second was from outside and both near locations of MD. Two soil samples (NWO-030-0008 and NWO-030-0009) were proposed and collected from the Turret Gunnery Training Range (Figure 7-7). Locations were from within the fan of the gunnery range.

The four samples were analyzed for select metals (chromium, copper, iron, lead, mercury, molybdenum, and nickel) by EPA Method 6020A. In addition, samples were analyzed for aluminum and manganese for potential use in evaluating naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen (2004). The two samples from the Demolition Area were also analyzed for explosives including nitroglycerin and PETN by EPA SW-846 Method 8330A (Table 3-1). Samples from the Turret Gunnery Training Range were not analyzed for explosives because only 20-mm ball practice rounds from ground-to-air gunnery practice were used.

7.4.1.1 Comparison to Background Data

The detected metals concentrations in soil from both SI and PA/SI sampling are listed on Tables 7-1, 7-2, and 7-3. There were no metals exceedances of the background soil concentrations in any samples (Figures 7-2, 7-4, and 7-7). There were no explosives detected in the two SI samples from the Demolition Area (Figure 7-5). There were no explosives detected and no perchlorate detected in the PA/SI samples (Figure 7-3).

7.4.1.2 Comparison to Human Health Screening Values

Soil analytical results are only compared to human health screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

7.4.1.3 Comparison to Ecological Screening Values

Soil analytical results are only compared to ecological screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

7.4.2 Surface Water Pathway

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 and no surface water or sediment samples were planned or collected.

7.4.3 Groundwater Pathway

The TPP Memorandum indicated that groundwater was a potentially affected media, with potential receptors located downgradient of the FUDS boundary (Shaw 2006b). No groundwater drinking water wells are located within the AOC, but drinking water wells are located downgradient of the AOC. As discussed in the TPP Memorandum, the PA/SI addressed the groundwater pathway for the Boardman AFR; therefore, sufficient data exists to assess groundwater. Section 2.5.3 of this SI report presents the results of the PA/SI sampling.

Groundwater samples were collected within, downgradient, and cross gradient of the Boardman AFR. A total of 25 groundwater samples were collected from the area within and surrounding the Boardman AFR. Four of the samples were located on the Boardman AFR FUDS. Samples were analyzed for explosive compounds and perchlorate (see Section 2.5.3). Metals were not included in the PA/SI analytical suite; however, the metals associated with the munitions used at this AOC have a low mobility. If impacts from metals in soil were present, movement to the groundwater would not be expected. As agreed to in the TPP Memorandum, no groundwater samples were planned or collected during the SI (Shaw, 2006b).

7.4.3.1 Comparison to Background

As agreed in the TPP Memorandum, no groundwater samples were collected from within the Range Complex No. 1 AOC during the SI, and no groundwater samples were collected from the AOC during the PA/SI (Shaw, 2006b). However, as discussed in Section 2.5.3, samples were collected down and cross gradient of the AOC and FUDS. The sampling results indicated that no explosives were detected in any groundwater sample and perchlorate was detected in 18 of 25 wells sampled in the PA/SI. In the 18 samples with perchlorate detections, concentrations ranged between 0.46 µg/L and 20.7 µg/L. No background value for perchlorate was established in the PA/SI. However, based on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater samples is not originating from sources within this AOC or the Boardman AFR FUDS.

7.4.3.2 Comparison to Human Health Screening Values

The DoD action level for perchlorate is 24 µg/L. All detected concentrations of perchlorate in the vicinity of Boardman AFR FUDS are below the DoD action level.

7.4.4 Air Pathway

Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The potential inhalation of soil particles is included in the development of health-based screening values for soil.

8.0 Demolition Area No. 2

8.1 History and Land Use

Demolition Area No. 2 was identified during the TPP meeting. The identification was made through interviews with a property leaseholder (The Nature Conservancy) and the Oregon State Police. The AOC consists of a number of detonation craters with MD (Figure 8-1). Munitions, fuzes, and MD were recently destroyed by the Oregon State Police at this AOC.

Little is known of the Demolition Area No. 2 AOC and who used it. The area appears to have been used as an ordnance disposal/demolition area. Note that the boundary for Demolition Area No. 2 is dashed because the extent of the AOC has not been verified (Figure 8-1). The dashed boundary does include extent of demolition craters observed on aerial photography. No groundwater wells are located within the boundary of this AOC. The land is currently used as a wildlife conservation area. Future land is expected to remain the same as current land use.

8.2 Previous Investigations

No previous investigations have been completed at this AOC.

8.3 MEC Evaluation

Munitions identified as having been present at the Demolition Area No. 2 include: 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). Other munitions may have been destroyed at this site. All of the above munitions have sensitive explosive components except for the C-4 blocks.

8.3.1 Field Observations and Historical Evidence of MEC

A visual reconnaissance with the aid of an all metal detector for safety was completed as part of the SI field activities. The path of the visual reconnaissance is shown on Figure 8-1. The UXO technician reported that large accumulations of MD were observed, including heavy wall fragments. No MEC was identified.

Debris from munitions was privately located by employees of The Nature Conservancy who manage a portion of land for critical wildlife habitat and Oregon State Police EOD unit. In June 2006 ordnance disposal of an M83 Butterfly bomb was completed by the Oregon State Police.

8.3.2 MEC Risk Assessment

The following section presents a qualitative assessment of the risk associated with potential MEC, as based on historical documentation and SI field work. A MEC assessment is provided to convey relative risk on a scale from low to high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

Access to Demolition Area No. 2 is restricted by locked gates and fences. Access is available through The Nature Conservancy.

The MEC risk for Demolition Area No. 2 is moderate. This assessment is based on:

- Recent find and demolition of a M83 butterfly bomb by Oregon State Police EOD Unit;
- Observed accumulations of MD;
- Sensitive fuzes contained in reported MEC and MD;
- Access through locked but unpatrolled gates.

8.4 Munitions Constituents Evaluation

Potential MC include metals associated with steel, sheet metal, paint, and other components of munitions (chromium, copper, iron, lead, mercury, molybdenum, and nickel) and explosives (TNT, tetryl, hexahydro-1,3,5-trinitro-1,3,5-triazine [RDX], and PETN). Perchlorate was not identified as a potential MC at Demolition Area No. 2. Nonetheless, discussion of perchlorate analytical results from groundwater samples collected during the PA/SI is included in the following evaluation for completeness.

8.4.1 Terrestrial Pathway

Terrestrial receptors may be exposed to MC because soil may have been directly affected by the corrosion of metals from the bomb bodies or explosives used. Two surface soil samples (NWO-030-0010 and NWO-030-0011) were proposed and collected from the Demolition Area No. 2. The sample locations are shown on Figures 8-2 and 8-3. The samples were analyzed for select metals (chromium, copper, iron, lead, mercury, molybdenum, and nickel) by EPA Method 6020A. In addition, samples were analyzed for aluminum and manganese for potential use in evaluating naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen (2004). The soil sample was also analyzed for explosives including nitroglycerin and PETN by EPA SW-846 Method 8330A (Table 3-1).

8.4.1.1 Comparison to Background Data

Detected metals were compared to background soil concentrations (Table 8-1). There were no exceedances of background soil concentrations. There were no detections of explosives in either sample.

8.4.1.2 Comparison to Human Health Screening Values

Soil analytical results are only compared to human health screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

8.4.1.3 Comparison to Ecological Screening Values

Soil analytical results are only compared to ecological screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

8.4.2 Surface Water Pathway

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. No surface water or sediment samples were planned or collected from the Demolition Area No. 2.

8.4.3 Groundwater Pathway

The TPP Memorandum indicated that groundwater was a potentially affected media, with potential receptors located downgradient of the FUDS boundary (Shaw, 2006b). No groundwater drinking water wells are located within the AOC, but drinking water wells are located downgradient of the Demolition Area No. 2 AOC. As discussed in the TPP Memorandum, the PA/SI addressed the groundwater pathway for the Boardman AFR, and sufficient data exist to assess groundwater. Section 2.5.3 of this SI report presents the results of the PA/SI sampling.

Groundwater samples were collected within, downgradient, and cross gradient of the Boardman AFR. A total of 25 groundwater samples were collected from the area within and surrounding the Boardman AFR. Four of the samples were located on the Boardman AFR FUDS. Samples were analyzed for explosive compounds and perchlorate (see Section 2.5.3). Metals were not included in the PA/SI analytical suite. However, the metals associated with the munitions used at this AOC have a low mobility, and if impacts from metals in soil were present, movement to the groundwater would not be expected. As agreed to in the TPP Memorandum, no groundwater samples were planned or collected during the SI (Shaw, 2006b).

8.4.3.1 Comparison to Background

As agreed in the TPP Memorandum, no groundwater samples were collected from within the Demolition Area No. 2 AOC during the SI, and no groundwater samples were collected from the AOC during the PA/SI (Shaw, 2006b). However, as discussed in Section 2.5.3, samples were collected down and cross gradient of the AOC and FUDS. The sampling results indicated that no explosives were detected in any groundwater sample and perchlorate was detected in 18 of 25 wells sampled in the PA/SI. In the 18 samples with perchlorate detections concentrations ranged between 0.46 µg/L and 20.7 µg/L. No background value for perchlorate was established in the PA/SI. However, based on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater samples is not originating from sources within this AOC or the Boardman AFR FUDS.

8.4.3.2 Comparison to Human Health Screening Values

The DoD action level for perchlorate is 24 µg/L. All detected concentrations of perchlorate in the vicinity of Boardman AFR FUDS are below the DoD action level.

8.4.4 Air Pathway

Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The potential inhalation of soil particles is included in the development of health-based screening values for soil.

9.0 Impact Area

9.1 History and Land Use

The Impact Area was identified following the TPP meeting. The identification was made through interviews with a property leaseholder (The Nature Conservancy) and located on aerial photography. According to The Nature Conservancy, the AOC consists of a number of impact craters with a small amount of MD. The AOC is locally known as the "Ship in the Desert". Apparent impact craters are also visible on aerial photographs (Figure 9-1).

Little is known of the Impact Area and who used it. The extent of the Impact Area is not known and therefore no boundary is placed on figures presented in this report. One groundwater well is located approximately 1 mile south (upgradient) of the AOC. The land is currently used as a wildlife conservation area. Future land use is expected to remain the same as current land use.

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

9.2 Previous Investigations

No previous investigations have been completed at the Impact Area.

9.3 MEC Evaluation

The potential munitions used at this AOC are AN-Mk 5, AN-Mk 23, and AN-Mk 43 practice bombs, which were the standard practice bombs used at Boardman AFR during World War II. These practice bombs contained black powder and a red or white phosphorus pyrotechnic spotting charge but contain no sensitive explosive components. The use of other practice bombs is possible.

9.3.1 Field Observations and Historical Evidence of MEC

A limited visual field reconnaissance aided by an all-metal detector for safety was completed at the Impact Area AOC. The path is shown on Figure 9-1. No MEC or MD was identified and no impact craters were observed. An employee of the Nature Conservancy stated that MD has been observed during The Nature Conservancy work in the area.

9.3.2 MEC Risk Assessment

The following section presents a qualitative assessment of the risk associated with potential MEC, as based on historical documentation and limited visual reconnaissance. A MEC assessment is provided to convey relative risk on a scale from low to high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

Access to the Impact Area is restricted by locked gates and fences. Access is controlled by The Nature Conservancy.

The MEC risk for the Impact Area AOC is low. This assessment is based on:

- No MEC has been reported at this AOC;
- No observed accumulations of MD during the SI. However, an employee of The Nature Conservancy stated that he has observed MD at the AOC;
- Munitions assumed to have been used at the Impact Area contain no sensitive explosive components;
- Access to area is only through locked gates.

9.4 Munitions Constituents Evaluation

Potential MC at the Impact Area includes metals associated with steel, sheet metal, paint, and other components of munitions metals (chromium, copper, iron, lead, molybdenum, and nickel) from bomb bodies. Black powder was the explosive most likely used; however, other explosives were possibly used. Perchlorate was not identified as a potential MC at the Impact Area. Nonetheless, discussion of perchlorate analytical results from groundwater samples collected during the PA/SI is included in the following evaluation for completeness.

9.4.1 Terrestrial Pathway

Terrestrial receptors may be exposed to MC because soil may have been directly affected by the corrosion of metals from the bomb bodies or explosives used. One surface soil sample (NWO-030-0012) was proposed and collected from the Impact Area. The samples were analyzed for select metals (chromium, copper, iron, lead, mercury, molybdenum, and nickel) by EPA Method 6020A. In addition, samples were analyzed for aluminum and manganese for potential use in evaluating naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen (2004). The two samples from the Demolition Area were also analyzed for explosives including nitroglycerin by EPA SW-846 Method 8330A (Table 3-1). The sample location and results are shown on Figures 9-2 and 9-3).

9.4.1.1 Comparison to Background Data

Detected metals were compared to background soil concentrations (Table 9-1). There were no exceedances of background soil concentrations.

9.4.1.2 Comparison to Human Health Screening Values

Soil analytical results are only compared to human health screening values if background concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

9.4.1.3 Comparison to Ecological Screening Values

Soil analytical results are only compared to ecological screening values if background

concentrations are exceeded. Because there were no exceedances of background concentrations, no comparison has been completed for this SI.

9.4.2 Surface Water Pathway

The surface water pathway at Boardman AFR is evaluated through sediments. The potential receptors for sediments are conservation area workers and wildlife. One sediment sample (NWO-030-1002) was proposed from this AOC (Figures 9-2 and 9-3). The sediment sample was analyzed for select metals (chromium, copper, iron, lead, mercury, molybdenum, and nickel) by EPA Method 6020A. In addition, aluminum and manganese were analyzed as they may be useful in evaluating naturally occurring concentrations of metals in soil using the method of Myers and Thorbjornsen (2004). The sediment sample was also analyzed for explosives including nitroglycerin by EPA SW-846 Method 8330A (Table 3-1).

9.4.2.1 Comparison to Background Data

The detected metals concentrations in sediment are listed on Table 9-2. There were no significant exceedances (greater than three times maximum background concentration) of the SI background sediment concentrations. No explosive compounds were detected.

9.4.2.2 Comparison to Human Health Screening Values

Sediment analytical results are only compared to human health screening values if background concentrations are significantly exceeded. Because there were no significant exceedances of background concentrations, no comparison has been completed for this SI.

9.4.2.3 Comparison to Ecological Screening Values

Sediment analytical results are only compared to ecological screening values if background concentrations are significantly exceeded. Because there were no significant exceedances of background concentrations, no comparison has been completed for this SI.

9.4.3 Groundwater Pathway

The TPP Memorandum indicated that groundwater was a potentially affected media, with potential receptors located downgradient of the FUDS boundary (Shaw 2006b). No groundwater drinking water wells are within the AOC, but drinking water wells are located downgradient of the Impact Area AOC. As discussed in the TPP Memorandum, the PA/SI addressed the groundwater pathway for the Boardman AFR; therefore, sufficient data exists to assess groundwater. Section 2.5.3 of this SI report presents the results of the PA/SI sampling.

Groundwater samples were collected within, downgradient, and cross gradient of the Boardman AFR. A total of 25 groundwater samples were collected from the area within and surrounding the Boardman AFR. Four of the samples were located on the Boardman AFR FUDS. Samples were analyzed for explosive compounds and perchlorate (see Section 2.5.3). Metals were not included in the PA/SI analytical suite. However, the metals associated with the munitions used at this AOC have a low mobility, and if impacts from metals in soil were present movement to

the groundwater would not be expected. As agreed to in the TPP Memorandum, no groundwater samples were planned or collected during the SI (Shaw, 2006b).

9.4.3.1 Comparison to Background

As agreed in the TPP Memorandum, no groundwater samples were collected from within the Impact Range AOC during the SI and no groundwater samples were collected from the AOC during the PA/SI (Shaw, 2006b). However, as discussed in Section 2.5.3, samples were collected down and cross gradient of the AOC and FUDS. The sampling results indicated that no explosives were detected in any groundwater sample and perchlorate was detected in 18 of 25 wells sampled in the PA/SI. In the 18 samples with perchlorate detections concentrations ranged between 0.46 µg/L and 20.7 µg/L. No background value for perchlorate was established in the PA/SI. However, based on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater samples is not originating from sources within this AOC or the Boardman AFR FUDS.

9.4.3.2 Comparison to Human Health Screening Values

The DoD action level for perchlorate is 24 µg/L. All detected concentrations of perchlorate in the vicinity of Boardman AFR FUDS are below the DoD action level.

9.4.4 Air Pathway

Air is considered to be a potential pathway due to inhalation of MC in from blowing dust. The potential inhalation of soil particles is included in the development of health-based screening values for soil.

10.0 Summary and Conclusions

The conclusions of the SI are presented in this section. Recommendations are presented in Section 11.0. Updated CSMs are presented in Appendix J.

The six AOCs at Boardman AFR include Target No. 1, Target No. 2, Carty Reservoir Bomb Target, Range Complex No. 1, Demolition Area No. 2, and the Impact Area. The former Boardman AFR is included on the MMRP Inventory in the 2006 ARC (DoD, 2006), and in the ASR Supplement (USACE, 2004b), with four identified ranges and three sub-ranges as follows:

Range Name	Range ID	Approximate Area (acres)	UTM Coordinates* (meters)
Target No. 1	F10OR016001R01	649	N 5063404; E 279733
Target No. 2	F10OR016001R02	649	N 5072555; E 280149
Carty Reservoir Bomb Target	F10OR016001R03	649	N 5061866; E 279539
Range Complex No. 1	F10OR016001R03	9,505	N 5072555; E 280149
INPR Site No. 1	F10OR016001R03-SR01	536	N 5072555; E 280149
Demolition Area	F10OR016001R03-SR02	157	N 5072555; E 280149
Turret Gunnery Training Range	F10OR016001R03-SR03	9,443	N 5072555; E 280149

*Coordinates for the ranges are in UTM Zone 11N, NAD 1983.

Of the 649 total acres reported for the Carty Reservoir Bomb Target, the ASR Supplement indicates 325 acres were on land and 324 acres were water acres. In addition to the four ranges and three sub-ranges, two other areas which were not identified in the range inventory, were evaluated in this SI. The two areas including coordinates are as follows:

- Demolition Area No. 2 N 5065433; E 284894
- Impact Area N 5059240; E 282333

10.1 Target No. 1

A visual reconnaissance of Target No. 1 was conducted prior to collecting a soil sample. MD, likely from a M38A2 practice bomb was identified. Previously MD was identified during the INPR site visit. No MEC has been identified at this AOC. The risk for potential MEC at Target No. 1 is considered to be low based on the following:

- No MEC has ever been reported or found;
- MD has been reported for this AOC;
- The reported munitions used at this AOC are practice munitions only;
- The munitions used at this target used relatively insensitive explosive components;
- The area is used for farming, undergoing yearly tillage to depths of approximately 18 inches without MEC discovery; and
- The unfenced area is not frequented by the public and only farm workers of PGE workers have access to the area.

One surface soil sample was collected from Target No. 1 and analyzed for select metals and explosives. Detected results were compared to background concentrations and there were no exceedances of background and there were no detections of explosive compounds. Because there were no exceedances of background concentrations, no comparison to human health or ecological screening values was completed. No surface water or sediment samples were collected from this AOC. Surface water and sediments were addressed under the adjacent Carty Reservoir Bomb Target (Section 10.3)

During the 2004 Weston PA/SI groundwater samples were collected from two wells located in the vicinity of the Target No. 1. One well was located upgradient of Target No.1 and one well was located within the Target No. 1 AOC boundary. Samples were analyzed for perchlorate. In addition, both of these wells are sampled annually by PGE for metals. Analytical results indicate that metals in the groundwater from the well located within Target No. 1 were below the background well concentrations. An exception to this was for iron, which significantly exceeded (three times the background concentration) the background concentration. However, the concentration was well below the human health screening value. In addition, iron was not detected in soil at concentrations that are above soil background concentrations. Molybdenum and nickel were not included in the groundwater analytical suite completed by PGE and no evaluation was completed for these analytes of concern. Perchlorate was detected in the upgradient well but not the downgradient well. The detection in the upgradient well was below the DoD action level.

10.2 Target No. 2

No MEC or MD was identified during the SI field activities. MEC has been identified as recently as Spring 2006 and destroyed by a Navy EOD unit. MD was observed during the ASR field visit. The risk for potential MEC at Target No. 2 is considered to be moderate based on the following:

- MEC has been reported as recently as March 2006, recent finds were AN-M57 GP practice bombs;

- All munitions contained relatively insensitive explosive components except for the AN-M57 which may have had a sensitive fuze;
- The area is used for farming, undergoing yearly tillage to depths of approximately 18 inches and MEC is periodically unearthed;
- The unfenced area is frequented by farm workers; the general public does not have routine access to the AOC.

Two surface soil samples were collected during the SI field activities and analyzed for select metals and explosives. In addition, two surface soil samples and two subsurface soil samples were collected from this AOC during the PA/SI (Weston, 2004). The PA/SI samples were analyzed for metals and perchlorate. Analytical results for metals for all soil samples were below Boardman AFR background values. There were no explosive or perchlorate detections.

No surface water or sediment samples were collected during the SI field activities at Target No. 2. Five surface water samples and one sediment sample were collected during the PA/SI from locations located west of the Target No. 2. The surface water samples were analyzed for perchlorate and the sediment sample was analyzed for metals. Perchlorate was detected in all surface water samples. All concentrations were below the DoD action level and below available ecological screening values. The highest perchlorate concentration was in the most upstream sample and the lowest was in the most downstream sample. The most upstream sample location is upstream of all FUDS AOCs. These results indicate that the source of perchlorate in Sixmile Canyon Creek is not from FUDS related activity. The metals analytical results from the sediment sample were below background concentration.

10.3 Carty Reservoir Bomb Target

No MEC or MD was observed during the SI field activities. During the ASR field visit, large amounts of MD were observed as well as relatively intact, fuzed and suspected live munitions. The risk for potential MEC at Carty Reservoir Bomb Target is considered to be moderate based on the following:

- MEC was reported during the ASR in 1995;
- The M75/M84 target marker bombs may have contained sensitive fuzing;
- The area is used for farming, undergoing yearly tillage to depths of approximately 18 inches;
- The unfenced area is frequented by farm workers; the general public does not have routine access to the AOC.

Two surface soil samples were collected during the SI field activities and analyzed for select metals. One of the two samples was also analyzed for explosives. Metal analytical results were all below Boardman AFR background values. There were no explosives detections. One sediment sample was collected during the SI field activities and analyzed for select metals and

explosives. Metals analytical results were all below background concentrations. There were no explosive detections. A surface water sample was collected from Carty Reservoir during the PA/SI (Weston, 2004). The sample was analyzed for perchlorate. There was no perchlorate detected.

10.4 Range Complex No. 1

Range Complex Consists of three sub-ranges: INPR Site No. 1, the Demolition Area, and the Turret Gunnery Training Range. Historically, MD has been reported at both INPR Site No. 1 (a former bombing target) and the Demolition Area. During the SI Field work MD was observed at the Demolition Area. No MEC has been reported at Range Complex No. 1. No MD was observed or has been reported within the Turret Gunnery Training Range. The risk for potential MEC at Range Complex No. 1 is considered to be moderate based on the following:

- Munitions debris has been reported at INPR Site No. 1 and the Demolition area;
- The BLU-73 that was located at INPR Site No. 1 contains extremely sensitive explosive components. The munitions likely drifted over from the adjacent Navy Range activities;
- Detonation cord used at the Demolition area contains sensitive explosive components;
- A portion of the area is used for farming, undergoing yearly tillage to depths of approximately 18 inches.
- Access to potions of INPR Site No. 1 and all of the Demolition Area are controlled by security personnel. The remainder of the area of INPR Site No. 1 is controlled by locked gates. All irrigated agricultural areas are frequented by farm workers: the general public does not have routine access to the AOC.

Two soil samples each were collected from the Demolition Area and the Turret Gunnery Training Range during the SI field activities. The two samples from the Demolition Area were analyzed for select metals and explosives and the two samples from the Turret Gunnery Training Range were analyzed for select metals only. Two samples were also collected during the PA/SI (Weston, 2004) at INPR Site No. 1 and analyzed for metals, explosives, and perchlorate. Metals analytical results for all samples were below Boardman AFR background concentrations. There were no detections of explosives or perchlorate.

No groundwater samples were collected from Range Complex No. 1. However the PA/SI (Weston, 2004) collected groundwater samples from wells located cross and down gradient of the FUDS. Samples were analyzed for explosives and perchlorate. There were no explosive detections. Perchlorate was detected in 18 of 25 wells sampled. All results were below the DoD action level. The ODEQ has identified perchlorate in groundwater throughout the lower Umatilla Basin in wells located within 10 miles from the Boardman AFR (ODEQ, 2005). Based on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and downgradient of the Boardman AFR. This

indicates that the perchlorate detected in groundwater samples is not originating from sources within this AOC or the Boardman AFR FUDS.

10.5 Demolition Area No. 2

MEC has been identified within the Demolition Area No. 2 vicinity as recently as June 2006. A visual reconnaissance of the area was completed during the SI field activities and large quantities of MD were observed in the area of the disposal pits. Based on the reported presence of MEC and MD, the risk for potential MEC is considered moderate based on the following:

- Recent find and demolition of a M83 butterfly bomb by Oregon State Police EOD Unit;
- Observed accumulations of MD;
- Sensitive fuzes contain in reported MEC and MD;
- Access through locked gates but unpatrolled.

Two soil samples were collected from Demolition Area No. 2 and analyzed for select metals and explosives. All metals detections were below Boardman AFR background concentrations. There were no explosive detections.

No groundwater samples were collected from Demolition Area No. 2. However the PA/SI collected groundwater sample from wells located cross and down gradient of the FUDS (Weston, 2004). Samples were analyzed for explosives and perchlorate. There were no explosive detections. Perchlorate was detected in 18 of 25 wells sampled. All results were below the DoD action level. The ODEQ has identified perchlorate in groundwater throughout the lower Umatilla Basin in wells located within 10 miles from the Boardman AFR (ODEQ, 2005). Based on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the lower Umatilla Basin in wells located up, cross, and downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater samples is not originating from sources within this AOC or the Boardman AFR FUDS.

10.6 Impact Area

MD has been reported by workers in the vicinity of the Impact Area. No MEC has been reported. No MEC or MD was identified during the SI field visual reconnaissance. The risk for potential MEC at the Impact Area is considered to be low based on the following:

- No MEC has been reported at this AOC;
- No observed accumulations of MD during the SI. However, an employee of The Nature Conservancy stated that he has observed MD at the AOC;
- Munitions assumed to have been used at the Impact Area contain no sensitive explosive components;
- Access to area is only through locked gates.

One soil sample and one sediment sample were collected from the Impact Area. Samples were analyzed for select metals and explosives. All metals results were below Boardman AFR background concentrations and no explosives were detected.

No groundwater samples were collected from the Impact Area. However the PA/SI (Weston, 2004) collected groundwater sample from wells located cross and down gradient of the FUDS. Samples were analyzed for explosives and perchlorate. There were no explosive detections. Perchlorate was detected in 18 of 25 wells sampled. All results were below the DoD action level. The ODEQ has identified perchlorate in groundwater throughout the lower Umatilla Basin in wells located within 10 miles from the Boardman AFR (ODEQ, 2005). Based on studies completed by the ODEQ and EPA (ODEQ, 2005), perchlorate is found throughout the lower Umatilla Basin in wells located up, cross and downgradient of the Boardman AFR. This indicates that the perchlorate detected in groundwater samples is not originating from sources within this AOC or the Boardman AFR FUDS.

11.0 Recommendations

Results of the SI provide the basis for conclusions and/or recommendations for further actions at each of the AOCs.

11.1 Target No. 1

Based on historical evidence and results from the SI field activities, there is potential for MEC at Target No. 1. Analytical results indicate that all soil metals results are below Boardman AFR background values and no explosives were detected. Groundwater analytical results indicate that metals concentrations are similar to background, with the exception of iron, which was above the background value but below the human health screening value. In addition, iron is not a CERCLA hazardous substance, and therefore a recommendation based on iron alone cannot be used to recommend RI/FS. Perchlorate was not detected in the groundwater sample from within the AOC. Based on the potential for MEC, a recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Target No. 1. Additionally, because all analytical results from samples collected in and around this MRS were either below background concentrations or screening values, Target No. 1 is recommended for NDAI relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

11.2 Target No. 2

Based on historical evidence and recent MEC finds, there is potential for MEC at Target No. 2. Analytical results indicate that all soil metals results are below Boardman AFR background values and no explosives were detected. While PA/SI (Weston, 2004) surface water analytical results indicate that perchlorate is present, the upstream sampling locations with the highest perchlorate concentrations indicate that the perchlorate is not from Target No. 2 or any other known FUDS AOC. Based on the potential for MEC, a recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Target No. 2. Additionally, because all analytical results from samples collected in and around this MRS were either below background concentrations or screening values, Target No. 2 is recommended for NDAI relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

11.3 Carty Reservoir Bomb Target

Based on historical evidence, there is potential for MEC at Carty Reservoir Bombing Target. Analytical results indicate that all soil metals results are below Boardman AFR background values and no explosives were detected. Surface water and sediment sample analytical results indicate that there are no observed adverse impacts. Based on the potential for MEC, a recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Carty

Reservoir Bomb Target. Additionally, because all analytical results from samples collected in and around this MRS were either below background concentrations or screening values, Carty Reservoir Bomb Target is recommended for NDAI relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

11.4 Range Complex No. 1

Based on historical evidence and results from the SI field activities, there is potential for MEC at Range Complex No.1. Analytical results indicate that all soil metals results are below Boardman AFR background values and no explosives or perchlorate were detected, indicating no observed adverse impacts from MC at Range Complex No. 1. Based on the potential for MEC, a recommendation for a RI/FS limited to further evaluation of the MEC hazard is made for Range Complex No. 1. Additionally, because all analytical results from samples collected in and around this MRS were either below background concentrations or screening values, Range Complex No. 1 is recommended for NDAI relative to MC and no additional investigations of any potential MC, chemical contamination, or perchlorate are recommended.

11.5 Removal Actions

Section 1.3 identified as one of the decision rules, evaluation of whether a removal action is warranted. A removal action would be warranted if a high MEC hazard or elevated MC risk was identified. There is no indication that a high MEC risk is present at Boardman AFR. No MEC was found or identified during the SI. MEC has been identified on remote and restricted access lands as recently as spring 2006. The exposure risk for MEC was evaluated to be moderate. Therefore, a removal action is not recommended for the Boardman AFR.

11.6 Munitions Response Areas

Results of the SI field activities provide the basis for identifying MRSs and, as appropriate, munitions response areas (MRAs), and for scoring each MRS using the MRSPP. A MRA is any area on a defense site that is known or suspected to contain MEC or MC, and may contain one or more MRS.

Based on the use and physical distribution of the AOCs at Boardman AFR, four MRSs are identified (Figure 11-1):

1. MRS #1 – Target No. 1.
2. MRS #2 – Target No. 2.
3. MRS #3 – Carty Reservoir Bomb Target.
4. MRS #4 – Range Complex No. 1.

MRSPP scoring is provided in Appendix K.

For the purposes of scoring, the Range Inventory list is used, as per USACE direction. MRS No. 1 - Target No. 1 consists of the area shown in the Range Inventory. MRS No. 2 is Target No. 2,

MRS No. 3 is the Carty Reservoir Bomb Target, and MRS No. 4 is the Range Complex No. 1 which includes INPR Site No. 1, the Demolition Area, and the Turret Gunnery Range.

Based on USACE guidance, only those ranges identified in the ARC (DoD, 2006) are assigned to an MRA/MRS and scored using the MRSPP protocols until DoD can determine the eligibility of the other AOCs. Recommendations for identification for those remaining AOC are provided below:

- Demolition Area No. 2 – Recommended to be identified as an MRS. The area has been used as a munitions demolition area as evidenced by several rows of detonation craters and a high density of MD. MEC was located and destroyed in June 2006. The MEC risk is considered to be moderate. Access to this area is restricted by the property leaseholder The Nature Conservancy.
- Impact Area – Recommended to be identified as an MRS. The area may have been used for unregulated practice bombing. The Nature Conservancy workers have stated that MD from practice bombs has been found in the area. The SI field team did not identify any craters or MD.
- If Demolition Area No. 2 and the Impact Area are identified as MRSs, it is recommended that additional investigations for MEC be completed. Additional investigations for MC are not recommended, as concentrations of MC in samples collected from these two AOCs did not exceed site background or screening values.

It is recommended that areas where MEC has been reported but are not included in the four MRSs presented above or the two additional AOCs recommended for identification as an MRS, be further investigated to determine whether additional MEC is present in the vicinity.

11.7 MRSPP Scoring

Draft MRSPP scoring was completed for the four identified MRSs. The priority scoring ranges from 1 to 8 (highest to lowest). The draft priority scores for the four MRSs are:

MRS	MRSPP Priority Score
Target No. 1	6
Target No. 2	4
Carty Reservoir Bomb Target	3
Range Complex No. 1	4

With the exception of Target No. 1, none of the MRSs presented sufficient risk to human health or the environment from MC to merit valuation under the HHE MRSPP module. Thus, in all but Target No. 1, the MRSs received the HHE rating of "No Known or Suspected MC Hazard." Target No. 1 was assigned value under the HHE module due to the presence of iron concentrations above the background values in a groundwater sample collected onsite. Overall, the MRSPP priority scores for the Boardman AFR MRSs reflect the risk of explosive hazards,

not chemical contamination at the sites. Note that these MRSPP priority scores are draft and additional review by DoD will be completed.

12.0 References

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