EPA Region X

START

Superfund Technical Assessment and Response Team

Boardman AFR FUDS
Preliminary Assessment/Site Inspection Report

TDD: 01-08-0006

EPA Contract: 68-S0-01-02

September 2004

Weston Solutions, Inc. · 190 Queen Anne Avenue North · Seattle, WA 98109-4926

PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT

Boardman AFR FUDS
Boardman, Oregon

TDD: 01-08-0006

Submitted To:

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LIST OF ACRONYMS

Acronym	Definition
AFR	Air Force Range
ASTM	American Society for Testing and Materials
bgs	below ground surface
Boeing	The Boeing Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
CLP	Contract Laboratory Program
cm/sec	centimeter per second
COC	contaminant of concern
CRQL	Contract Required Quantitation Limit
DERP	Defense Environmental Restoration Program
DI	deionized
DO	Dissolved Oxygen
DOA	Department of Army
DOD	Department of Defense
DQI	Data Quality Indicators
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
EE/CA	Engineering Evaluation/Cost Analysis
EOD	Explosive Ordnance Disposal
EPA	United States Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Rate Insurance Maps
FUDS	Formerly Used Defense Site
GIS	Geographical Information Systems

LIST OF ACRONYMS (*Continued*)

Acronym	Definition
GPS	Global Positioning System
HRS	Hazard Ranking System
ID	Identification
IDW	Investigation Derived Waste
IRA	Interim Remedial Action
lb	pound
LCS	laboratory control sample
MEL	Manchester Environmental Laboratory
MQO	Method Quality Objective
MS	matrix spike
NA	Not Applicable
NBEC	Nitrogen Based Explosive Compounds
NPL	National Priorities List
NRCS	Natural Resource Conservation Service
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish & Wildlife
ODVA	Oregon Department of Veteran Affairs
OE	Ordnance and Explosives
ONHIC	Oregon Natural Heritage Information Center
ORP	Oxidation Reduction Potential
OWRD	Oregon Water Resources Department
PA	Preliminary Assessment
PCB	Polychlorinated Biphenyl
PE	performance evaluation
PGE	Portland General Electric
PPE	Probable Point of Entry
QA	Quality Assurance
QC	Quality Control

LIST OF ACRONYMS (*Continued*)

Acronym	Definition
QMP	Quality Management Plan
RPD	relative percent difference
RSCC	Regional Sample Control Coordinator
SARA	Superfund Amendments and Reauthorization Act
SDWIS	Safe Drinking Water Information System
SI	Site Inspection
SOPs	Standard operating procedures
SOW	Statement of Work
SQAP	Sampling and Quality Assurance Plan
SQL	Sample Quantitation Limit
START	Superfund Technical Assessment and Response Team
TAL	Target Analyte List
TDD	Technical Direction Document
TDL	Target Distance Limit
TPH	Total Petroleum Hydrocarbons
USACE	United States Army Corp of Engineers
µg/L	micrograms/Liter
USCS	Unified Soil Classification System
USCB	United States Census Bureau
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
UST	Underground Storage Tank
UXO	Unexploded Ordnance
Weston	Weston Solutions, Inc.
WDFW	Washington Department of Fish and Wildlife
WRCC	Western Regional Climate Center

SECTION 1

INTRODUCTION

Under the authority of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980 and the 1986 Superfund Amendments and Reauthorization Act (SARA), Weston Solutions, Inc. (Weston) has completed a Preliminary Assessment and Site Inspection (PA/SI) of the Boardman Air Force Range (AFR) Formerly Used Defense Sites (FUDS) located in Boardman, Oregon (CERCLIS ID No.: ORD987175627). The United States Environmental Protection Agency (EPA) Region 10 retained Weston to complete this PA/SI investigation pursuant to the EPA Superfund Technical Assessment and Response Team (START) Contract No. 68-S0-01-02 and Technical Direction Document (TDD) No. 01-08-0006. The purpose of this report is to provide the EPA with the background information collected for the site, to discuss the sampling activities conducted and the data collected during the PA/SI, and to present the analytical results from the data obtained as part of the investigation.

PAs and SIs are generally the first and second screening investigations, respectively, in a series of assessments that EPA may complete at a known or potential hazardous waste site that is being investigated under CERCLA/SARA prior to its potential inclusion on the National Priorities List (NPL). The combined PA/SI Assessment integrates activities typically conducted during the PA (e.g., information gathering, site reconnaissance) with activities typically conducted during the SI [e.g., development of site-specific Sampling Quality and Analyses Plans (SQAP), field sampling, filling data gaps] to achieve one continuous site investigation. The main objectives for the PA/SI activities are to:

- Determine if the site is, has, or may have the potential to release hazardous substances to the environment, in order to differentiate between sites that pose little or no threat to human health or the environment from those that may warrant further investigation.
- Identify waste source areas at the site in an attempt to document the presence of hazardous waste substances in these areas.
- Evaluate the threat posed by migration of or exposure to hazardous substances from the site.
- Collect information that can be used to assess the site using EPA's Hazard Ranking System (HRS).
- Help determine whether further investigation of the site under CERCLA/SARA is warranted in order to pursue listing on the NPL.

Any use of this document or the information contained herein by persons or entities other than the EPA Region 10 shall be at the sole risk and liability of said person or entity. START, therefore, expressly disclaims any liability to persons other than the EPA Region 10 who may use or rely upon this report in any way or for any purpose.

SECTION 2

SITE BACKGROUND

2.1 SITE DESCRIPTION AND BACKGROUND INFORMATION

Information presented in the following sections is based on a review of Oregon Department of Environmental Quality (ODEQ) records, United States Army Corps of Engineers (USACE) records, interviews with property owner representatives, and Weston's field sampling investigation conducted in June 2004.

This section describes the site location, site description, ownership history, and operational history of the Boardman AFR FUDS. Photographs of site features taken during the field effort are included in Appendix A. A site location map showing site features is presented in Figure 2-1.

2.1.1 Site Location

Site Name:	Boardman AFR FUDS
CERCLIS ID No.:	ORD987175627
Location:	Boardman, Oregon
Latitude:	45°45'00" North
Longitude:	119°47'00" West
Legal Description:	Sections 1-24, Township 2N, Range 24E
	All Sections, Township 3N, Range 24 E
	Sections15, 20-22, 25-36, Township 4N, Range 24E
County:	Morrow
Site Owner(s):	Three-Mile Canyon Farms 75906 Three-Mile Road Boardman, Oregon 97818
	Port of Morrow Boardman Airport PO Box 200 Boardman, Oregon 97818

Portland General Electric (PGE)
PO Box 499
Boardman, Oregon 97818

Site Operator/Contact(s):

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2.1.2 Site Description

The Boardman AFR FUDS is an inactive former bombing range located near the northern Oregon border to Washington State and is approximately 5 miles west of Boardman, Oregon (Figure 2-1). Of the original 95,986 acres used as a bombing range, 37,321 acres are currently a designated bombing range owned and operated by the Department of Navy in conjunction with Whidbey Island Naval Air Station. The western half of the site is the inactive bombing range (the FUDS portion) consisting of 58,665 acres, which is the focus of this PA/SI.

The 58,665 acres of the Boardman AFR FUDS currently contains: a coal-fired power plant owned and operated by PGE; the Boardman airport owned and operated by the Port of Morrow; a Boeing antennae testing site owned by Three-Mile Canyon Farms and operated by Boeing; and irrigated farmland utilized for livestock grazing, livestock and dairy cattle production, and agricultural production operated by Inland Land Co. and owned by Three-Mile Canyon Farms (Figure 2-2).

The primary landscape feature is high plain desert with low-lying vegetation. The Columbia River, which has a local average elevation of 250 feet, is located approximately one mile from the northern site boundary. Elevations at the site range from 300 feet at the northern boundary near the Columbia River to 1,000 feet at the southern boundary.

2.1.3 Site Ownership

From 1941 to 1943, the War Department acquired 95,986 acres for the operation of a precision bombing range. Between 1941 and 1960 the USACE, the United States Air Force, and the United States Navy utilized the site. In 1963 the site was divided into two almost equal halves. The eastern half became the U.S. Navy property and the western half reverted to the State of Oregon Department of Veteran Affairs (ODVA; USACE 1997a). The U.S. Navy property was not investigated as a part of this PA/SI. The FUDS property is operational and is owned by several entities as described below.

- In 1963, Boeing signed a 77-year lease with ODVA for 95,000 acres, consisting of the 58,665 acres of FUDS land and 36,335 acres of adjacent land to the west. This area was renamed the Boardman Space Age Industrial Park.

- In 1975, PGE purchased 3,520 acres in the south central portion of the FUDS land from ODVA for the construction of a 550-megawatt coal-fired thermal power plant.

- In 1983, the Port of Morrow subleased the Boardman airstrip (2,700 acres) from Boeing and purchased the land from ODVA in 1991.

- In 1986, under the lease previously signed with ODVA, Boeing developed 4,000 acres as the Boardman Antenna Test Range. The Boardman Antenna Test Range is currently operated by Boeing under a lease with Three-Mile Canyon Farms.

- In 2000, Boeing sold the 95,000 acre 77-year land lease (with the exception of the PGE owned and Port of Morrow owned land) and ODVA sold their rights as ownership of the land to R.D. Offutt Company, an agribusiness firm. R.D. Offutt owns Three-Mile Canyon Farms which is currently listed with the Lane County tax assessor as the contact for the property. Inland Land Company operates the property under a lease with Three-Mile Canyon Farms. Boeing currently leases 4,000 acres (the Boardman Antenna Test Range) from Three-Mile Canyon Farms. The Nature Conservancy holds a management sublease from Three-Mile Canyon Farms to manage 22,642 acres for the Oregon State listed endangered Washington ground squirrel. The Nature Conservancy has the option to purchase the 22,642 acres in 2040.

In summary, PGE, Port of Morrow, and Three-Mile Canyon Farms currently own portions of the Boardman AFR FUDS property.

2.1.4 Site Operations and Source Characteristics

From 1941 to 1945, the U.S. Army Air Corps utilized the Boardman AFR for precision bombing and the Walla Walla Army Air Base used the site for air-to-ground gunnery practice. An airstrip was also developed on the property during this time that is currently operated as the Boardman Airport. After World War II, the U.S. Army categorized the property as surplus but did not release the land. In 1948, the Air Force withdrew the lands from surplus and continued using the site as a precision bombing range until 1960. Between 1952 and 1956, Fairchild Air Force Base took control of the Boardman AFR. The Air Force declared the subject property (approximately the western half of the AFR) as excess on August 11, 1960 (USACE 1997b). Due to activity at the former AFR, contaminants of concern (COC) were identified and include perchlorate, nitrogen based explosive compounds (NBEC), and target analyte list (TAL) metals.

In 1963, Boeing obtained a lease from ODVA to operate the site as the Boardman Space Age Industrial Park. A portion of the lease included part of the Boardman AFR FUDS. The site was selected for a test location of rocket and jet engines (Boeing 1989). In 1971, Boeing Agri-Industries took over management of the Boeing lease and installed a pumping system from the Columbia River for agricultural irrigation purposes and obtained nine water rights permits. From 1971 to 1975, Boeing Argi-Industries produced potatoes, wheat, corn, and alfalfa from several 100- to 150-acre crop circles. In 1975, Boeing subleased 35,000 acres to P.J. Taggares Farms where agricultural practices were continued. Of the 35,000 acres used for agricultural purposes, approximately 8,000 acres were located on the FUDS (north and west portions of the site). In 1978, the area produced one-percent of the nations potato crop and over one million bushels of wheat (Boeing 1989). Currently, Inland Land Company conducts farming and livestock operations on Three-Mile Canyon Farms property.

In 1975, PGE purchased 3,520 acres and constructed a 550-megawatt coal-fired thermal power plant and developed the Carty Reservoir. The Carty Reservoir was formed by damming the streams in Four-mile Canyon and Six-mile Canyon, obtaining water from groundwater wells, and using pipelines from the Columbia River (Global Security 2003). The plant is owned and operated by PGE and is currently operational.

In May 2001 the Nature Conservancy accepted a management sublease from Three-Mile Canyon Farms for the Boardman Conservation Area. The sublease extends to 2040 and includes 22,642 acres of grasslands and shrub lands with the majority of the area on the southern and eastern portions of the Boardman AFR FUDS with approximately 18,000 acres located on the FUDS. The Washington ground squirrel, an Oregon State listed endangered species, is managed on the Boardman Conservation Area.

2.2 SITE CHARACTERIZATION

Figure 2-2 presents a current site diagram and Figure 2-3 presents a historical site diagram.

The source(s) of perchlorate and explosives in Six-mile Canyon and/or groundwater monitoring wells have not been identified by ODEQ or EPA. Commercial, industrial, and bombing range activities are scattered throughout the Boardman area and may be a source of contamination.

2.2.1 Previous Site Investigations

In August 1989, the USACE under the Defense Environmental Restoration Program (DERP) conducted an investigation at the Boardman Airstrip (Area K; Figure 2-3). One underground storage tank (UST) was located and determined to be ineligible for removal funding since there was beneficial use of the UST following Department of Defense (DOD) ownership. A former trash and potential asbestos containing material disposal trench site was identified and visually inspected. The site was determined ineligible for cleanup since there was no visual evidence of hazardous or toxic waste (USACE 1989a). In 1990, the tank was removed and the trenches were further investigated, as discussed below.

In September 1989, the USACE conducted a Site Inspection of the Boeing Test Facility (Areas E, F, and I) and former Target No. 2 (Areas C and D; Figure 2-3). At Areas E, F, and I, a series of craters with artillery and bomb shrapnel, a variety of detonators, and several intact bombs were identified during the investigation (USACE 1989b). At Areas C and D a metal Conex shipping container used as a target, an old car used as a target, artillery shells, various rockets, hedge hogs, 0.50-caliber ammunition, bombs and incendiary bombs were identified. The Site Inspection recommended a cleanup of the Areas E, F, I, C, P. No records of removal have been located.

In October 1989, the Department of the Army (DOA) conducted a survey of possible hazards that may exist at two of the former target areas. One area was an ammunition destruction site and a target area for air dropped practice bombs. The hazards associated with that site include black powder and white phosphorous based spotting charges. The other area was an incendiary target area with thermite mixtures and red or white phosphorous as the identified hazards (DOA 1989).

In February 1990, ODEQ contacted the EPA and identified target Areas C and E and four filled-in trenches located near the airstrip (Area K) as concerns associated with Boardman AFR FUDS (Figure 2-3; ODEQ 1990). Explosive spotting charges were the concern associated with the target areas and hazardous waste disposal of trash and potential asbestos containing material were the concerns associated with the four filled-in trenches, which are located in the NW ¼ of Section 22, Township 4 North, Range 24 East.

In July 1990, as part of an agreement with ODVA, Boeing removed an abandoned underground storage tank (UST) from the trench area near the airstrip. Soil samples collected from the sides and beneath the tank were analyzed for total petroleum hydrocarbons (TPH); no contaminants were detected (Boeing 1990; ODEQ 1992).

In August 1990, Boeing performed a cleanup of asbestos siding and pipe insulation from the trench areas identified by ODEQ. ODEQ was present on-site during the asbestos cleanup while three test pits were dug in the three remaining trenches. No hazardous substances were visually identified. Soil samples were collected from each trench test pit and were analyzed for polychlorinated biphenols (PCBs), TPH, and metals. All trench test pit samples were found to be at or below background levels (Boeing 1990; ODEQ 1992).

In May 1992, ODEQ conducted a PA. ODEQ investigated target impact Areas C and E, the associated safety zone for target impact Areas C and E (Areas D and F), and the four filled in trenches near the airstrip (Figure 2-3). The site was scored using PREScore 1.0 and received a site score of 0.30.

In August 1997, the USACE under DERP conducted an Archive Search Report for Boardman AFR FUDS (USACE 1997a). Thirteen areas were identified and inspected for ordnance and explosives: four target impact areas (Areas A, C, E and G), four target safety zones (Areas B, D, F and H), one demilitarization pit (Area I), a gunnery safety fan (Area J), the Boardman airstrip (Area K), and the remaining lands as a buffer area (Figure 2-3). Ordnance was confirmed at three target impact areas and the demilitarization pit. Ordnance was qualified as potentially present at the three associated target safety zones. All other areas were reported as ordnance not present. The report concluded that no Interim Remedial Action (IRA) was necessary due to the lack of evidence of imminent danger. The report did recommend an Engineering Evaluation/Cost Analysis (EE/CA) for the areas where ordnance was confirmed and qualified as potentially present.

In January 2001, Landau Associates (acting as Boeing's consultant) collected soil samples from 11 test pits and 21 surface water samples in areas to be graded for the expansion of the Beef Northwest Feeders feedlot and in locations near the former Boeing rocket test stand pad on adjacent property. Records do not indicate that Boeing tested rockets on the FUDS property and there are no records regarding fuel storage or disposal on the FUDS property. From February to July 2002, Landau collected an additional 20 surface water samples due to the confirmed presence of perchlorate from the 2001 sampling event. All samples were collected on the most western edge of the property in Six-mile Canyon Creek and on the western property adjacent to the Boardman AFR FUDS. All samples were analyzed for perchlorate. Perchlorate was detected on the FUDS property in Six-mile Canyon Creek at concentrations ranging from 3.0 micrograms per liter (µg/L) to 14.0 µg/L (Landau 2002).

In June 2003, ODEQ collected groundwater samples from three monitoring wells at the northern edge of the property boundary adjacent to the current bombing range. These samples were analyzed for metals, explosives, and general chemistry parameters. Of the general chemistry parameters, perchlorate was detected in all three wells at concentration ranging from 3.7µg/L to 4.1µg/L (ODEQ 2003). The explosive series analysis detected 1,3-dinitrobenzene at a concentration of 10µg/L but was determined by ODEQ to be an inconclusive result.

2.3 WASTE SOURCE AREAS AND SITE CONCERNS

Sampling during the PA/SI was conducted at areas considered to be potentially contaminated sources and targets, and from areas that may have been contaminated by the migration of hazardous substances from sources on-site. A discussion of waste source areas and site concerns is presented below. Site features are presented in Figure 2-2.

The source(s) of the perchlorate contamination of groundwater and surface water at the Boardman AFR FUDS is unknown. The PA/SI included sampling of sediment, soil, surface water and groundwater (via wells located onsite and offsite) that may potentially be contaminated by migration of hazardous substances from the potential sources discussed below. Based on the available information from the USACE, the areas or features identified for inspection during the Boardman AFR PA/SI are outlined below and illustrated in Figure 2-1.

Although the source(s) of perchlorate in Six-mile Canyon Creek and groundwater monitoring wells has not been identified, perchlorate contamination in groundwater has been identified allowing the groundwater plume to be eligible as a source for the Hazard Ranking System (HRS) scoring purposes. NBEC are also contaminants of concern at the following potential sources.

2.3.1 Known and Potential Source Areas

The following potential source areas were identified during the USACE file review (Figure 2-3). Area C and Area E were visited during the PA/SI field activities as discussed in Section 6.1.

- *Area A: Target Impact Area*—Consists of 46 acres located in Section 4, Township 2 North, Range 24 East. Small arms cartridge cases were encountered when the PGE coal-fired plant was constructed.
- *Area B: Target Area Safety Zone*—Consists of 1,106 acres located in Sections 4 and 5, Township 2 North, Range 24 East, and Section 32 and 33, Township 3 North, Range 24 East. Approximately 40 percent of this area is beneath the Carty Reservoir where bombing debris could exist.
- *Area C: Target Impact Area*—Consists of 357 acres located in Section 4, Township 3 North, Range 24 East. Ordnance and/or Explosives (OE) have been confirmed by the USACE consisting of 100 pound (lb) practice bombs, 2 lb and 4 lb incendiary bombs, and practice rockets. According to Boeing Agri-Industrial, the Boardman Sheriff once stored contraband fireworks in a van onsite. During one summer the fireworks ignited and the remains of the steel van structure remain at the target area (USACE 1997a).

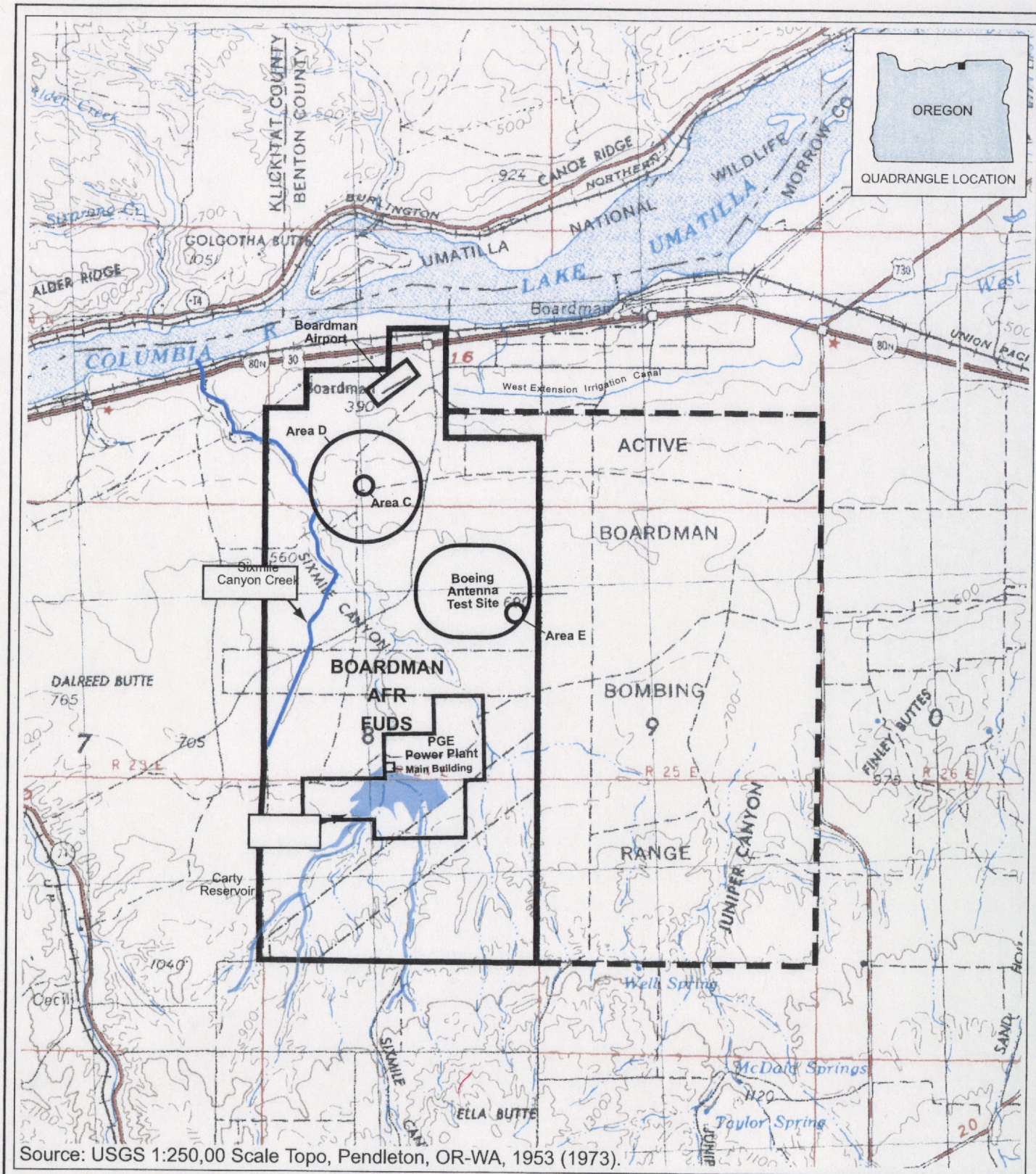
- *Area D: Target Area Safety Zone*—Consists of 795 acres located in Sections 4 and 5, Township 3 North, Range 24 East, and Section 32 and 33, Township 4 North, Range 24 East. According to USACE, there is a potential for OE in the area. A scrap dump was located by USACE approximately 400 yards west of the target area.
- *Area E: Target Impact Area*—Consists of 305 acres located in Section 13, Township 3 North, Range 24 East. OE has been confirmed by the USACE: 3 lb, 25 lb, 56 lb, and 100 lb practice bombs and 2,000 lb nuclear practice bombs. This area is currently part of the restricted Boeing Antenna Test Site.
- *Area F: Target Area Safety Zone*—Consists of 618 acres located in Sections 11-14, 23, and 24, Township 3 North, Range 24 East. According to USACE, there is a potential for OE in the area. Debris from several vehicles was located by USACE approximately 400 yards west of the target center.
- *Area G: Target Impact Area*—Consists of 118 acres located in Section 4, Township 2 North, Range 24 East. OE has been confirmed by the USACE: 3 lb and 100 lb practice bombs and target marker bombs. The USACE observed live, intact, fused, and suspected live OE and notified PGE and the Army Explosive Ordnance Disposal (EOD). The EOD located and disposed of five suspected bombs (USACE 1997a). Several mangled galvanized water tanks were reported by the USACE to currently exist at the target area. This area is located on the western shore of the Carty Reservoir on PGE owned property.
- *Area H: Target Area Safety Zone*—Consists of 1,034 acres located in Sections 4, 5, 8, and 9, Township 2 North, Range 24 East. According to USACE, there is a potential for OE in the area. Approximately 40 percent of this area is under the Carty Reservoir.
- *Area I: Demilitarization Pits*—Consists of 157 acres located in Section 13, Township 3 North, Range 24 East. The pits consist of two rows, 200 feet apart, each having approximately 20 craters spaced 50 feet apart. These pits were used as an ammunition destruction area. OE has been confirmed by the USACE: fragment from fuses and ordnance items such as projectiles and bombs were scattered in a wide radius from the pits.
- *Area J: Gunnery Range Safety Fan*—Consists of 8,335 acres located in Sections 26, 34, and 35, Township 4 North, and Sections 1-4, and 9-16, Township 3 North Range 24 East. The former firing points are located on the bombing range currently owned by the Navy.
- *Area K: Boardman Airstrip*—Consists of 1,693 acres located in Sections 20-22, Township 4 North, Range 24 East. The Boardman Airstrip served as the range control and containment area for the former bombing range. Approximately 20 wooden and concrete structures were constructed and utilized by the military when the bombing range was operational. All structures have been reportedly razed except for one building used as a storage warehouse by the Port of Morrow.
- *Area L: Trace Test Firing Range*—Consists of 2,313 acres located in Sections 26-28, 33-35, Township 4 North, Range 24 East, Sections 2-4, 9 and 10, Township 3 North, Range 24 East. The USACE has records that this area was designated for trace test firing, but does not have any records that the site was used. It is possible trace testing did occur and that the existing gunnery range was utilized (USACE 1997a).

- *Area M: All Remaining Lands*—Consists of 31,372 acres. Irrigated crop circles mainly dominate the western portion of the site. Grasslands utilized for cattle grazing and sensitive and endangered species management dominates the remaining southern and eastern portions of the site. Bombing debris could exist in this area.
- *U.S. Navy AFR*—Consists of 37,320.31 acres of property east of the FUDS. This area is currently designated as a bombing range owned and operated by the Department of Navy in conjunction with Whidbey Island Naval Air Station.

2.3.2 Potential Receptors

- **Groundwater.** The release of contaminants to groundwater may have impacted water quality in area aquifers. Groundwater is used for irrigation of agricultural crops, livestock, domestic drinking water wells, and industrial purposes. The Boardman municipal well is located within the 4-mile TDL and downgradient of the current bombing range.

- **Surface Water.** The release of contaminants to surface water may have impacted water quality in Six-mile Canyon Creek and the Columbia River. There are wetlands along Six-mile Canyon Creek and the Columbia River. Both water bodies are utilized for irrigation of agricultural crops and for watering commercial livestock. There is a potential for fish harvest in Six-mile Canyon Creek and recreational and commercial fish harvest occurs in the Columbia River.



Source: USGS 1:250,00 Scale Topo, Pendleton, OR-WA, 1953 (1973).

Site Location Map
Boardman AFR FUDS PA/SI
Boardman, Oregon

0 1.5 3

Scale in Miles

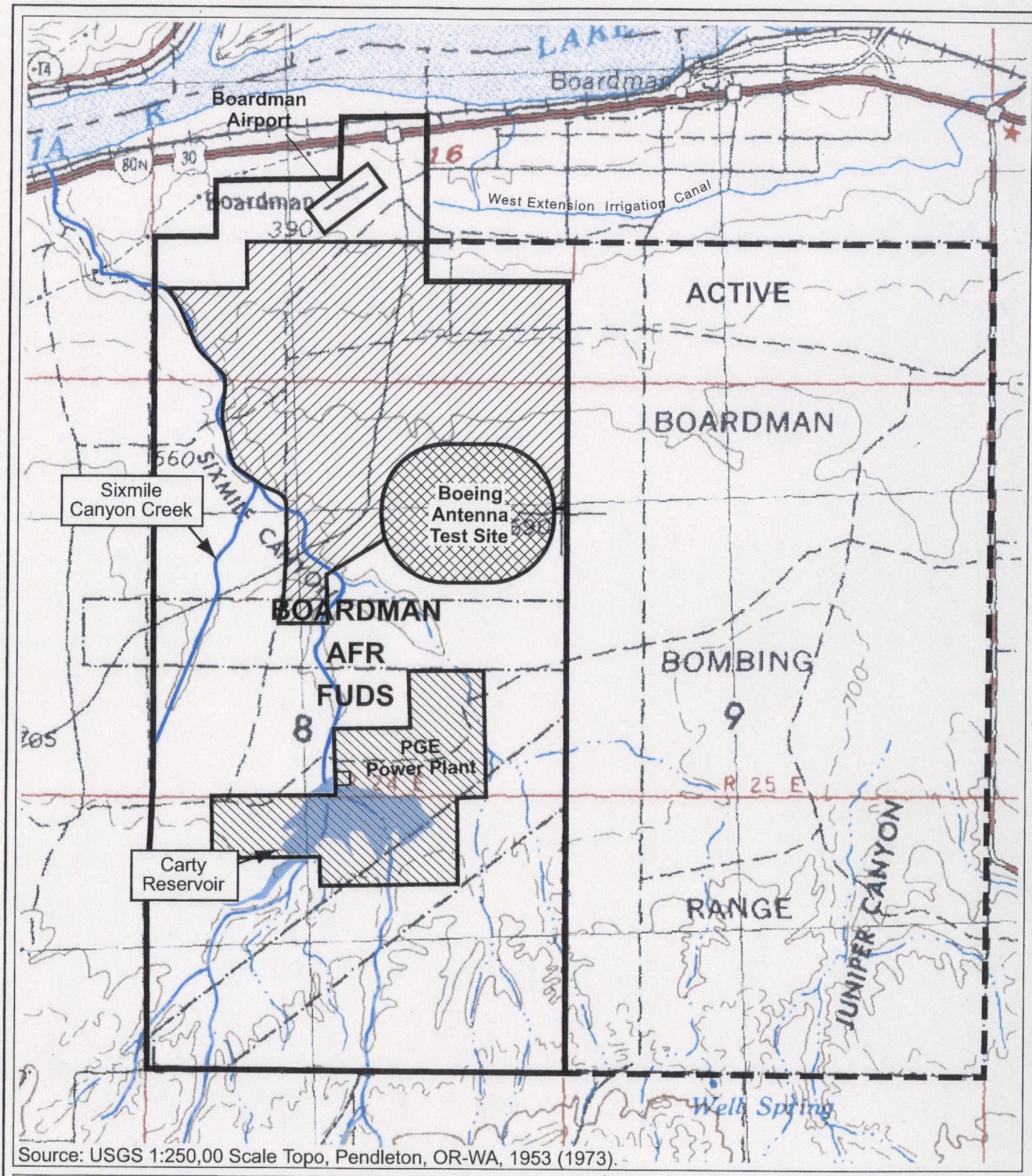
Boardman AFR FUDS Site Boundary

U.S. Navy AFR Boundary

WESTON SOLUTIONS

Figure
2-1

04-0217 Fig2-1.ai



Source: USGS 1:250,00 Scale Topo, Pendleton, OR-WA, 1953 (1973).

N

0 1 2

Scale in Miles

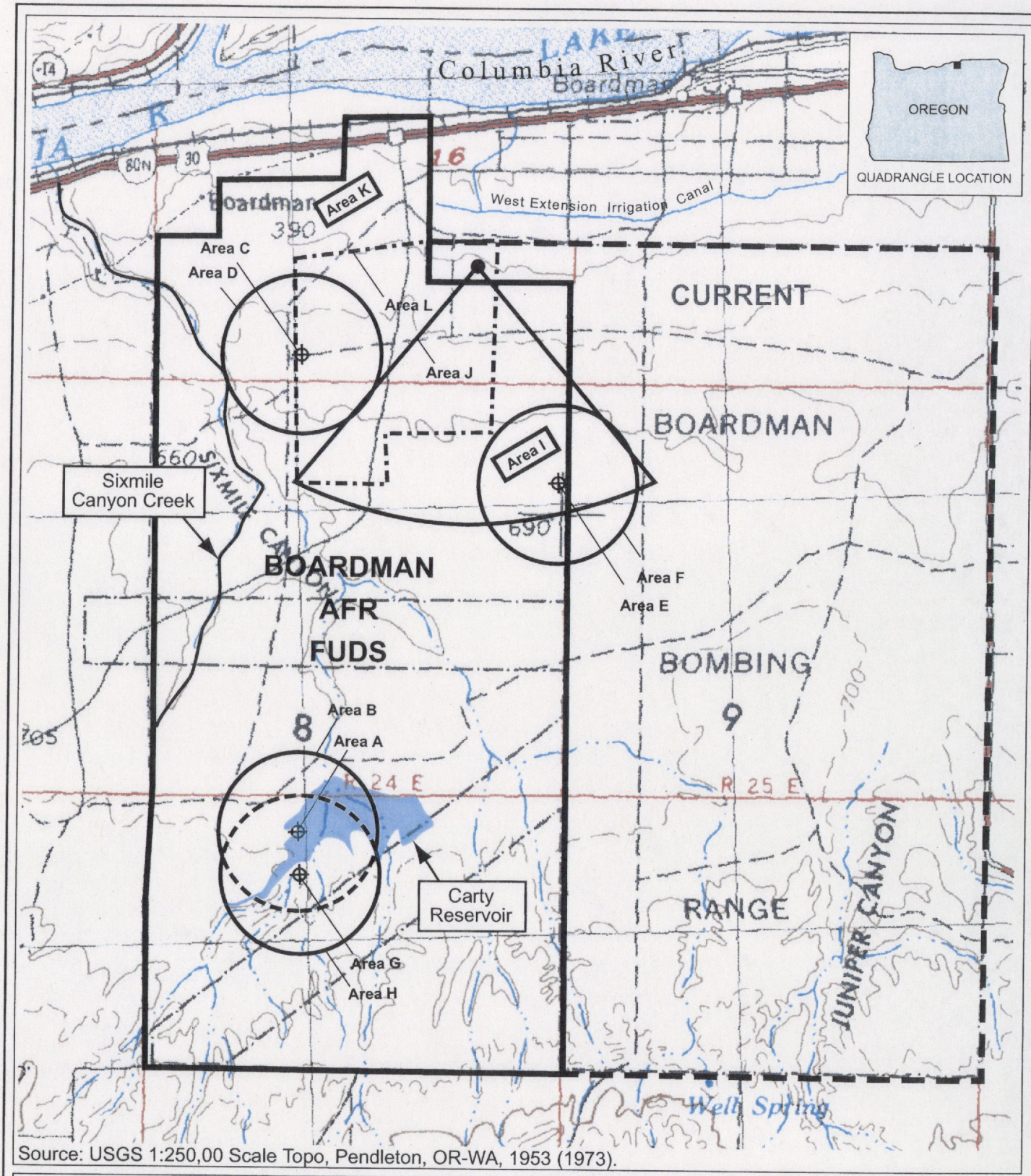
- Boardman AFR FUDS Site Boundary
- U.S. Navy AFR Boundary
- PGE Property
- Inland Land Co. Lease
- Boeing Lease

WESTON SOLUTIONS

Site Diagram
Boardman AFR FUDS PA/SI
Boardman, Oregon

Figure
2-2

04-0217 Fig2-2.ai



Source: USGS 1:250,00 Scale Topo, Pendleton, OR-WA, 1953 (1973).

Note: Areas on FUDS are not to scale.
See Section 1.2.3 for exact descriptions.

N

0 1 2

Scale in Miles

- Boardman AFR FUDS Site Boundary
- U.S. Navy AFR Boundary
- Creek
- Target Impact Area

Former Site Use Diagram
Boardman AFR FUDS PA/SI
Boardman, Oregon

Figure
2-3

WESTON SOLUTIONS

04-0217 Fig2-3.ai

SECTION 3

FIELD ACTIVITIES AND ANALYTICAL PROTOCOL

Weston prepared a SQAP for the Boardman AFR FUDS in June 2004 prior to conducting any field activities (Weston 2004). The SQAP was developed based on a review of regulatory records, interviews with site owners and representatives, and background and site reconnaissance information. The SQAP describes the sampling strategy, sampling methods, and analytical protocols used to investigate potential hazardous substance sources and potential targets at the site and vicinity. With few exceptions, the PA/SI field activities were conducted in accordance with the approved SQAP. Deviations from the SQAP are described when applicable in the sampling location discussions in Section 6 (source areas) and Section 7 (target areas). Sample locations are presented in Figures 3-1 and 3-2. A summary of all 43 samples collected for laboratory analysis during the PA/SI is presented in Table 3-1. Table 3-2 summarizes the field sample code. Photographic documentation of the PA/SI field activities is presented in Appendix A.

3.1 SAMPLING DESIGN (TYPES, NUMBERS, AND RATIONALE)

Field activities were conducted from June 21 through June 24, 2004 and included the collection of 43 samples as described below. As shown in Table 3-1, all samples collected for the Boardman AFR FUDS PA/SI were assigned internal Weston sample identification numbers, Contract Laboratory Program (CLP) sample numbers, and EPA sample identification numbers. For simplicity, samples discussed in this report will be referred to using their Weston station IDs (e.g., sample GW-MW001 refers to Weston sample ID BAFR-GW-MW001-0000).

3.1.1 Soil

- **Area E.** Two colocated surface and subsurface soil samples were collected at Area E (SS-PS001, SB-PS001, SS-PS002, and SB-PS002).
- **Area C.** Two colocated surface and subsurface soil samples were collected at Area C (SS-PS003, SB-PS003, SS-PS005, and SB-PS005)

3.1.2 Sediment

One sediment sample (SD-SC002) was collected along Six-mile Canyon Creek and colocated with surface water sample SW-SC002.

3.1.3 Surface Water

- **Carty Reservoir.** One surface water sample (SW-CR001) was collected from the eastern shoreline of the Carty Reservoir located on PGE property.
- **Six-mile Canyon Creek.** Five surface water samples were collected from Six-mile Canyon Creek (SW-SC001 through SW-SC006, excluding SW-SC003).

3.1.4 Groundwater Onsite

- **PGE.** Five groundwater samples were collected from wells owned by PGE: one drinking water supply well (GW-DS003) and four monitoring wells (GW-MW022 through GW-MW025; Figure 3-1).
- **Port of Morrow.** Two groundwater samples were collected from two Boardman Airport wells: one drinking water well and one irrigation well located on the Port of Morrow property. The groundwater samples were designated as: GW-DS001 and GW-DS002.

3.1.5 Groundwater Offsite

- **Three-Mile Canyon Farms.** Three groundwater samples were collected from monitoring wells located on Three-Mile Canyon Farms property (GW-MW016, GW-MW017, and GW-MW020; Figure 3-1).
- **Port of Morrow Monitoring Wells.** Seven groundwater samples were collected from Port of Morrow monitoring wells located just north of the current bombing range. The groundwater samples were designated as: GW-MW001, GW-MW002, GW-MW003, GW-MW005, GW-MW006, GW-MW007, and GW-MW009.
- **Private Domestic Wells.** Three groundwater samples were collected from private domestic use wells adjacent to the north end of the Boardman AFR FUDS and the U.S. Navy Bombing Range. The samples were designated: GW-DW001, GW-DW002, and GW-MW003.
- **Coyote Springs 2.** Five groundwater samples were collected from monitoring wells located at the Coyote Springs 2 natural gas-fired generating plant (Figure 3-2). The facility is located north of the Port of Morrow monitoring wells. The groundwater samples were designated as: GW-MW011 through GW-MW015.

3.1.6 Background Samples

One sediment background sample (SD-BK001) was collected upgradient of the site and all suspected sources from Six-mile Canyon Creek. One background soil sample (SS-BK001) was collected approximately 100 feet southwest of SD-BK001. There was no surface water running in the Six-mile Canyon Creek channel so no sample was collected. The background samples were collected to establish background concentrations present in soil and sediment in the vicinity of the site. The background sample locations were selected to assess samples having similar physical characteristics and (in the case of sediment samples) depositional environments as those of the target and attribution samples.

3.1.7 Quality Assurance/Quality Control (QA/QC)

One QA/QC equipment rinsate sample was collected from equipment used to collect the groundwater samples.

3.2 SAMPLING METHODS

Field activities included the collection of surface and subsurface soil samples on the site in the vicinity of potential source areas, groundwater samples collected from wells both on and offsite that included domestic supply wells, drinking water wells, and monitoring wells. Surface water samples were collected along Six-mile Canyon Creek. A complete description of the samples collected is discussed in Section 3.1.

At the time of sampling, site-specific conditions (i.e., topography, accessibility issues, and visual evidence of contamination) were incorporated, when applicable, into the placement of sampling locations. Deviations from the planned number of samples to be collected during the field effort are discussed in Sections 6 and 7. These deviations are documented in the Sample Plan Alteration forms included in Appendix B. This section presents a brief summary of field methods and procedures used during the Boardman ARF FUDS PA/SI field effort. All samples were collected in accordance with Weston's Standard Operating Procedures (SOPs) and the site-specific SQAP (Weston 2004).

3.2.1 Surface Soil Sampling

Surface soil (0 to 6 inches bgs) was collected in accordance with Weston SOP RFW/R10-001. The sand-sized and finer fractions of the soil was targeted for collection and material unsuitable for analysis, such as grass, leaves, other vegetative materials, and rocks were removed from the sample material before placement into sample containers. The surface soil samples were collected using dedicated stainless steel spoons and were homogenized in dedicated stainless steel bowls. The sample material was classified according to the Unified Soil Classification System (USCS; American Society for Testing and Materials [ASTM] 2488). Sampling information and the sample description were recorded on a standardized field sampling form. A representative sample was placed into a pre-labeled sample container and any excess sample material was returned to the sampling location. The samples were stored in an iced cooler and remained under Weston personnel chain of custody prior to shipment to the analytical laboratory(ies).

3.2.2 Subsurface Soil Sampling

Subsurface soil (0.5 to 2 feet bgs) was collected in accordance with Weston SOP RFW/R10-001. The sand-sized and finer fractions of the subsurface soil were targeted for collection and material unsuitable for analysis, such as vegetative materials, and rocks were removed from the sample material before placement into sample containers. A small excavation was made to the appropriate depth using a steel spade shovel. Subsurface soil samples were colocated with a surface soil sample and were collected from the bottom of the small excavation using dedicated stainless steel spoons and were homogenized in dedicated stainless steel bowls. The sample material was classified according to the USCS described in ASTM 2488. Sampling information and the sample description were recorded on a standardized field sampling form. A representative sample was placed into a pre-labeled sample container and any excess sample material was returned to the sampling location. The samples were stored in an iced cooler and remained under Weston personnel chain of custody prior to shipment to the analytical laboratory(ies).

3.2.3 Sediment Sampling

Sediment samples (0 to 6 inches) were collected in accordance with Weston SOP RFW/R10-003. The sediment samples were collected using dedicated stainless steel spoons and homogenized in dedicated stainless steel bowls. A physical description of the sample material, including estimated grain size proportions (percent gravel, sand, and fines), organic content, color, etc., was recorded on a surface sediment field sampling record form. A representative subsample was placed into a pre-labeled sample container and any excess sample material collected was returned to the sampling location. The samples were stored in an iced cooler and remained under Weston personnel chain of custody prior to shipment to the analytical laboratory(ies).

3.2.4 Groundwater Sampling

3.2.4.1 Private and Public Drinking Water Supply Sampling

Samples from private drinking water and domestic supply wells were collected in accordance with SOP RFW/R10-002. Water from each location was sampled from a spigot located as near to the well head as possible and prior to any treatment, if applicable. Water from the spigot was allowed to flow freely for approximately 10 minutes prior to sample collection and was collected directly from the spigot into pre-cleaned sample containers. The samples were stored in an iced cooler and remained under Weston personnel chain of custody prior to shipment to the analytical laboratory(ies).

3.2.4.2 Monitoring Well Sampling

Groundwater samples collected from monitoring wells were purged and sampled in accordance with Weston's SOP for low-flow groundwater sampling (RFW/R10-009). Water quality parameters (turbidity, temperature, pH, specific conductance, oxidation reduction potential [ORP], and dissolved oxygen [DO]) were obtained using a YSI Meter and recorded during well purging every 3 minutes. Purging was considered complete and sampling began when selected water quality parameters stabilized. Stabilization was considered to be achieved when three consecutive readings, taken at 3-minute intervals, were within the following criteria: pH (± 0.1 unit), specific conductance (± 3%), and DO (± 10%).

Groundwater samples collected from monitoring wells were sampled using either a Grundfos pump and dedicated polyethylene tubing or an inertia pump with pre-existing dedicated tubing. The samples were stored in an iced cooler prior to shipment to the analytical laboratory.

3.2.5 Surface Water Sampling

Surface water samples from Six-mile Canyon Creek and the Carty Reservoir were collected in accordance with SOP RFW/R10-004. The samples were collected by hand dipping the sample container into the water until full. Surface water samples from Six-mile Canyon Creek were collected in order from downstream to upstream to minimize cross-contamination in the downstream samples. Colocated sediment samples were collected after the surface water sample, taking care not to disturb the sediment. Information regarding the sample collection

activities was recorded on a surface water field sampling record form. The samples were stored in an iced cooler prior to shipment to the analytical laboratory(ies).

3.3 ANALYTICAL PROTOCOL

The soil samples were analyzed for TAL metals (CLP SOW ILM05.3: nine samples), NBEC (Method SW846 8330: three samples), and perchlorate (EPA Method 314.0: nine samples). The sediment sample was analyzed for TAL metals only (CLP SOW ILM05.3). All surface water samples were analyzed for perchlorate only (EPA Method 314.0). All groundwater samples were analyzed for perchlorate (EPA Method 314.0) and NBEC (Method SW846 8330). Five surface water samples and seven groundwater samples were analyzed for perchlorate according to Method 8321A-mod.

3.4 SAMPLE GLOBAL POSITIONING SYSTEM LOCATIONS

A Trimble GeoExplorer Global Positioning System (GPS) unit with data logger was used to record the coordinates of the PA/SI sample locations. Location data for each station was stored in individual files within the GPS unit and were recorded on the appropriate field sampling record. Data files from the GPS unit were downloaded by Weston personnel and e-mailed to Mr. Matt Gubitosa at the EPA. Mr. Gubitosa conducted differential corrections of the data to improve location accuracy. Corrected and uncorrected GPS coordinates are provided in Appendix C.

3.5 INVESTIGATION DERIVED WASTE

Investigation Derived Waste (IDW) generated during the PA/SI sampling effort consisted of solid disposable sampling equipment. Solid disposable sampling equipment generated during the PA/SI activities was double bagged in plastic garbage bags and disposed as solid waste. Purge water generated during groundwater sampling activities was stored in steel 55-gallon drums and was removed and disposed of in accordance with applicable State and Federal regulations. No IDW or general trash generated by Weston personnel remains at the site.

3.6 SAMPLE HANDLING AND CUSTODY

All chain-of-custody requirements complied with Weston's SOPs for sample handling and sample control. Chain-of-custody procedures followed the *Contract Laboratory Program Guidance for Field Samplers* (EPA 2001). Samples were identified using the regional tracking numbers assigned by the EPA Regional Sample Control Coordinator (RSCC) in addition to a unique Weston identification code based on a consistent sample designation scheme presented in Table 3-2 and the *Boardman AFR FUDS PA/SI SQAP* (Weston 2004). Information obtained during sampling was recorded in the project logbook and/or data forms in accordance with the SQAP. Samples were also documented with photographs including sampling location and site features as deemed appropriate by the Weston field team.

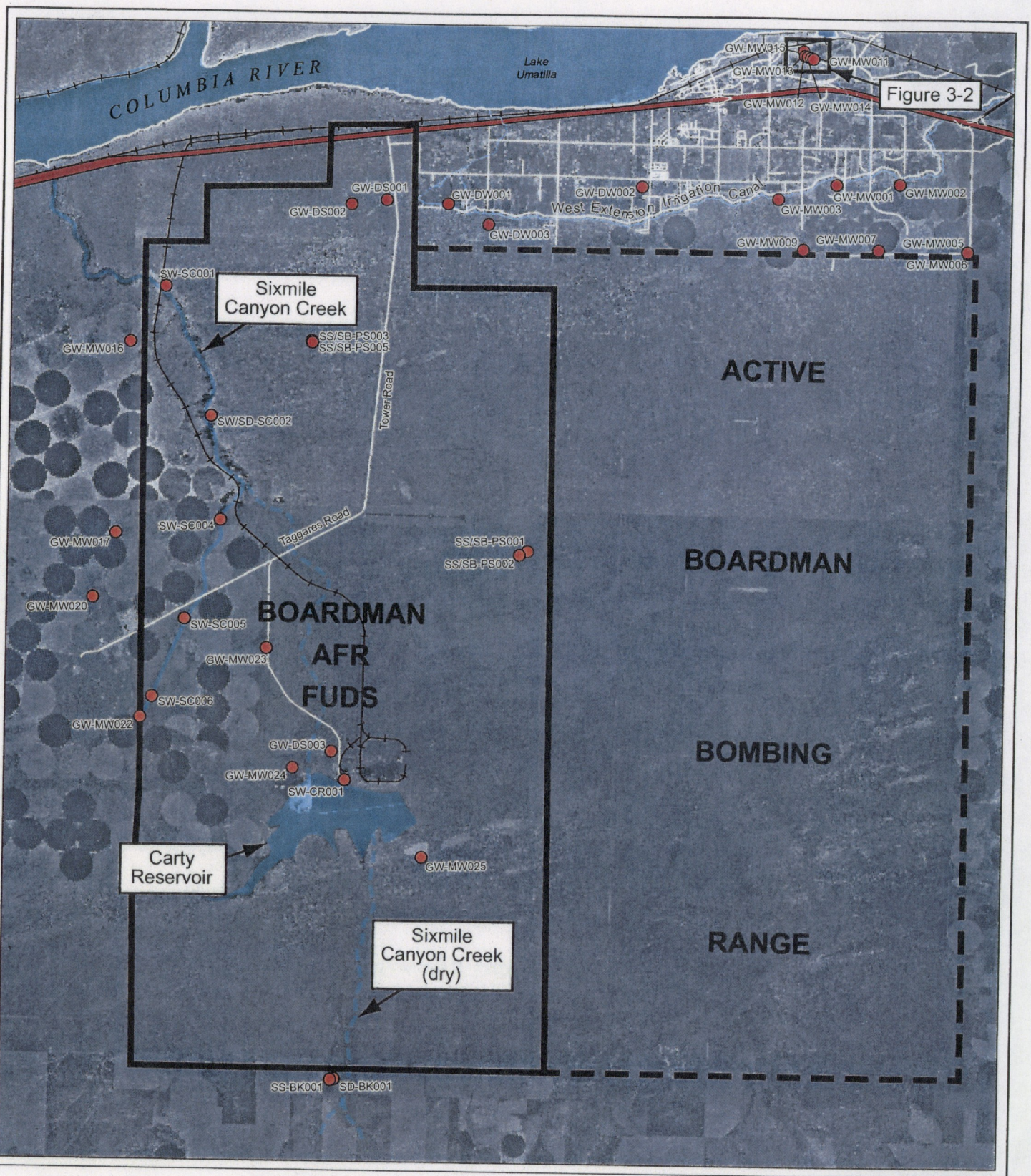
3.7 SAMPLE IDENTIFICATION

All samples were identified using the sample numbers assigned by the EPA RSCC; however, in addition to the EPA sample numbers, all samples collected were assigned a unique Weston identification code based on a consistent sample designation scheme that was used internally by Weston and in this report. The sample designation scheme is designed to suit the needs of the field staff, data management and data users and was not provided to the CLP or MEL analytical laboratories.

The Weston sample ID consists of four components separated by a dash. These components are site ID, media code, station code, and sample type:

Site ID		Media Code		Station Code		Sample Type
SSSS	-	MM	-	SSsss	-	t [ddd]

Table 3-2 presents the codes used during the Boardman AFR FUDS PA/SI. The media and station designation codes will be used in the results discussions in Sections 5 through 8.



0 1 2

Scale in Miles

Boardman AFR FUDS Site Boundary

U.S. Navy AFR Boundary

SW-SC004 Station ID

Sample Location

SW Surface Water Sample

GW Groundwater Sample

SS Surface Soil Sample

SD Sediment Sample

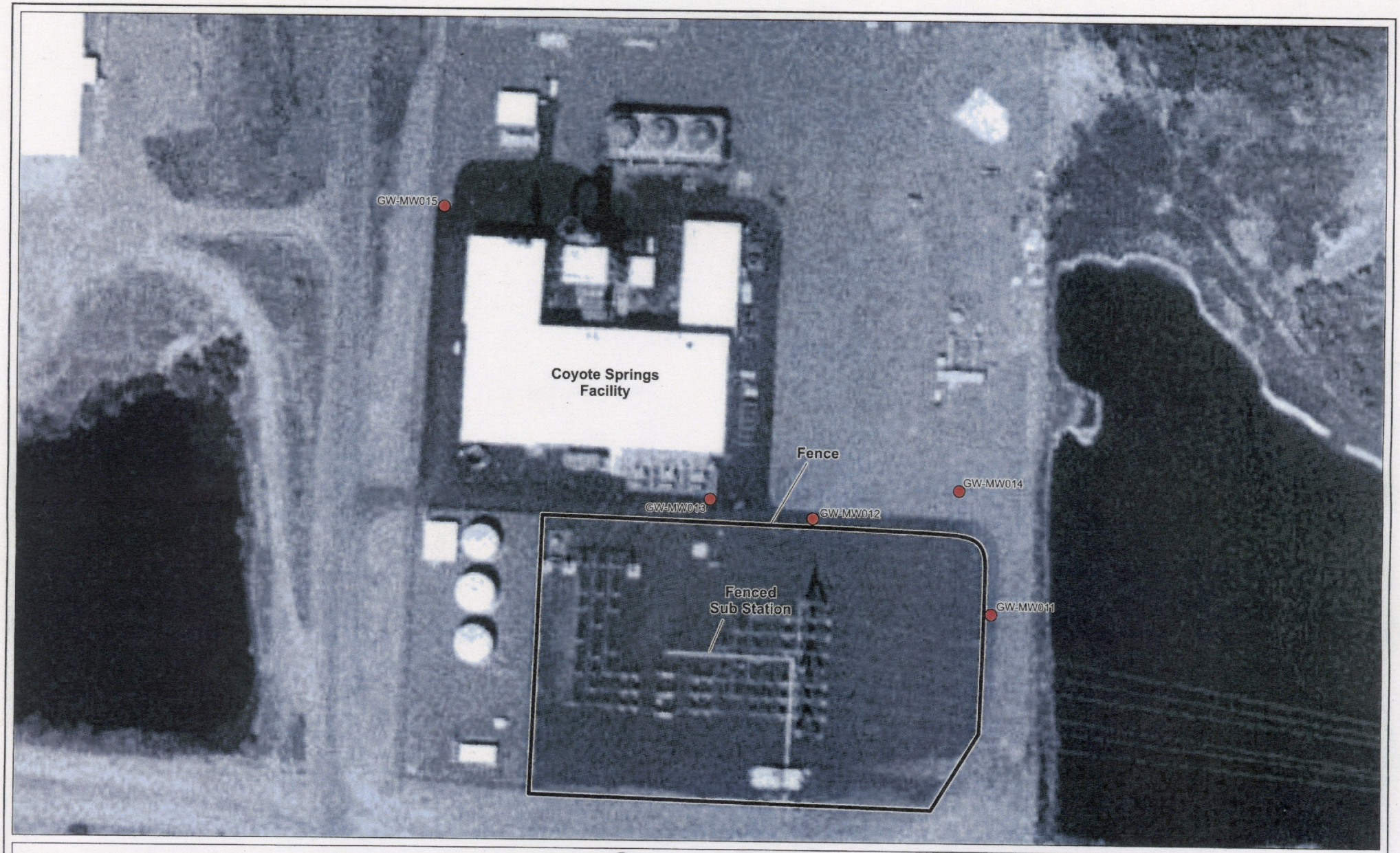
SB Subsurface Sample

SS/SB Colocated Samples

Sample Location Map
Boardman AFR FUDS PA/SI
Boardman, Oregon

Figure
3-1

04-0217 Fig3-1.ai



0 25 50

Scale in Miles

GW-MW013 Station ID

Sample Location

WESTON SOLUTIONS

Coyote Springs 2 Facility Sample Location Map
Boardman AFR FUDS PA/SI
Boardman, Oregon

Figure
3-2

04-0217 Fig3-2.ai

Table 3-1—Sample Collection And Analyses Summary-Boardman AFR FUDS PA/SI
Boardman, Oregon

Weston Sample Number	Depth Interval (ft bgs)	EPA Regional Tracking Number	CLP Sample Number	Sample Date	Sample Time	Analyses Conducted (Method)				Notes
						TAL Metals (ILM05.3)	NBEC (8330)	Perchorate (314.0)	Perchorate (8321A-mod)	
Domestic Well Groundwater										
BAFR-GW-DW001 - 0000	NA	04264350	NA	6/21/2004	1000		X	X		Poe Residence
BAFR-GW-DW002 - 0000	NA	04264364	NA	6/22/2004	1715		X	X	X	Galloway Residence
BAFR-GW-DW003 - 0000	NA	04264351	NA	6/21/2004	1055		X	X		Suter Residence
Drinking Water Supply Well Groundwater										
BAFR-GW-DS001 - 0000	NA	04264385	NA	6/22/2004	1505		X	X		Port of Morrow Airport Well
BAFR-GW-DS002 - 0000	NA	04264386	NA	6/22/2004	1515		X	X		Port of Morrow Airport Irrigation Well
BAFR-GW-DS003 - 0000	NA	04264369	NA	6/23/2004	0945			X		PGE Drinking Water Well
Monitoring Well Groundwater										
BAFR-GW-MW001 - 0000	NA	04264362	NA	6/22/2004	1440		X	X		Port of Morrow Monitoring Well: MW-13
BAFR-GW-MW002 - 0000	NA	04264363	NA	6/22/2004	1530		X	X		Port of Morrow Monitoring Well: MW-14
BAFR-GW-MW003 - 0000	NA	04264361	NA	6/22/2004	1350		X	X		Port of Morrow Monitoring Well: MW-12
BAFR-GW-MW005 - 0000	NA	04264358	NA	6/22/2004	0940		X	X		Port of Morrow Monitoring Well: MW-15
BAFR-GW-MW006 - 0000	NA	04264357	NA	6/22/2004	0925		X	X		Port of Morrow Monitoring Well: MW-15s
BAFR-GW-MW007 - 0000	NA	04264359	NA	6/22/2004	1120		X	X	X	Port of Morrow Monitoring Well: MW-16
BAFR-GW-MW009 - 0000	NA	04264360	NA	6/22/2004	1220		X	X		Port of Morrow Monitoring Well: MW-17
BAFR-GW-MW011 - 0000	NA	04264356	NA	6/21/2004	1825		X	X		Coyote Springs Monitoring Well: CSMW-6
BAFR-GW-MW012 - 0000	NA	04264354	NA	6/21/2004	1620		X	X	X	Coyote Springs Monitoring Well: CSMW-7
BAFR-GW-MW013 - 0000	NA	04264353	NA	6/21/2004	1515		X	X		Coyote Springs Monitoring Well: CSMW-8
BAFR-GW-MW014 - 0000	NA	04264355	NA	6/21/2004	1725		X	X		Coyote Springs Monitoring Well: CSMW-9
BAFR-GW-MW015 - 0000	NA	04264352	NA	6/21/2004	1410		X	X		Coyote Springs Monitoring Well: CSMW-10
BAFR-GW-MW016 - 0000	NA	04264377	NA	6/23/2004	1745		X	X		Three-Mile Canyon Farms Monitoring Well: RDOU-1
BAFR-GW-MW017 - 0000	NA	04264376	NA	6/23/2004	1635		X	X	X	Three-Mile Canyon Farms Monitoring Well: SU-3
BAFR-GW-MW020 - 0000	NA	04264374	NA	6/23/2004	1405		X	X	X	Three-Mile Canyon Farms Monitoring Well: SU-1
BAFR-GW-MW022 - 0000	NA	04264379	NA	6/24/2004	0905		X	X	X	PGE Monitoring Well: 107
BAFR-GW-MW023 - 0000	NA	04264380	NA	6/24/2004	1015		X	X	X	PGE Monitoring Well: 104
BAFR-GW-MW024 - 0000	NA	04264381	NA	6/24/2004	1135		X	X		PGE Monitoring Well: 008
BAFR-GW-MW025 - 0000	NA	04264382	NA	6/24/2004	1305		X	X		PGE Monitoring Well: 120
Carty Reservoir Surface Water										
BAFR-SW-CR001 - 0000	NA	04264378	NA	6/24/2004	0735			X		Carty Reservoir Surface Water
Sixmile Canyon Creek Surface Water										
BAFR-SW-SC001 - 0000	NA	04264387	NA	6/24/2004	1535			X	X	Sixmile Canyon Creek Surface Water
BAFR-SW-SC002 - 0000	NA	04264388	NA	6/24/2004	1750			X		Sixmile Canyon Creek Surface Water
BAFR-SW-SC004 - 0000	NA	04264390	NA	6/24/2004	1905			X		Sixmile Canyon Creek Surface Water
BAFR-SW-SC005 - 0000	NA	04264391	NA	6/24/2004	1920			X		Sixmile Canyon Creek Surface Water
BAFR-SW-SC006 - 0000	NA	04264392	NA	6/24/2004	1955			X		Sixmile Canyon Creek Surface Water
Area C Surface Soil										
BAFR-SS-PS003 - 0000	NA	04264365	MJ4562	6/23/2004	0805	X		X		Area C Surface Soil
BAFR-SS-PS005 - 0000	NA	04264367	MJ4564	6/23/2004	0830	X		X		Area C Surface Soil
Area C Subsurface Soil										
BAFR-SB-PS003 - 0015	NA	04264366	MJ4563	6/23/2004	0810	X		X		Area C Subsurface Soil
BAFR-SB-PS005 - 0015	NA	04264368	MJ4565	6/23/2004	0840	X		X		Area C Subsurface Soil
Area E Surface Soil										
BAFR-SS-PS001 - 0000	NA	04264370	MJ4566	6/23/2004	1140	X		X		Area E Surface Soil
BAFR-SS-PS002 - 0000	NA	04264372	MJ4568	6/23/2004	1215	X	X	X		Area E Surface Soil
Area E Subsurface Soil										
BAFR-SB-PS001 - 0015	NA	04264371	MJ4567	6/23/2004	1155	X		X		Area E Subsurface Soil
BAFR-SB-PS002 - 0015	NA	04264373	MJ4569	6/23/2004	1225	X	X	X		Area E Subsurface Soil
Sixmile Canyon Creek Sediment										
BAFR-SD-SC002 - 0000	0-6 inches	04264389	MJ4572	6/24/2004	1800	X				Sixmile Canyon Creek Sediment
Background Soil										
BAFR-SS-BK001 - 0000	0-6 inches	04264384	MJ4571	6/24/2004	1400	X	X	X		Background Soil
Background Sediment										
BAFR-SD-BK001 - 0000	0-6 inches	04264383	MJ4570	6/24/2004	1340	X				Bankground Sediment
Rinsate Blank										
BAFR-WT-MW017 - 4000	NA	04264375	NA	6/23/2004	1535		X	X	X	Rinsate Blank

Table 3-2—Field Sample Code
Boardman AFR FUDS PA/SI
Boardman, Oregon

Digits	Descriptions	Code Example
1, 2, 3, 4	Site ID	BAFR (Boardman AFR FUDS)
5, 6	Media Code	GW (Groundwater)
		SD (Sediment)
		SS (Surface Soil)
		SB (Subsurface Soil)
		SW (Surface Water)
		WT (Water, Other)
7, 8	Station Code	BK (Background)
		DS (Drinking Water Supply Well)
		DW (Domestic Well)
		MW (Monitoring Well)
		SC (Sixmile Canyon Creek)
		CR (Carty Reservoir)
		PS (Potential Source)
9, 10, 11	Consecutive Sample Number	001 (First Sample of Station Code)
12	Sample Type	0 (Field Sample)
		4 (Equipment Rinsate Blank)
13, 14, 15	Sample Depth (feet bgs)	000 (i.e., 0 to 0.5 ft bgs)

SECTION 4

QUALITY ASSURANCE/QUALITY CONTROL

In order to ensure data quality objectives are met, data quality indicators are evaluated to determine sample and laboratory performance. These data, known as Quality Assurance/Quality Control (QA/QC) data, are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of sampling equipment, glassware, and reagents due to sample collection, preparation, and analysis activities.

Specific QC requirements for laboratory analyses are incorporated in the *USEPA Methods for the Determination of Organic and Inorganic Compounds in Drinking Water, Volume 1* (EPA 2000a), *Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods SW-846* (EPA 1996), and laboratory standard operating procedures.

The QC requirements or scope of work requirements were followed for analytical results reported for the *Boardman FUDS PA/SI Sampling and Quality Assurance Plan* (SQAP; Weston 2004). This section describes the QA/QC measures followed for sample analysis associated with the PA/SI and provides an evaluation for the end-user regarding usability of the data presented in this report.

All samples were collected following the procedures outlined in the site-specific SQAP prepared for this PA/SI (Weston 2004). Three laboratories conducted the chemical analysis of samples collected during the PA/SI.

- Severn Trent Laboratories, located in Denver, Colorado, conducted water analysis for perchlorate following *USEPA Method 314.0 Determination of Perchlorate in Drinking Water by Ion Chromatography* (EPA 2000a) and *USEPA SW-846 Method 8321-modified Determination of Perchlorate by Liquid Chromatography/Mass Spectrometry* (STL 2003).
- Ceimic Corporation, located in Narragansett, Rhode Island, conducted soils analysis for TAL metals following specifications in the USEPA *Contract Laboratory Program Statement of Work for Inorganics Analysis (CLP-SOW) ILM05.3* (EPA 2004).
- Manchester Environmental Laboratory (MEL) located in Port Orchard, Washington, conducted surface water sample analysis for perchlorate following *USEPA Method 314.0 Determination of Perchlorate in Drinking Water by Ion Chromatography* (EPA 2000a), and for nitrogen-based explosive compounds following *USEPA SW-846 Method 8330 Determination of Nitroaromatics and Nitramines by High Performance Liquid Chromatography* (nitrogen-based explosive compounds, NBEC).

MEL chemists reviewed all data from analyses performed by MEL, EPA chemists reviewed all data from analyses performed by CLP, and Weston reviewed all data from analyses performed by STL. Weston validated these data relative to project data quality objectives (DQOs). Data qualifiers were applied following the *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* ([EPA 2002a], with exceptions noted in Section 4.4)

Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA 1999), and/or criteria specified in the individual analytical methods.

4.1 SATISFACTION OF DATA QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The project data quality objectives for the field effort were designed to produce data of known and documented quality in order to characterize sources, determine off-site migration of contaminants, determine whether the site is eligible for placement on the NPL, and to document threat(s) or potential threat(s) to public health or the environment posed by the site. The DQO process applied to this project followed that described in the EPA document, *Guidance for the Data Quality Objectives Process EPA QA/G-4*, (EPA 2000b).

All samples collected during the PA/SI investigation were analyzed using definitive analytical methods, and EPA accepted all analytical methods employed for this project. The data generated for this project met or exceeded requirements for the definitive data category as defined in The EPA document, *Guidance for the Data Quality Objectives Process for Hazardous Waste Site Operations EPA QA/G-4HW*, (EPA 2000c).

A detailed discussion of the project quality objectives achieved during the PA/SI is presented in the following sections.

4.2 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Quality control checks for sample collection were evaluated by a combination of Chain-of-Custody protocols and laboratory quality assurance as prescribed in the sampling or analytical methods. Quality control samples (e.g., matrix spike/duplicate spike samples, rinsate samples, field blanks) at a frequency of one per 20 samples (or per method) per media were collected during the PA/SI field effort. Results from these samples were compared to each method's criteria and to criteria specified in the SQAP (Weston 2004).

All of the analyses conducted during this project yielded definitive data. Data quality indicator targets for this project are specified below—DQOs are summarized in the SQAP. Bias on estimated, qualified data was determined and/or confirmed through the validation process. The laboratories' DQO for completeness was 95% for aqueous samples. Precision and accuracy requirements are also outlined in the SQAP (Weston 2004).

4.3 PROJECT-SPECIFIC DATA QUALITY OBJECTIVES

Data quality indicator (DQI) goals—precision, accuracy, representativeness, comparability, and completeness—for this project were developed following guidelines presented in EPA *Guidance for Quality Assurance Project Plans, EPA QA/G-5* (EPA 2002b). The basis for assessing each of the elements of data quality is discussed in the following subsections. Quality assurance objectives for measurement of analytical data (Method Quality Objectives; MQOs) and QC guidelines for precision and accuracy are presented in the SQAP (Weston 2004). Other DQI

goals are included in EPA analytical methods employed (EPA 2004, 2000a, 1996) and in the laboratories' standard operating procedures.

The laboratory and field team were able to meet overall project DQO goals.

4.3.1 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions.

Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. When recovery results between different analytical delivery groups are compared, the laboratory control sample (LCS) may be used to determine the precision of the analytical method. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch. Rather, the comparison is between the sample and samples analyzed in previous delivery groups. A LCS may be prepared and analyzed within a given batch; in this case, the analytical precision is associated with a particular preparation and analysis sequence.

Total precision is the measurement of the variability associated with the entire sampling and analysis process for one sampling event. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples may be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results.

The laboratory was able to meet project DQOs, with the exceptions listed in Section 4.4 below.

4.3.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS (blank spike) or into a field sample (to prepare a matrix-spiked sample or matrix-spiked duplicate sample) to a control limit.

The laboratory was able to meet project DQOs.

4.3.3 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a population, including a sampling point, a process condition, or an environmental condition. Representativeness is the qualitative term that should be evaluated to determine that measurements are made and physical samples collected at locations and in a manner resulting in

characterizing a matrix or media. Subsequently, representativeness is used to ensure that a sampled population represents the target population and an aliquot represents a sampling unit.

The field team was able to meet project DQOs.

4.3.4 Comparability

Comparability is the qualitative term that expresses the measure of confidence that two data sets or delivery groups can contribute to a common analysis and evaluation. Comparability with respect to laboratory analyses pertains to method type comparison, holding times, stability issues, and aspects of overall analytical quantitation. The following items are evaluated when assessing data comparability:

- Determining if two data sets or delivery groups contain the same set of parameters.
- Determining if the units used for each data set are convertible to a common metric.
- Determining if similar analytical procedures and quality assurance were used to collect data for both data sets.
- Determining if the analytical instruments used for both data sets have approximately similar detection levels.
- Determining if samples within data sets were selected and collected in a similar manner.

To ensure comparability of data collected during this investigation to other data that may have been or may be collected for the site, standard sample collection and measurement techniques were used. The field team was able to meet project DQOs.

4.3.5 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not rejected through data validation. The requirement for completeness for this project is 95% for aqueous samples and 90% for soil samples.

The following formula is used to calculate completeness:

$$\%\ \text{completeness} = \frac{\text{number of valid results}}{\text{number of possible results}}$$

For this investigation, all samples are considered critical. Therefore, standard collection and measurement methods will be used to achieve the completeness goal. All laboratory data were reviewed for usability, and all project data were determined to be useable.

The project DQOs of 95%/90% for completeness were met.

4.4 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PARAMETERS

The laboratory data also were reviewed for technical holding time compliance, blank samples contamination, laboratory control sample recovery, interference check sample recovery, duplicate sample analysis, matrix spike sample analysis, and serial dilution performance.

These parameters are described below in more detail, and sample-specific detail (including qualification of individual analyte results for associated samples) is provided in the data validation memoranda. Direction of bias is also described in the individual data review memoranda (Appendix D).

4.4.1 Holding Times

All analyses were completed within the technical holding times, with the following exception.

- Six water samples submitted for analysis of NBEC were extracted five days outside the technical holding time criterion of 14 days. NBEC was not detected in any samples. Associated results were flagged as non-detected (U), estimated concentration (J), unknown bias (K).

4.4.2 Blank Sample Results

All blank sample analyses met the frequency and recovery criteria.

4.4.3 Calibration Check Sample Analysis

All calibration check sample analyses met acceptance criteria for frequency and recovery.

4.4.4 Laboratory Control Sample Analysis

All laboratory control samples analyzed met frequency and recovery criteria.

4.4.5 Inductively Coupled Plasma-Atomic Emission Spectroscopy—Interference Check Sample Analysis

All ICP-AES interference check sample analyses met frequency and recovery criteria.

4.4.6 Duplicate Sample Analysis

The duplicate sample analysis was performed using matrix spike/duplicate spike samples. All frequency and precision criteria were met.

4.4.7 Matrix Spike Sample Analysis

Matrix spike analysis met frequency and recovery criteria, with the following exceptions.

- Matrix spike recoveries exceeded the acceptance criteria for antimony (27%) and silver (0%). All associated sample results were rejected for use (R).

- Matrix spike recoveries exceeded the acceptance criteria for beryllium (72%) and thallium (47%). These analytes were not detected in any samples. All associated sample results were flagged as estimated (J), unknown bias (K).

4.4.8 System Monitoring Compound (Surrogate) Spike Analysis

Surrogate spike analysis is not applicable to this project.

4.4.9 Internal Standard Analysis

Internal standard recovery associated with the GC/MS analyses met laboratory control limits.

4.4.10 Detection Limits

Sample results that fall between the method detection limit (MDL) and the Practical Quantitation Limit (PQL) are flagged as estimated concentrations (J), with an additional concentration flag (B). This is described is Section 4.4.12.

All detection limits were acceptable, with the following exception.

- Results for nine solid samples submitted for analysis of perchlorate were reported on a wet-weight basis. Percent moisture results were not provided. Perchlorate was not detected in any samples. The detection limit reported is considered to be an estimate, as it is dependent upon percent moisture correction. All results were flagged as non-detected (U), estimated concentration (J), unknown bias (K).

4.4.11 Serial Dilutions

Serial dilution analysis met all frequency and recovery criteria.

4.4.12 Other Data Assessment

For ILM05.3, the laboratory is required to flag all detected results below the CRQL with a 'J' concentration qualifier (result below the CRQL but above the MDL). For consistency with previous START PA/SI reports, and as an aid in the Hazard Ranking System scoring, the 'J' concentration qualifier is replaced with the equivalent 'B' data validation qualifier.

For the Inorganic Functional Guidelines review, the '+' and '-' bias designators are replaced with 'H' and 'L' designators to indicate potential high and low bias, respectively. The 'K' designator is used to indicate unknown bias. This approach is consistent with Region 10 policy.

Bias associated with estimated, non-detected values is unknown and flagged as such, since the reporting limit cannot be determined.

The data, as qualified, are ACCEPTABLE and can be used for all purposes.

SECTION 5

ANALYTICAL RESULTS REPORTING AND BACKGROUND SAMPLES

The following sections present the reporting criteria and reporting methods applied to the PA/SI data set. This section also presents the locations, analyses conducted, and analytical results of designated background samples collected during this PA/SI. Sampling locations are presented in Figures 3-1 and 3-2. Tables 6-1, 6-2, and 7-6 present the analytical results for the surface soil and sediment background samples collected. Data validation memoranda and Form I Analytical Results (or equivalent) are included in Appendix D.

5.1 ANALYTICAL RESULTS EVALUATION CRITERIA

Analytical results of samples collected during this PA/SI are presented in summary tables in Section 6 (source sample reporting) and Section 7 (migration exposure pathways and targets). The first column of each analytical summary table present background sample concentrations (where appropriate) followed by the analytical results of samples collected for that particular media. The background sample concentrations were used for comparison purposes to determine detections at or above background. Concentrations of analytes reported in water, soil, and sediment above the sample quantitation limit (SQL) are presented in bold typeface. Analytical results indicating significant concentrations in source samples (Section 6) with respect to background concentrations are underlined in addition to the bolding. Similarly, analytical results indicating elevated concentrations of contaminants in target samples (Section 7) with respect to background concentrations are also underlined in addition to the bolding. For target sample locations, only those analytes that were also detected in a source at the site were evaluated to determine whether their concentrations were elevated. For the purposes of this investigation, significant/elevated concentrations are:

- Equal to or greater than the sample's SQL if the analyte was not detected in the background samples collected for that media.
- Equal to or greater than the background sample's SQL when background concentrations were reported as non-detected at the SQL.
- At least three times greater than the background concentration when the background concentration is reported as detected.

Based on EPA Region 10 policy regarding common earth crust elements, aluminum, calcium, iron, magnesium, potassium, and sodium are listed in the tables if detected; however, the concentrations are not evaluated or discussed in the text.

5.2 BACKGROUND SAMPLE LOCATION AND ANALYTICAL RESULTS

With the exception of groundwater and surface water, background samples were collected for each of the naturally occurring media (soil and sediment) from which PA/SI samples were

collected. Results for the appropriate background sample appear in the first column of the analytical results summary tables included in Sections 6 and 7 to be used for comparison against source and target results. Soil and sediment sample locations are presented in Figure 3-1.

Based on the currently available information, this PA/SI assumes that perchlorate is not naturally occurring in the area. Background concentrations of perchlorate, therefore, are assumed to be zero. As a result, all reported concentrations of perchlorate that exceeded the quantitation limit are considered to have exceeded the CRQL.

5.2.1 Background Sample Locations

One background surface soil sample (SS-BK001) and one background surface sediment sample (SD-BK001) were collected during the PA/SI field event. As previously presented in Section 3.1, the sediment sample was collected from a station along Six-mile Canyon Creek. The background soil sample was collected approximately 100 feet southwest of SD-BK001. All background samples were collected upgradient of the site and are used for comparison with applicable samples.

5.2.2 Background Sample Results

Surface soil background sample SS-BK001 consisted predominantly of fine sand with a light brown color. Laboratory results indicated that detectable concentrations of arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc are present in the sample (Table 6-1).

Sediment sample SD-BK001 consisted of light brown fines and contained detectable concentrations of arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc (Table 7-6).

There were no reported concentrations of NBECs in either background sample.

SECTION 6

POTENTIAL SOURCE CHARACHTERIZATION

The following section presents the locations, analyses conducted, and analytical results of samples collected from potential site sources identified during this PA/SI, as well as comparisons to background concentrations. Source and background sampling locations are presented in Figure 3-1. Tables 6-1 and 6-2 present analytical results for inorganics and NBEC, respectively, of source samples collected and comparisons to background concentrations. Data validation memoranda and Form I Analytical Results are included in Appendix D.

6.1 POTENTIAL SOURCE SAMPLING LOCATIONS AND ANALYTICAL RESULTS

As presented in Section 2.3.1, two potential source areas were identified at the Boardman AFR FUDS for further investigation. These areas are: Area C (Target Impact Area) and Area E (Target Impact Area). Sampling activities were conducted at Area C and E on 23 June 2004.

Area C was chosen for evaluation based on its historic use as a target impact area and its proximity to Six-mile Canyon Creek. Area C was also considered to be the nearest potential source area to the PPE.

Although Area I was specified for evaluation in the SQAP (Weston 2004), Area E was chosen for investigation based on field reconnaissance and the presence of several practice bombs and an apparent impact area (Appendix A.1, Photo 8).

Sampling locations were selected at those places most likely to contain detectable concentrations of hazardous substances. The following sections present the location and analytical results of samples collected from these sources.

All soil analytical results are summarized in Tables 6-1 and 6-2. Sample locations are presented in Figure 3-1.

6.1.1 Area C – Target Impact Area

Area C is located in the Inland Land Co.'s lease area in the northern half of the Boardman AFR FUDS approximately 1 mile west of Tower Road and approximately 3 miles south of Highway I-84. As presented in Section 2.3.1, Area C is estimated to be approximately 357 acres located in Section 4, Township 3 North, Range 24 East. At the time of sampling, a vast majority of Area C was covered with crop circles.

6.1.1.1 Sample Locations

As presented in Section 3.1.1, Weston personnel collected four samples from two stations (colocated surface and subsurface soils). Both of the sample stations (PS003 and PS005) were located between several crop circles near a hay stack and pile of rocks. Each sample station was

located in the immediate vicinity of unexploded ordinances that were identified and deemed safe by trained Weston personal. Photographic documentation with brief descriptions of the observed unexploded ordinances (UXO) is presented in Appendix A.2.

6.1.1.2 Sample Results—Preliminary

Fixed laboratory analytical results for these samples indicate that arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc were detected in surface and subsurface samples collected in Area C (Table 6-1). There were no reported concentrations that significantly exceeded background levels, as discussed in Section 5.

There were no reported concentrations of either perchlorate or NBECs in any surface or subsurface soil sample collected from Area C (Tables 6-1 and 6-2).

6.1.2 Area E – Target Impact Area

Area E consists of 305 acres located in Section 13, Township 3 North, Range 24 East and is currently part of the restricted Boeing Antenna Test Site.

6.1.2.1 Sample Location

As presented in Section 3.1.1, Weston personnel collected four samples from two stations (colocated surface and subsurface soils). Both of the sample stations (PS001 and PS002) were located inside of the Boeing Antenna Test Site. Each sample station was located in the immediate vicinity of unexploded ordinances that were identified and deemed safe by trained Weston personal. Photographic documentation with brief descriptions of the observed UXOs is presented in Appendix A.2.

6.1.2.2 Sample Results

Fixed laboratory analytical results for these samples indicate that arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc were detected in surface and subsurface samples collected in Area E (Table 6-1). There were no reported concentrations that significantly exceeded background locations, as discussed in Section 5.

There were no reported concentrations of perchlorate or NBECs in any surface or subsurface soil sample collected from Area E (Tables 6-1 and 6-2).

Table 6-1—Potential Source Samples
Potential Source Sample Analytical Results: Inorganics and Perchlorate—Boardman AFR FUDS PA/SI
Boardman, Oregon

Description	Background	Potential Sources							
Field Number	SS-BK001	SS-PS001	SB-PS001	SS-PS002	SB-PS002	SS-PS003	SB-PS003	SS-PS005	SB-PS005
EPA Number	04264384	04264370	04264371	04264372	04264373	04264365	04264366	04264367	04264368
CLP Number	MJ4571	MJ4566	MJ4567	MJ4568	MJ4569	MJ4562	MJ4563	MJ4564	MJ4565
Location	Background Soil	Area E	Area E	Area E	Area E	Area C	Area C	Area C	Area C
Perchlorate (mg/kg)	0.010 UJK	0.010 UJK	0.010 UJK	0.010 UJK	0.010 UJK	0.010 UJK	0.010 UJK	0.010 UJK	0.010 UJK
Inorganics (mg/kg)									
Aluminum	**10100**	**7400**	**5960**	**5970**	**6320**	**6120**	**6270**	**6150**	**6840**
Antimony	R	R	R	R	R	R	R	R	R
Arsenic	**1.5**	**0.40 BJK**	**0.30 BJK**	**0.46 BJK**	**1.4**	**1.0**	**0.57 BJK**	**1.9**	**1.8**
Barium	**150**	**96.5**	**92.3**	**85.7**	**100**	**83.9**	**106**	**97.9**	**94.3**
Beryllium	0.49 UJK	0.50 UJK	0.45 UJK	0.46 UJK	0.49 UJK	0.45 UJK	0.42 UJK	0.49 UJK	0.50 UJK
Cadmium	0.49 U	0.50 U	0.45 U	0.46 U	0.49 U	0.45 U	0.42 U	0.49 U	0.50 U
Calcium	**5240**	**3570**	**3990**	**3150**	**4450**	**3640**	**5600**	**4680**	**9500**
Chromium	**11.8**	**9.0**	**7.0**	**8.5**	**8.0**	**8.1**	**8.4**	**8.9**	**9.1**
Cobalt	**11.2**	**9.6**	**8.6**	**8.5**	**9.0**	**8.3**	**9.0**	**8.6**	**9.0**
Copper	**17.3**	**11.5**	**11.6**	**9.5**	**11.1**	**10.6**	**12.0**	**13.7**	**13.5**
Iron	**20600**	**19700**	**16400**	**17400**	**18000**	**16400**	**16500**	**24500**	**18400**
Lead	**6.7**	**3.7**	**3.6**	**6.1**	**4.0**	**4.4**	**4.0**	**5.2**	**4.3**
Magnesium	**4700**	**4000**	**3800**	**3520**	**3770**	**3750**	**3800**	**3930**	**4370**
Manganese	**491**	**329**	**298**	**299**	**337**	**320**	**346**	**344**	**327**
Nickel	**11.6**	**9.3**	**8.1**	**8.3**	**8.8**	**8.3**	**9.2**	**9.6**	**9.0**
Potassium	**3510**	**1870**	**1590**	**1570**	**1620**	**1560**	**1410**	**2110**	**1550**
Selenium	3.5 U	3.5 U	3.1U	3.2 U	3.5 U	3.2 U	2.9 U	3.4 U	3.5 U
Silver	R	R	R	R	R	R	R	R	R
Sodium	**165 BJK**	**129 BJK**	**93.3 BJK**	**99.4 BJK**	**102 BJK**	**96.5 BJK**	**87.8 BJK**	**102 BJK**	**103 BJK**
Thallium	2.5 UJK	2.5 UJK	2.2 UJK	2.3 UJK	2.5 UJK	2.3 UJK	2.1 UJK	2.5 UJK	2.5 UJK
Vanadium	**40.1**	**46.3**	**33.7**	**40.3**	**40.6**	**35.1**	**37.8**	**38.5**	**42.5**
Zinc	**48.2**	**38.5**	**33.7**	**36.8**	**36.1**	**38.1**	**31.9**	**35.3**	**36.3**

Notes:

Bold type indicates the sample concentration is at or above the SQL.

BK: Background.

BJK: The analyte was detected above the MDL, but not above the SQL. The associated numerical value is an unknown bias estimate of the concentration of the analyte in the sample, and is below the sample quantation limit.

CLP: Contract Laboratory Program.

EPA: United States Environmental Protection Agency.

mg/kg: milligram per kilogram.

JL: The analyte was positively identified. The associated numerical value is a low-bias estimate.

NA: Not Analyzed.

PS: Potential Source.

R: Rejected data, not tabulated or used.

SB: Subsurface Soil.

SS: Surface Soil.

U: The analyte was analyzed for but not detected at or above the MDL. The associated numerical value is the sample quantitation limit.

UJK: The analyte was not detected at or above the reported concentration, which is an estimate of the reporting limit due to QC exceedance(s). Bias is unknown, since the analyte was not detected.

Table 6-2—Potential Source Samples
Potential Source Sample Analytical Results: NBEC—Boardman AFR FUDS PA/SI
Boardman, Oregon

Description	Background	Potential Sources			
Field Number	SS-BK001	SS-PS001	SB-PS001	SS-PS002	SB-PS002
EPA Number	04264384	04264370	04264371	04264372	04264373
Location	Background Soil	Area E	Area E	Area E	Area E
Nitrogen Based Explosive Compounds (NBEC) (µg/kg)					
1,3,5-Trinitrobenzene	180 U	190 U	180 U	180 U	180 U
1,3-Dinitrobenzene	180 U	190 U	180 U	180 U	180 U
2,4,6-Trinitrotoluene	180 U	190 U	180 U	180 U	180 U
2,4-Dinitrotoluene	180 U	190 U	180 U	180 U	180 U
2,6-Dinitrotoluene	180 U	190 U	180 U	180 U	180 U
2-Amino, 4,6-dinitrotoluene	180 U	190 U	180 U	180 U	180 U
2-Nitrotoluene	180 U	190 U	180 U	180 U	180 U
3-Nitrotoluene	180 U	190 U	180 U	180 U	180 U
4-Amino, 2,6-dinitrotoluene	180 U	190 U	180 U	180 U	180 U
4-Nitrotoluene	180 U	190 U	180 U	180 U	180 U
HMX	180 U	190 U	180 U	180 U	180 U
Nitrobenzene	180 U	190 U	180 U	180 U	180 U
RDX	180 U	190 U	180 U	180 U	180 U
TETRYL	180 U	190 U	180 U	180 U	180 U

Notes:

BK: Background.

EPA: United States Environmental Protection Agency.

PS: Potential Source.

SB: Subsurface Soil.

SS: Surface Soil.

µg/kg: microgram per kilogram.

U: The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

SECTION 7

MIGRATION/EXPOSURE PATHWAYS AND TARGETS

7.1 GROUNDWATER MIGRATION PATHWAY

The Boardman AFR FUDS site is located within the Columbia Basin in northeastern Oregon and nearly abuts the Columbia River. The area is underlain by a lava-floored plain of Columbia River basalt, which was deposited during the Miocene epoch (Natural Resource Conservation Service [NRCS] 1983). The basalt has a maximum thickness of approximately 4,000 feet. The weight of the basalt layers has caused faulting throughout the area. Geological events towards the end of the ice age in the Pleistocene epoch have greatly influenced the characteristics of the soils located above the Columbia River basalt. Melt waters from receding glaciers, flooding events, and prevailing winds have caused the basalt layer to be overlain with sand, gravel, and silt. Based on the geology in the area, Weston assumed a hydraulic conductivity of 10^{-4} centimeters per second (cm/sec). According to well logs for on-site wells, water bearing zones exist around 8-, 18-, 85-, 160-, 235-, and 485-feet below ground surface (bgs) (Oregon Water Resource Department [OWRD] 2003).

A shallow alluvial aquifer and deeper basalt aquifers are present within the area of the Boardman AFR FUDS. Groundwater can migrate between the aquifers through well borings that are open to more than one aquifer (ODEQ 1992). The alluvial aquifer includes all saturated elements that overlie the Columbia River Basalt Group. The alluvial aquifer is composed chiefly of sand, gravel, and silt deposited by glacial outwash and flooding events. Water-bearing zones in the basalt aquifers are limited to thin breccias or fracture zones at the top or base of individual basalt flows. Both aquifers are used for domestic, public-supply, irrigation, livestock, monitoring, and industrial purposes (OWRD 2003). The aquifer is not a designated sole source aquifer (EPA 2003a).

The Columbia River, which has a local average elevation of about 250 feet, is located approximately one mile from the northern site boundary. Elevations at the site range from about 300 feet at the northern boundary near the Columbia River to about 1,000 feet at the southern boundary. The terrain varies from rolling hills to nearly level relief. The average annual precipitation for the Boardman area is 8.49 inches (Western Regional Climate Center [WRCC] 2003).

7.1.1 Groundwater Pathway Targets

Groundwater is documented for use as drinking water, irrigation, industrial, and livestock purposes within the 4-mile target distance limit (TDL; Figure 7-1). The 4-mile TDL is based on reported concentrations of perchlorate in groundwater greater than 4 ug/L; each associated well is considered a source area.

There are wellhead protection areas within the 4-mile TDL.

The City of Boardman operates a municipal well that is documented as serving 2,550 people (EPA 2003b). According to the City of Boardman, the population of Boardman (3,100 people) is served by the municipal well. Domestic use wells listed by OWRD are primarily used for irrigation purposes with the allowance to irrigate up to ½-acre without a water rights permit (Byler 2003). With the exempt status of domestic well use, the permitting process is much easier and cheaper to install a domestic designated well for irrigation purposes versus irrigation designated wells (Byler 2003); therefore, there may be discrepancies in the drinking water population served by domestic wells.

The nearest privately owned domestic designated well is approximately 80-feet deep and is located 2,000 feet north of the site boundary. The Boardman municipal well is located approximately 3½ miles east of the boarder of the Boardman FUDS and approximately 2½ miles north of the border of the current Navy Bombing Range. The Boardman municipal well is located adjacent to the Columbia River.

The onsite wells are designated for domestic and public water use, irrigation, industrial, livestock, and monitoring use. According to a PGE representative the nearest drinking water well that serves the most people is located onsite at the PGE plant (Anderson 2003). PGE obtains drinking water from a well approximately 300 feet deep that is located on their property and serves 75 people (EPA 2003b). Boardman Airport obtains drinking water from one well on their property and also has two irrigation wells. The Boardman airport serves approximately 20 employees.

Three-Mile Canyon Farms has six monitoring wells and two livestock wells on the FUDS. Boeing has two industrial wells and one piezometer on the FUDS. The number of water supply well systems and their associated population (organized by distance rings) is provided in Table 7-1.

7.1.2 Groundwater Sample Locations and Analytical Results

The sample location and associated analytical results for all groundwater samples discussed in this section are presented in Figure 7-2 and Tables 7-2 and 7-3, respectively. Boring logs of wells sampled are presented in Appendix E.

7.1.2.1 Domestic Well Sample Locations

As presented in Sections 3.1.5 and 3.2.4, groundwater samples GW-DW001, GW-DW002, and GW-DW003 were collected from wells located at three residences. The properties and wellheads are all located north of the current Navy Bombing Range.

7.1.2.2 Domestic Well Analytical Results

Fixed laboratory analytical results reported that perchlorate was present in all three groundwater samples at concentrations of 1.5 µg/L in GW-DW001 (estimated value), 0.46 µg/L in GW-DW002, and 8.08 µg/L in GW-DW003 (Table 7-2).

There were no reported concentrations of NBECs in any groundwater sample collected from domestic wells during this sampling event (Table 7-3).

7.1.2.3 Drinking Water Supply Well Locations

As presented in Sections 3.1.4 and 3.2.4, groundwater samples GW-DS001, GW-DS002, and GW-DS003 were collected from domestic supply wells located on the Boardman AFR FUDS (tables 7-2 and 7-3).

7.1.2.4 Drinking Water Supply Well Analytical Results

Fixed laboratory analytical results reported that perchlorate and NBECs were not present in any of the three groundwater samples collected.

7.1.2.5 Monitoring Well Locations

Nineteen groundwater samples were collected from monitoring wells located both onsite (7 wells) and offsite (12 wells).

7.1.2.6 Monitoring Well Analytical Results

Of the 19 wells sampled, 15 had detectable concentrations of perchlorate ranging from 1.1 µg/L to 20.7 µg/L (Table 7-2).

There were no reported concentrations of NBECs in any groundwater sample collected from monitoring wells during this investigation (Table 7-3).

7.2 SURFACE WATER MIGRATION PATHWAY

Surface water runoff from the site generally flows northwesterly across the former bombing range to Six-mile Canyon Creek, which drains to the Columbia River. There is a low probability that surface water in the vicinity of each source area would flow to Six-mile Canyon Creek. However, during times of heavy rainfall there is a potential that surface water from each source area would drain into Six-mile Canyon Creek. The point where surface water flow drains from the northern most target area (Area C) into Six-mile Canyon Creek was identified as the probable point of entry (PPE) for the site. From the designated PPE, Six-mile Canyon Creek flows approximately 4½ miles northwesterly to its confluence with the Columbia River. The surface water pathway continues along the Columbia River for 10½ miles to the end of the 15-mile TDL (Figure 7-3). Six-mile Canyon Creek has an estimated flow of 10 to 100 cfs. The Columbia River has an estimated flow of greater than 100,000 cfs and is not tidally influenced. Based on their flow rates, Six-mile Canyon Creek is considered a small to moderate stream and the Columbia River is considered a very large river. Carty Reservoir is an artificial water body which was created by damming a portion of Six-mile Canyon Creek; there is no surface water outlet from the reservoir. PGE uses water from the reservoir for operational uses in their coal-fired power plant located adjacent to the plant.

Upland drainage associated with the site and sources consist of over 1,000 acres (United States Geological Survey [USGS] 1993a, b, c). The 2-year, 24-hour rainfall for the Boardman area is 1¼ inches (WRCC 2003). According to the Federal Emergency Management Agency (FEMA) the areas of concern are not located in a floodplain (FEMA 2003). There are no reported surface water drinking water intakes along the 15-mile TDL. Surface water is utilized for agricultural and livestock irrigation and as a recreational resource within the 15-mile TDL.

Surface water on the FUDS property consists of Six-mile Canyon Creek and the Carty Reservoir. Six-mile Canyon Creek flows through the most westerly portion of the site in a northerly direction (Figure 2-1). The majority of Carty Reservoir is located on PGE-owned property and is utilized by PGE. The Carty Reservoir provides cooling water to the coal-fired power plant and serves as a sink for some plant effluent (Global Security 2003).

7.2.1 Surface Water Pathway Targets

The nearest surface water intake is located along Six-mile Canyon Creek located within the site boundary. This intake is used for irrigation purposes. There are no municipal surface water intakes within the 15-mile TDL. There are six recorded water right claims designated for irrigation use along the Columbia River located between the city of Boardman and the confluence of Six-mile Canyon Creek and the Columbia River (OWRD 2003). These water right claims are located upstream of the identified 15-mile TDL from the FUDS.

Sport and commercial fish catch data for the Columbia River is available for 140 miles along the Columbia River from Bonneville Dam to McNary Dam (Oregon Department of Fish & Wildlife [ODFW] and Washington Department of Fish & Wildlife [WDFW] 2003). Approximately 10 and a half miles of the Columbia River are located within the 15-mile TDL, which accounts for seven-percent of the total fish reported. Chinook salmon (130,622 fish), coho salmon (1,649 fish), summer steelhead (13,761 fish), and white sturgeon (209 fish) have been reportedly caught in the 2002 fishing season. Weston assumes from the total 146,241 fish reportedly caught, 10,237 are caught within the 15-mile TDL accounting for approximately 20,474 pounds of fish per year (Table 7-4). Fish catch data for Six-mile Canyon Creek is not available (ODFW 2003).

Sensitive environments are present along the 15-mile downstream TDL (Oregon Natural Heritage Information Center [ONHIC] 2003).

- The Washington ground squirrel (*Spermophilus washingtoni*), a state-listed endangered species, is recorded to be present on site. Approximately 18,000 acres of the FUDS is a designated conservation area managed by the Nature Conservancy for the endangered Washington ground squirrel (ONHIC 2003; Nelson 2003).
- Steelhead middle Columbia River summer run (*Oncorhynchus mykiss*), a federal listed endangered species, is recorded to be present along the 15-mile TDL.

Wetland frontage along the 15-mile TDL is approximately 5¼ miles (U.S. Fish & Wildlife Service [USFWS] 1981a, 1981b, 1981c). Wetland frontage along Six-mile Canyon Creek consists of 4½-miles of palustrine wetlands. Wetland frontage along the Columbia River consists of ½-mile palustrine wetlands and ¼-mile lacustrine wetlands. Surface water along Six-mile

Canyon Creek and the Columbia River are currently used to irrigate commercial food crops and water commercial livestock (OWRD 2003).

7.2.2 Surface Water Sample Locations and Analytical Results

The location and analytical results for all surface water samples discussed in this section are presented in Figure 7-2 and Table 7-5, respectively.

7.2.2.1 Six-mile Canyon Creek Sample Locations

Five surface water samples (SW-SC001, SW-SC002, SW-SC004, SW-SC005, and SW-SC006) and one sediment sample colocated with SW-SC002 (SD-SC002) were collected from Six-mile Canyon Creek to determine whether contaminants are migrating from potential sources at the site and impacting targets in the surface water pathway.

7.2.2.2 Six-mile Canyon Creek Surface Water Analytical Results

Fixed laboratory analytical results reported that perchlorate was present in all five surface water samples collected from Six-mile Canyon Creek. Concentrations decreased along the creek in a downstream direction and ranged in value from 7.49 µg/L in SW-SC006 to 0.32 µg/L in SW-SC001 (Table 7-5).

7.2.2.3 Carty Reservoir Sample Location

One surface water sample (SW-CR001) was collected from Carty Reservoir to determine whether contaminants are migrating from potential sources at the site and impacting targets in the surface water pathway. There is no outlet from Carty Reservoir. Surface water sample SW-CR001 was collected from the southeast bank of the reservoir near the PGE power plant.

7.2.2.4 Carty Reservoir Surface Water Analytical Result

Fixed laboratory analytical results reported that perchlorate was not present in the surface water sample collected from Carty Reservoir.

7.2.3 Sediment Sample Location and Analytical Results

The sediment sample location and analytical result are presented in Figure 2-4 and Table 7-6, respectively.

7.2.3.1 Six-mile Canyon Creek Sediment Sample Location

One sediment sample was collected from Six-mile Canyon Creek (SD-SC002), the sample was colocated with SW-SC002. The purpose of the sample was to determine whether contaminants are migrating from potential sources at the site and impacting targets in the surface water pathway. SD-SC002 was collected approximately 4½ miles upstream of the confluence of Six-mile Canyon Creek and the Columbia River at the estimated PPE.

7.2.3.2 Six-mile Canyon Creek Sediment Sample Analytical Result

Fixed laboratory analytical results for these samples indicate that barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc were detected in the sediment sample collected from Six-mile Canyon Creek (Table 7-6). There were no reported concentrations that were elevated above background concentrations, as discussed in Section 5.

7.3 SOIL EXPOSURE PATHWAY

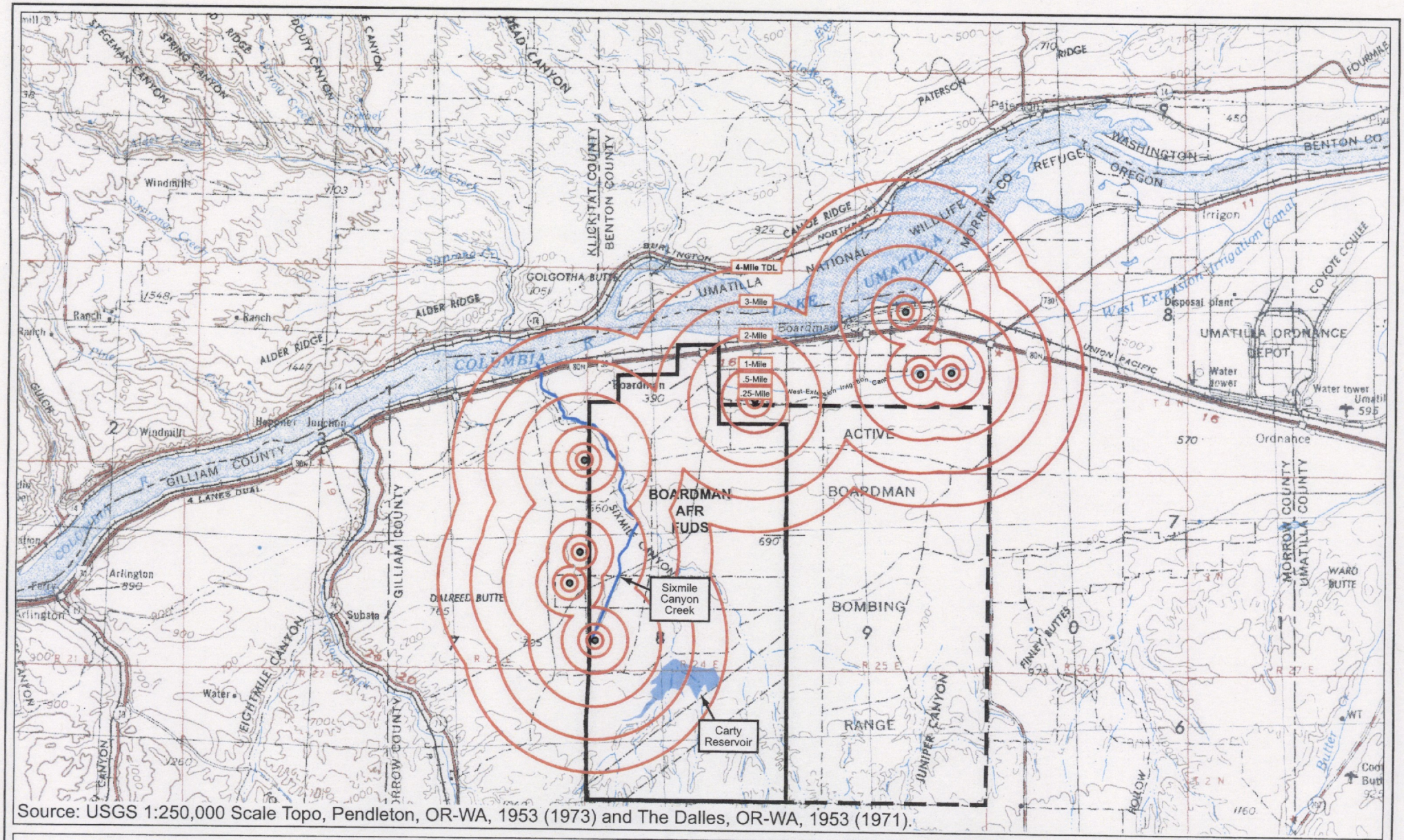
7.3.1 Soil Exposure Pathway Targets

There are no residences located on the Boardman AFR FUDS or within 200 feet of potential sources of contamination. There are no schools or daycare facilities located within 200 feet of the site. There are approximately 20 workers at the Boardman Airport and approximately 75 employees at the PGE Coal fired power plant. There are regularly occupied residences, schools, and places of employment within 1 mile of the site. The nearest occupied residence is located within ½ mile (approximately 2,000 feet) from the northeastern boundary of the site. Table 7-7 provides population data and summarizes wetland acreage within the 4-mile TDL.

Access to the site is restricted by a barbed wire fence (Nelson 2003). Wetland areas and the Washington ground squirrel, a state listed endangered species, are recorded to be present on site. A portion of the historic Oregon Trail is located along the southern site boundary. Commercial agriculture, commercial livestock production and grazing occur onsite.

7.4 AIR MIGRATION PATHWAY

The source(s) of the perchlorate contamination of groundwater and surface water at the Boardman AFR FUDS is unknown. The air migration pathway cannot be evaluated until a contaminant source is identified. Per EPA direction the air migration pathway was not evaluated during this PA/SI.



Source: USGS 1:250,000 Scale Topo, Pendleton, OR-WA, 1953 (1973) and The Dalles, OR-WA, 1953 (1971).

0 2 4

Scale in Miles

Boardman AFR FUDS Site Boundary

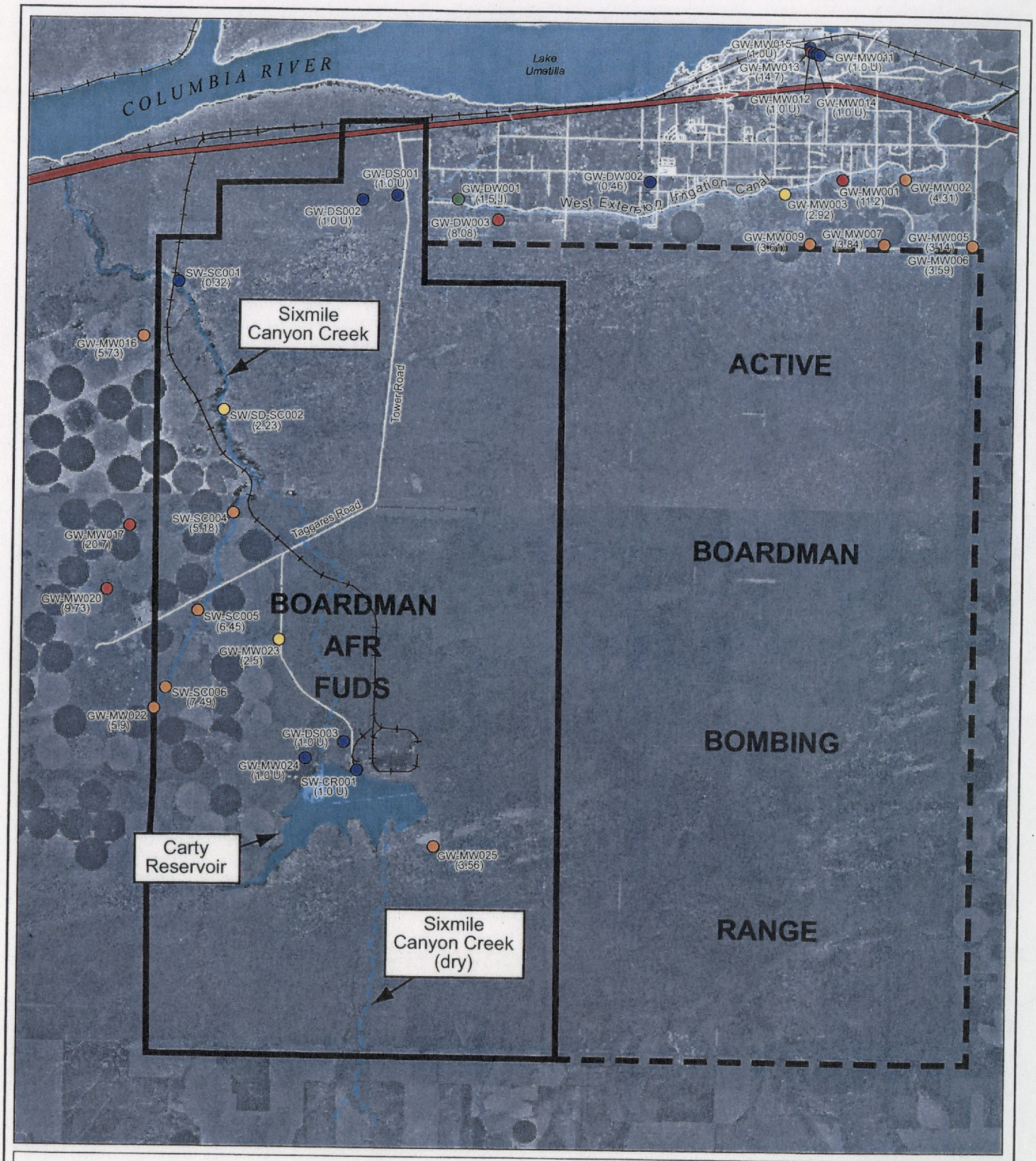
U.S. Navy AFR Boundary

WESTON SOLUTIONS

4-Mile Target Distance Limit (TDL) Map
Boardman AFR FUDS PA/SI
Boardman, Oregon

Figure
7-1

04-0217 Fig7-1.ai



0 1 2

Scale in Miles

WESTON SOLUTIONS

Boardman AFR FUDS Site Boundary

U.S. Navy AFR Boundary

SC002 Station ID

(2.23) Perchlorate Concentration (µg/L)

Sample With Perchlorate Result >8 µg/L

Sample With Perchlorate Result Between 3 and 8 µg/L

Sample With Perchlorate Result Between 2 and 3 µg/L

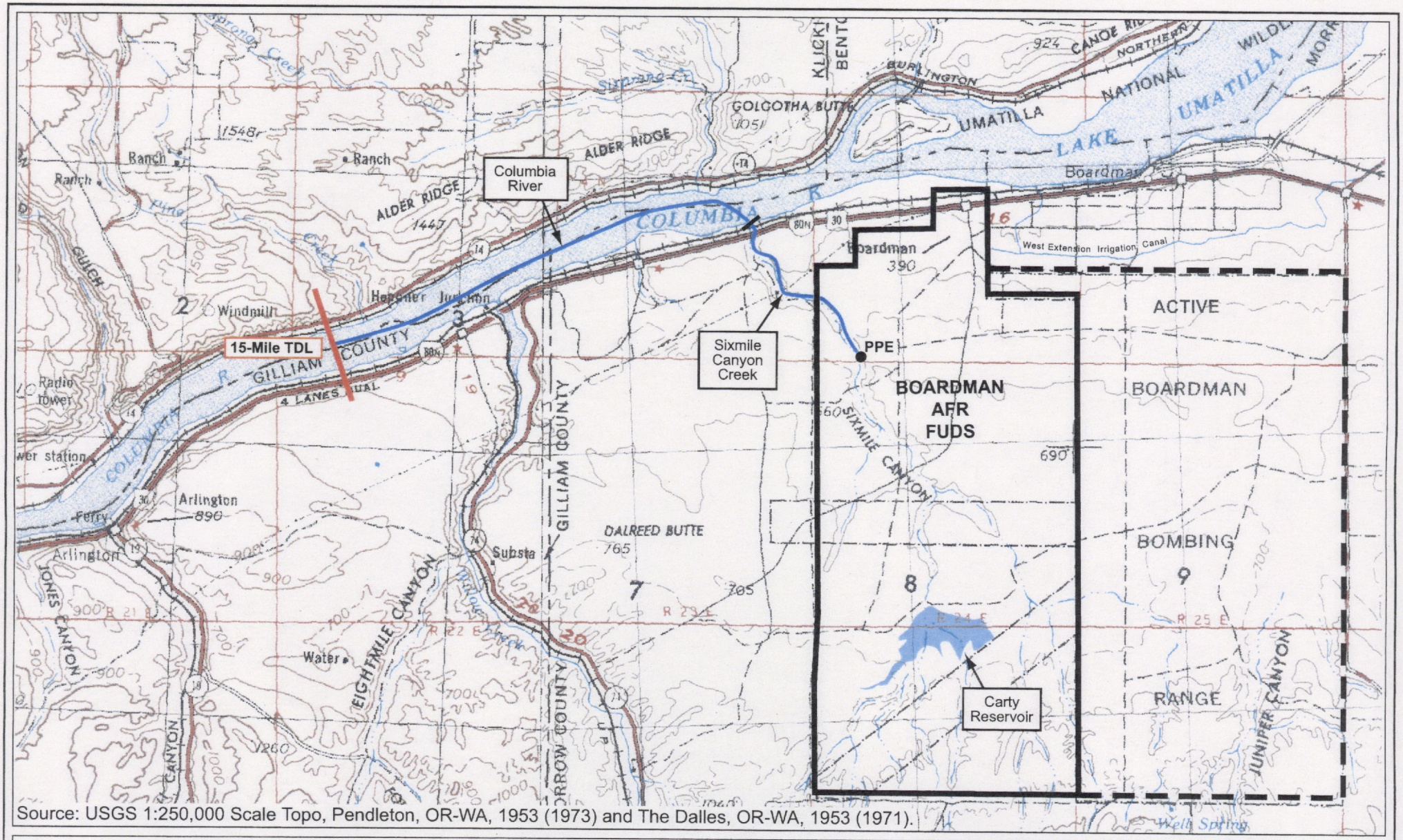
Sample With Perchlorate Result Between 1 and 2 µg/L

Sample With Perchlorate Result <1 µg/L

Perchlorate Results
Boardman AFR FUDS PA/SI
Boardman, Oregon

Figure
7-2

04-0217 Fig7-2.ai



0 1.5 3

Scale in Miles

Boardman AFR FUDS Site Boundary

U.S. Navy AFR Boundary

Probable Point of Entry

15-Mile Target Distance Limit (TDL) Map
Boardman AFR FUDS PA/SI
Boardman, Oregon

Figure
7-3

04-0217 Fig7-3.ai

Table 7-1—Groundwater Wells and Associated Population within the 4-Mile TDL Boardman AFR FUDS PA/SI

Distance (Miles)	Wells		Population	
	Domestic[a]	Municipal[b]	Domestic[c]	Municipal[d]
Onsite	0	3	0	95
0 - ¼	0	0	0	0
¼ - ½	9	0	26	26
½ - 1	5	0	14	0
1 - 2	17	0	49	0
2 - 3	20	0	58	0
3 - 4	22	1	64	2,550
Total	**73**	**4**	**211**	**2,671**

Sources:

[a]ODWR 2003.

[b]EPA Safe Drinking Water Information System (SDWIS) Database. 2003b.

[c]U.S. Census Bureau (USCB). 2003. Census 200. Morrow County, Washington. Average household size 2.90 people.

Table 7-2—Groundwater Sample Analytical Results: Perchlorate
Boardman AFR FUDS PA/SI
Boardman, Oregon

Field Number	EPA Regional Tracking Number	Location	Perchlorate (314.0) µg/L	Perchlorate (8321A-mod) µg/L
Domestic Well				
GW-DW001	04264350	Poe Residence	**1.5 BJK**	NA
GW-DW002	04264364	Galloway Residence	1.0 U	**0.46**
GW-DW003	04264351	Suter Residence	**8.08**	NA
Drinking Water Supply Well				
GW-DS001	04264385	Port of Morrow Airport Well	1.0 U	NA
GW-DS002	04264386	Port of Morrow Airport Irrigation Well	1.0 U	NA
GW-DS003	04264369	Portland General Electric Company	1.0 U	NA
Monitoring Well				
GW-MW001	04264362	Port of Morrow Monitoring Well: MW-13	**11.2**	NA
GW-MW002	04264363	Port of Morrow Monitoring Well: MW-14	**4.31**	NA
GW-MW003	04264361	Port of Morrow Monitoring Well: MW-12	**2.92**	NA
GW-MW005	04264358	Port of Morrow Monitoring Well: MW-15	**3.14**	NA
GW-MW006	04264357	Port of Morrow Monitoring Well: MW-15s	**3.59**	NA
GW-MW007	04264359	Port of Morrow Monitoring Well: MW-16	**3.84**	**4.2**
GW-MW009	04264360	Port of Morrow Monitoring Well: MW-17	**3.61**	NA
GW-MW011	04264356	Coyote Springs Monitoring Well: CSMW-6	1.0 U	NA
GW-MW012	04264354	Coyote Springs Monitoring Well: CSMW-7	1.0 U	**1.1**
GW-MW013	04264353	Coyote Springs Monitoring Well: CSMW-8	**14.7**	NA
GW-MW014	04264355	Coyote Springs Monitoring Well: CSMW-9	1.0 U	NA
GW-MW015	04264352	Coyote Springs Monitoring Well: CSMW-10	1.0 U	NA
GW-MW016	04264377	Three-Mile Canyon Farms Monitoring Well: RDOU-1	**5.73**	NA
GW-MW017	04264376	Three-Mile Canyon Farms Monitoring Well: SU-3	**20.7**	**18**
GW-MW020	04264374	Three-Mile Canyon Farms Monitoring Well: SU-1	**9.73**	**9.8**
GW-MW022	04264379	PGE Monitoring Well: 107	**5.85**	**5.9**
GW-MW023	04264380	PGE Monitoring Well: 104	**2.0**	**2.5**
GW-MW024	04264381	PGE Monitoring Well: 008	1.0 U	NA
GW-MW025	04264382	PGE Monitoring Well: 120	**3.56**	NA

Notes:

Bold type indicates the sample concentration is at or above the SQL.

BJK: The analyte was detected above the MDL, but not above the SQL. The associated numerical value is an unknown bias estimate of the concentration of the analyte in the samp

DW: Domestic Well.

DS: Drinking Water Supply Well.

EPA: United States Environmental Protection Agency.

GW: Groundwater.

MW: Monitoring Well.

NA: Not Analyzed.

PGE: Portland General Electric.

µg/L: microgram per liter.

U: The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

Table 7-3—Groundwater Sample Analytical Results: NBEC
Boardman AFR FUDS PA/SI
Boardman, Oregon
Boardman, Oregon

Field Number	GW-DW001	GW-DW003	GW-MW015	GW-MW013	GW-MW012	GW-MW014	GW-MW011	GW-MW006	GW-MW005	GW-MW007	GW-MW009	GW-MW003	GW-MW001	GW-MW002	GW-DW002	GW-DS003	GW-MW020	GW-MW017	GW-MW016	GW-MW022	GW-MW023	GW-MW024	GW-MW025	GW-DS001	GW-DS002
EPA Number	04264350	04264351	04264352	04264353	04264354	04264355	04264356	04264357	04264358	04264359	04264360	04264361	04264362	04264363	04264364	04264369	04264374	04264376	04264377	04264379	04264380	04264381	04264382	04264385	04264386
Location	Poe Residence	Suter Residence	Coyote Springs Monitoring Well: CSMW-10	Coyote Springs Monitoring Well: CSMW-8	Coyote Springs Monitoring Well: CSMW-7	Coyote Springs Monitoring Well: CSMW-9	Coyote Springs Monitoring Well: CSMW-6	Port of Morrow Monitoring Well: MW-15s	Port of Morrow Monitoring Well: MW-15	Port of Morrow Monitoring Well: MW-16	Port of Morrow Monitoring Well: MW-17	Port of Morrow Monitoring Well: MW-12	Port of Morrow Monitoring Well: MW-13	Port of Morrow Monitoring Well: MW-14	Galloway Residence	PGE Drinking Water Well	Three-Mile Canyon Farms Monitoring Well: SU-1	Three-Mile Canyon Farms Monitoring Well: SU-3	Three-Mile Canyon Farms Monitoring Well: RDOU-1	PGE Monitoring Well: 107	PGE Monitoring Well: 104	PGE Monitoring Well: 008	PGE Monitoring Well: 120	Port of Morrow Airport Well	Port of Morrow Airport Irrigation Well
Nitrogen Based Explosive Compounds (NBEC) (µg/L)																									
1,3,5-Trinitrobenzene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
1,3-Dinitrobenzene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
2,4,6-Trinitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
2,4-Dinitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
2,6-Dinitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
2-Amino, 4,6-dinitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
2-Nitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
3-Nitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
4-Amino, 2,6-dinitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
4-Nitrotoluene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
HMX	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
Nitrobenzene	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
RDX	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK
TETRYL	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 U	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK	0.40 UJK

Notes:
DW: Domestic Well.
DS: Drinking Water Supply Well.
EPA: United States Environmental Protection Agency.
GW: Groundwater.
MW: Monitoring Well.
NA: Not Analyzed.
PGE: Portland General Electric.
µg/L: microgram per liter.
U: The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.
UJK: The analyte was not detected at or above the reported concentration, which is an estimate of the reporting limit due to QC exceedance(s). Bias is unknown, since the analyte was not detected.

Table 7-4—Annual Sports Fish Harvest within 15-Miles of the Site
Boardman AFR FUDS PA/SI
Boardman, Oregon

Species	Total Columbia Fish Catch	Number Harvested*	Pounds Harvested**
Chinook Salmon	130,622	9,144	18,287
Summer Steelhead	13,761	963	1,927
Coho Salmon	1,649	115	231
White Sturgeon	209	15	29
Total	**146,241**	**10,237**	**20,474**

Notes:

*Estimated by Weston to be 7 percent of the total Columbia River Fish Catch.

**Estimated at 2 pounds per fish.

Table 7-5—Surface Water Sample Analytical Results: Perchlorate
Boardman AFR FUDS PA/SI
Boardman, Oregon

Field Number	EPA Regional Tracking Number	Location	Analysis (Method)	
			Perchlorate (314.0) µg/L	Perchlorate (8321A-mod) µg/L
Sixmile Canyon Creek				
SW-SC001	04264387	Sixmile Canyon Creek	1.0 U	**0.32**
SW-SC002	04264388	Sixmile Canyon Creek	**2.23**	NA
SW-SC004	04264390	Sixmile Canyon Creek	**5.18**	NA
SW-SC005	04264391	Sixmile Canyon Creek	**6.43**	NA
SW-SC006	04264392	Sixmile Canyon Creek	**7.49**	NA
Carty Reservoir				
SW-CR001	04264378	Carty Reservoir	1.0 U	NA

Notes:

Bold type indicates the sample concentration above the detection limit.

CR: Carty Reservoir.

DW: Domestic Well.

DS: Drinking Water Supply Well.

EPA: United States Environmental Protection Agency.

NA: Not Analyzed.

PGE: Portland General Electric.

SC: Sixmile Canyon Creek.

SW: Surface Water.

µg/L: microgram per liter.

U: The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

Table 7-6—Sixmile Canyon Creek Sediment Sample Analytical Results: Inorganics Boardman AFR FUDS PA/SI Boardman, Oregon

Description	Background	PPE Sediment
Field Number	SD-BK001	SD-SC002
EPA Number	04264383	04264389
CLP Number	MJ4570	MJ4572
Location	Background Sediment	Sixmile Canyon Creek
Inorganics (mg/kg)		
Aluminum	**13800**	**5620**
Antimony	R	R
Arsenic	**1.9**	**0.92 BJK**
Barium	**171**	**95.8**
Beryllium	0.45 UJK	0.61 UJK
Cadmium	0.45 U	0.61 U
Calcium	**4740**	**3600**
Chromium	**16.6**	**8.0**
Cobalt	**13.3**	**7.5**
Copper	**22.4**	**9.9**
Iron	**27200**	**16300**
Lead	**8.2**	**4**
Magnesium	**5710**	**3520**
Manganese	**542**	**391**
Nickel	**14.7**	**8.1**
Potassium	**3880**	**1640**
Selenium	3.1 U	4.3 U
Silver	R	R
Sodium	**170 BJK**	**212 BJK**
Thallium	2.2 UJK	3.0 UJK
Vanadium	**52.7**	**36.9**
Zinc	**62.4**	**41.1**

Notes:

Bold type indicates the sample concentration is at or above the SQL.

The associated numerical value is an unknown bias estimate of the concentration of the analyte in the sample, and is below the sample quantation limit.

BK: Background.

CLP: Contract Laboratory Program

EPA: United States Environmental Protection Agency.

mg/kg: milligram per kilogram

JK: The analyte was positively identified. The associated numerical value is an unknown bias estimate.

MIS: Mulit-increment sample.

PPE: Probable point of Entry.

R: Rejected data, not usable.

SC: Sixmile Canyon Creek.

SD: Sediment.

U: The analyte was analyzed for but not detected. The associated numerical value is the sample quantitation limit.

UJK: The analyte was not detected at or above the reported concentration, which is an estimate of the reporting limit due to QC exceedance(s). Bias is unknown, since the analyte was not detected.

Table 7-7—Population and Wetland Acreage within the 4-Mile TDL
Boardman AFR FUDS PA/SI
Boardman, Oregon

Distance Ring (Miles)	Population	Wetlands (Acreage)*
Onsite	0	0
0 - ¼	0	0
¼ - ½	10	0
½ - 1	15	0
1 - 2	74	15
2 - 3	23	15
3 - 4	898	15
Total	**1,020**	**45**

Sources:

PCGems. 1995. PCGEMS Version 2.03: 6/28/95 Beta-Test Version.

EPA. 2002a. EPA Geographical Information Query System (Version 97.1.8). 27 June 2002.

*Average wetlands from EPA Query for 1-4 miles with wetland acres (45 acres/3 TDL rings =15 per distance ring).

SECTION 8

SUMMARY

The Boardman AFR FUDS is an inactive former bombing range located approximately 5 miles west of Boardman, Oregon in the northeastern portion of the State (Figure 2-1). Of the original 95,986 acres are used as a bombing range, 37,320 acres are currently a designated bombing range owned and operated by the Department of Navy in conjunction with Whidbey Island Naval Air Station. The western half of the site is the inactive bombing range (the FUDS portion) consisting of 58,665 acres, which is the focus of this PA/SI.

The 58,665 acres of the Boardman AFR FUDS currently contains: a coal-fired power plant owned and operated by PGE; the Boardman airport owned and operated by the Port of Morrow; a Boeing antennae testing site owned by Three-Mile Canyon Farms and operated by Boeing; and irrigated farmland utilized for livestock grazing, livestock and dairy cattle production, and agricultural production operated by Inland Land Co. and owned by Three-Mile Canyon Farms (Figure 2-2).

The primary landscape feature is high plain desert with low-lying vegetation. The Columbia River, which has a local average elevation of 250 feet, is located approximately one mile from the northern site boundary. Elevations at the site range from 300 feet at the northern boundary near the Columbia River to 1,000 feet at the southern boundary.

Two potential source areas were selected for evaluation at the Boardman AFR FUDS. These areas are: Area C (Target Impact Area) and Area E (Target Impact Area). Surface and subsurface samples were collected from each area.

Analytical results for surface and subsurface soil samples collected from Area C and Area E indicate that arsenic, barium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc were present in both areas; however, no reported metals results significantly exceeded background concentrations. NBECs were not detected in any sample collected from Area E and concentrations of perchlorate exceeding the method detection limit were not reported in any sample collected from either Area C or Area E.

Groundwater samples were collected from 25 wells according to the following breakdown: three domestic wells, 19 monitoring wells (seven onsite wells and 12 offsite wells), two drinking water supply wells, and one irrigation well. Of the 25 groundwater samples collected 18 had detectable concentrations of perchlorate ranging in value from (0.46 μg/L to 20.7 μg/L).

Five surface water samples and one sediment sample were collected from Six-mile Canyon Creek and one surface water sample was collected from Carty Reservoir. Perchlorate was detected in every surface water sample collected from Six-mile Canyon Creek at concentrations ranging from 0.32 ug/L to 7.49 ug/L. Concentrations of perchlorate reported in stream samples decreased in a downstream direction, indicating a potential, unidentified source upgradient of the stream. Perchlorate was not reported in the surface water sample collected from Carty Reservoir.

NBECs were not detected in any groundwater or sediment sample collected during this PA/SI.

Several human health and ecological targets are present. Local residents use groundwater in the vicinity of the site as their drinking water source. Approximately 25 people live within one mile of the site (EPA 2003b) and approximately 2,882 people are estimated to utilize groundwater for drinking water purposes within 4 miles from the site. Approximately 5¼ miles of wetland frontage were identified along the 15-mile TDL and the middle Columbia River summer run steelhead (*Oncorhynchus mykiss*), a federal listed endangered species, is recorded to be present along the 15-mile TDL. The Washington ground squirrel (S*permophilus washingtoni*), a state listed endangered species, is recorded to be present on site. Approximately 18,000 acres of the FUDS is a designated conservation area managed by the Nature Conservancy for the endangered Washington ground squirrel (ONHIC 2003; Nelson 2003). Some areas on the site have been used for commercial agriculture, commercial livestock production, and grazing.

Based on human health and ecological targets identified during this PA/SI, it is determined that the groundwater and surface water migration pathways were the only significant pathways at the Boardman AFR FUDS. Based on information gathered during the PA/SI, it was determined that the air migration pathway would not significantly contribute to the site HRS score, and therefore was not evaluated.

SECTION 9

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APPENDIX A

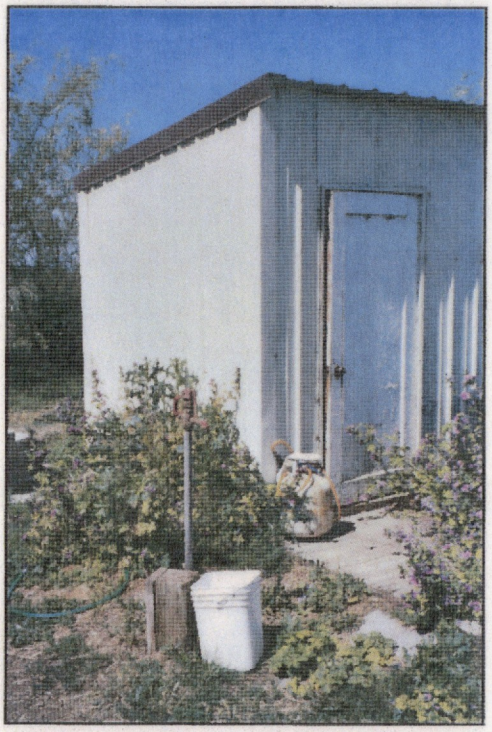
PHOTOGRAPHIC DOCUMENTATION

A.1 FIELD PHOTOGRAPHS

photo 1

Poe residence domestic well and sampling spigot (sample ID: GW-DW001).

photo 2

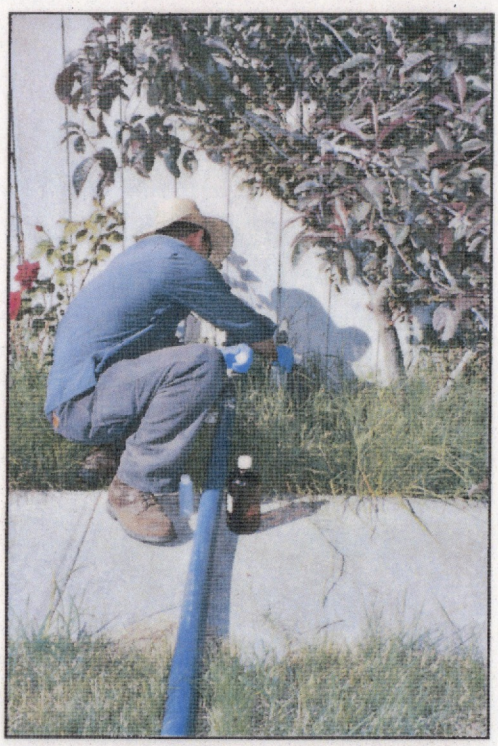


Suter residence domestic well house and sampling spigot (sample ID: GW-DW003).

Photolog
Field Photographs

WESTON SOLUTIONS

photo 3



Galloway residence sampling spigot (sample ID: GW-DW002).

photo 4

Coyote Springs Facility monitoring well CSMW-7 (sample ID: GW-MW012) sampled using low flow technique. Substation shown in background facing southeast.

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Field Photographs

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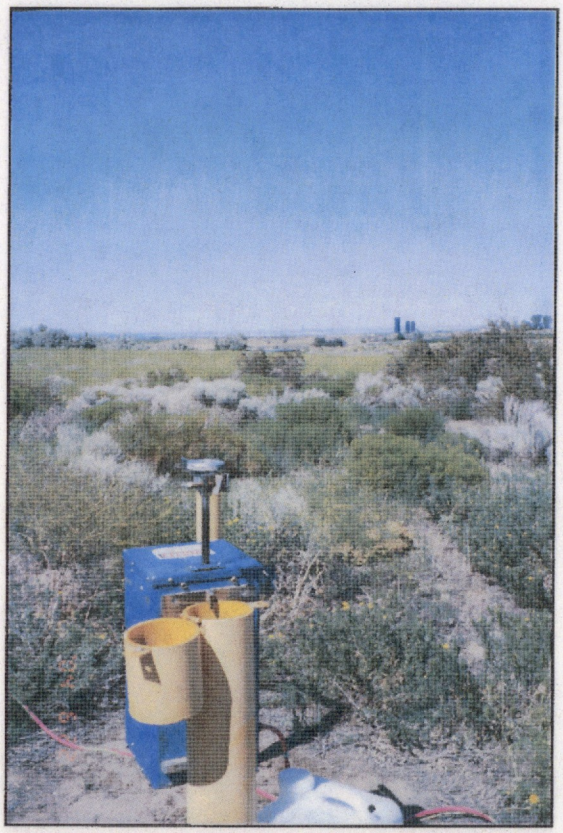
04-0217 Photolog.ai

photo 5



Port of Morrow monitoring well MW-014s (Sample ID: GW-MW002) sampled using inertia pump.

photo 6

Area C facing west.

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Field Photographs

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04-0217 Photolog.ai

photo 7

Area E with Mark-12 practice bomb facing north.

photo 8

Area E showing metal debris in observed target area.

Photolog
Field Photographs

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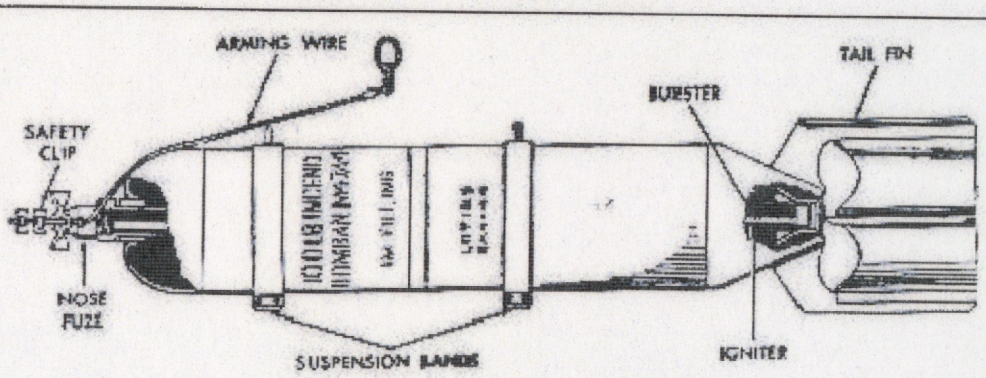
A.2 UXO RECON PHOTOGRAPHS

Bomb Practice AN M-47

Frag-A: Observed at Area C



AN M-47 Cut-A-Way

AN M-47A1:	Practice	Wet Sand
	Smoke	WP
	Incendiary	H Levinstein Mustard
	Incendiary	HD Mustard
	Incendiary	HS Mustard

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UXO Recon Photographs

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Bomb Practice Mk-15

Frag-B: Observed at Area C

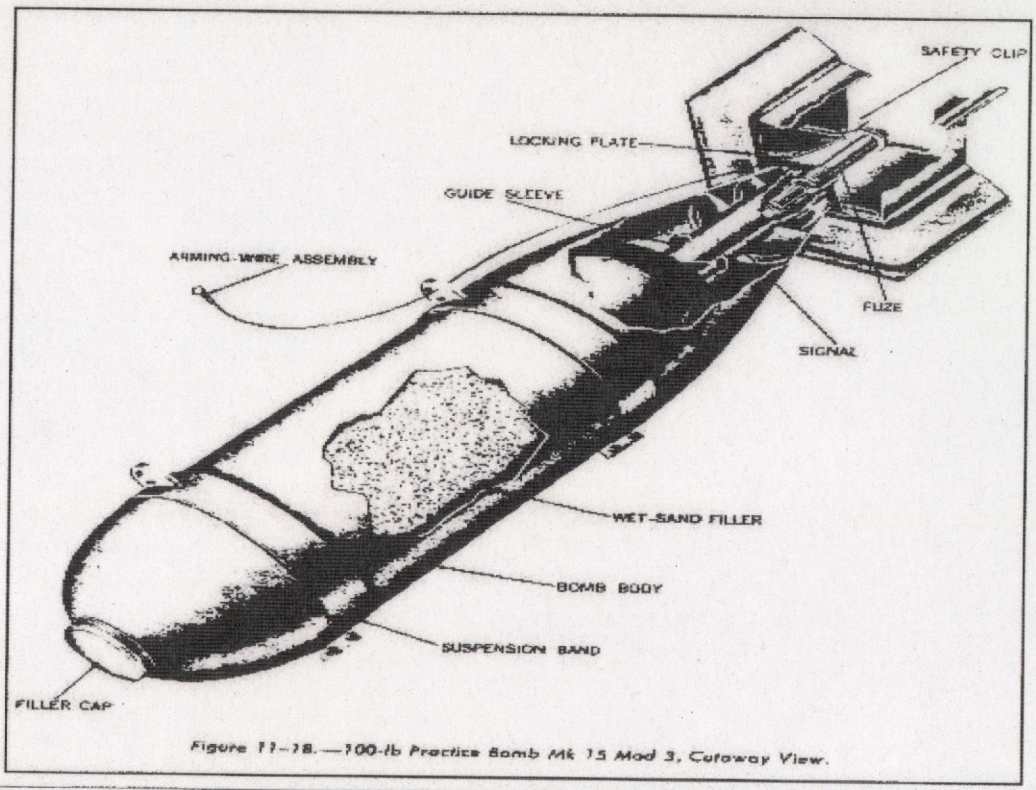

Figure 11-18.—100-lb Practice Bomb Mk 15 Mod 3, Cutaway View.

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UXO Recon Photographs

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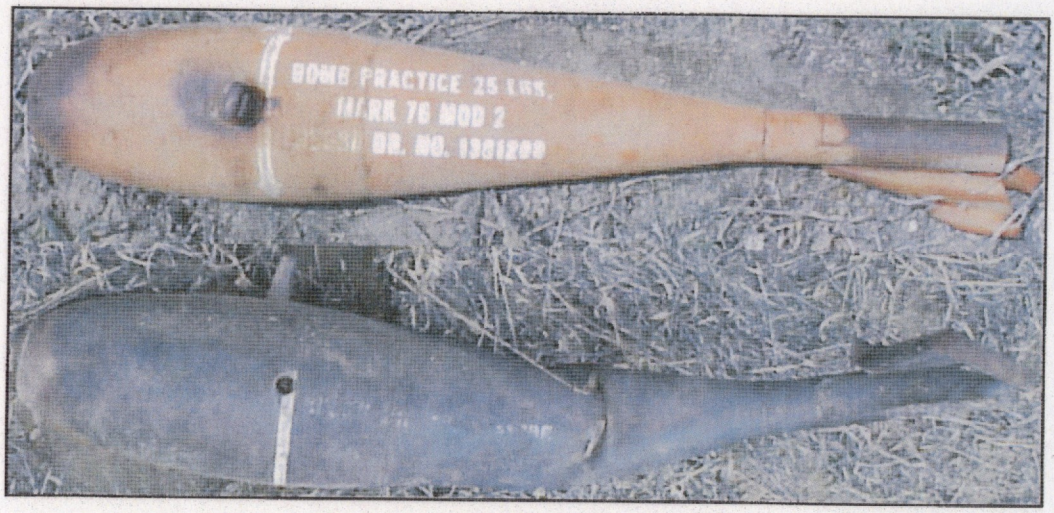
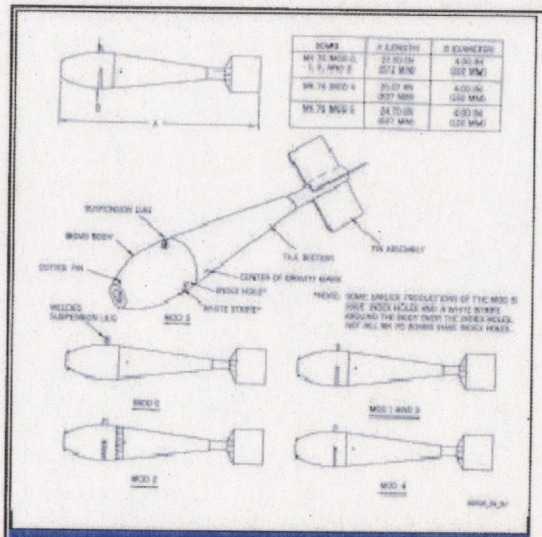
Photolog
A.2-2

Bomb Practice Mk-76



Frag-C: Observed at Area E



External View

Country of Origin	United States
Diameter/Width	102.00 mm
Length	572.00 mm
Weight	11.00 kg
Explosive Type	NONE
Net Explosive Weight	Not Available

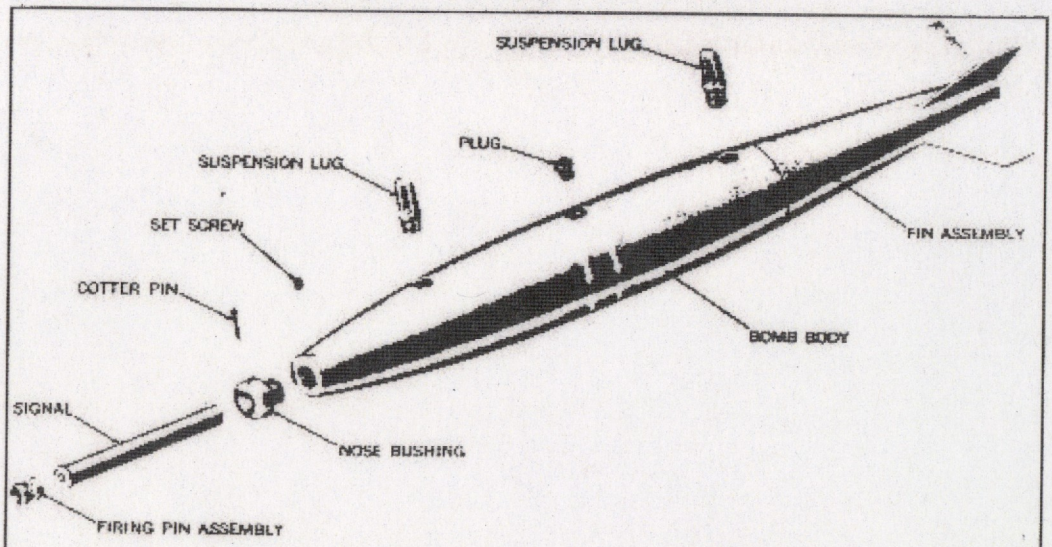
Special instructions required for transportation.

Disposal by detonation.

These bombs are signal-generating, impact-or impact-inertia-fired practice/simulated bombs. These bombs use either the Mk 4-series, Mk 5 Mod 0, CXU-3/B, CXU-3A/B signal cartridge, or the CXU-2/B spotting charge. The Mk 76-series bombs are painted black or blue. The Mk 76 Mods 1, 2, 3, 4, and some Mod 5 bombs have a 0.25-inch (6-millimeter) white stripe over the index holes. The bombs contains no hazardous components. Hazardous components are contained in the signal cartridge or spotting charge. The Mk 76- and BDU-33-series bombs are cast iron with sheet steel fin assemblies.

Bomb Practice Mk-89

Frag-D: Observed at Area E



56-lb Practice Bomb Mk 89 Mod 1, Exploded View.

Mark Mod	89 0	89 1
Length of Bomb (in.):		
Assembled with Firing Pin	31.3	31.3
Assembled with Fuze	None	32.9
Diameter of Body (in.)	4.0	4.0
Fin Span (in.)	6.63	6.63
Distance between Suspension Lugs Center-to-Center (in.)	14.0	14.0
Weight of Bomb (lb):		
Assembled with Firing Pin	56.6	56.6
Assembled with Fuze AN-M146A1, M907E2	None	57.3, 57.9
Practice Bomb Signal	Mk4 Mod 3	Mk4 Mod 3
Firing-Pin Assembly	Mk1 Mod 0	Mk1 Mod 0
Fuze		AN-M146A1 M907E2

a. Description. Practice bomb MK89 Mod 0 (fig. 2-60 and table 2-49) is a low-drag (sub-caliber) practice bomb, similar in shape to the low-drag series of general purpose service bombs. The cast iron body is slender with a long, pointed nose. The conical fin assembly is of welded sheet metal or cast aluminum-magnesium construction. The tail fins are canted 2 degrees to impart spin to the bomb

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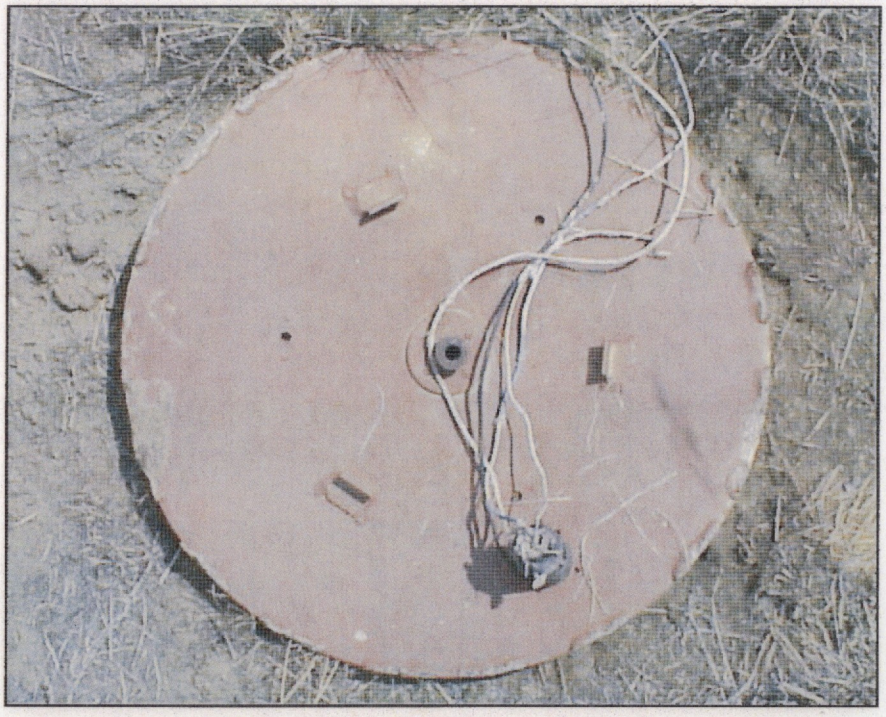
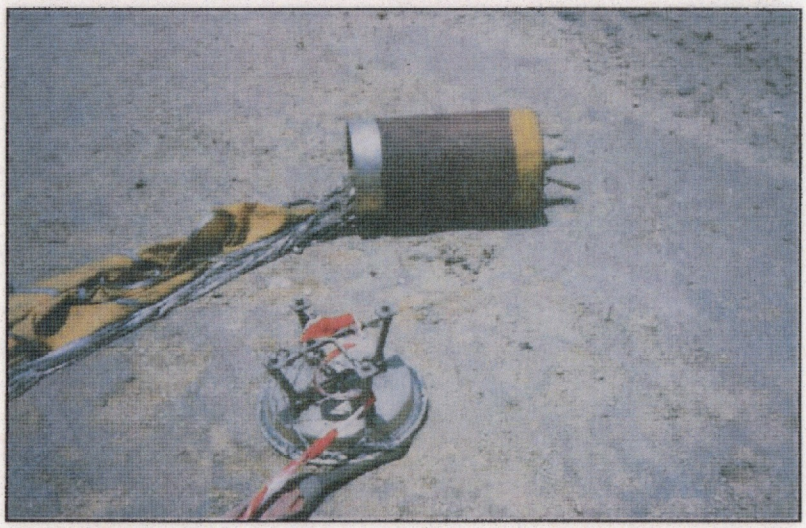
Bomb Fuel-Air-Explosive (FAE) BLU-95



Frag-E: Observed at Area E



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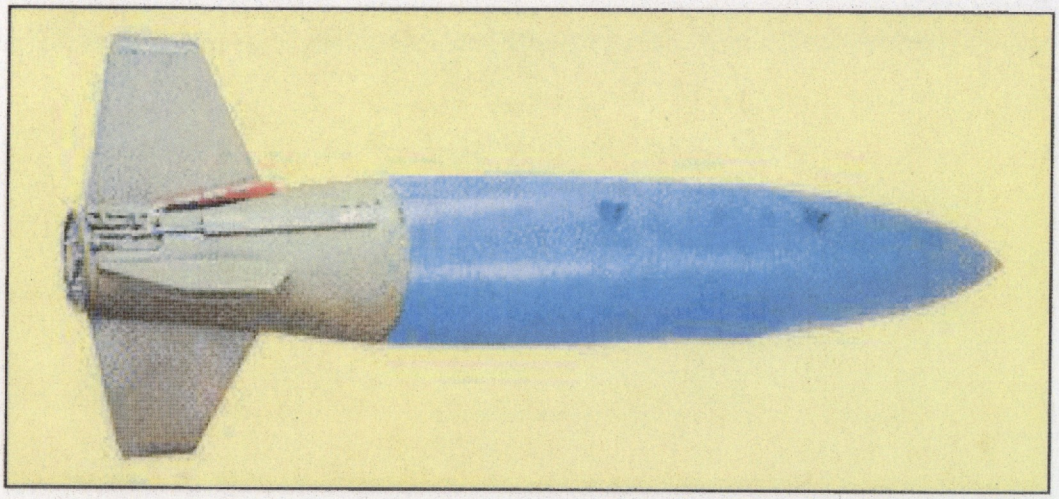
Bomb Practice Mk-84

Frag-F: Observed at Area E

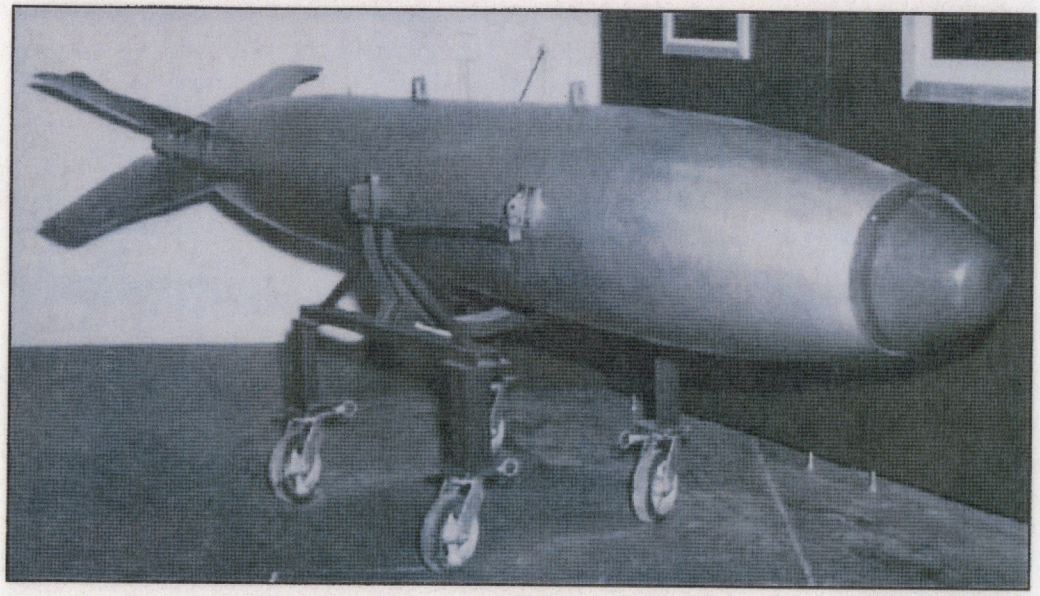


The Mark 84 concrete or sand-filled practice bombs are used to train pilots in delivery techniques. These bombs normally do not contain any explosive filler or spotting charge. Explosive-loaded practice bombs have been found; therefore, all Mark 84 concrete and sand-filled bombs should be treated as suspect. These bombs may contain live internal fuzes with boosters, live external fuzes and adapter-boosters, or a spotting charge adapter with a signal cartridge installed. They are all designed to function on impact, producing blast and fragmentation or a puff of white smoke.

The Mark 84 bombs are painted blue or olive drab, with white or black markings. Bombs fitted with a signal charge will have a brown or yellow band no wider than 76 millimeters (3.00 inches) circumscribed near the nose of the bomb. However, explosive-loaded practice bombs may be found without markings or color band indicating the explosive content.

Bomb Practice Nuclear Mark-12

Frag-G: Observed at Area E



Mark-12-P Practice Nuclear Bomb. High-speed fighter-bomber weapon; 92-point implosion weapon; nicknamed "Brok"; first weapon using beryllium tamper; 4 versions stockpiled – 2 prototypes, 2 mods. 12-14 Kt yield, manufactured 12/54 and retired 7/62, only 250 produced. Practice Bomb has no hazardous parts and is concrete filled.

APPENDIX B

SAMPLE PLAN ALTERATION FORMS

SAMPLE PLAN ALTERATION FORM

Project Name and Number: Boardman AFR FUDS PA/SI 12644.001.002.0110.27

Media to be sampled: Groundwater

Measurement Parameter: Perchlorate and NBEC

Standard Operating Procedure for Field collection and Laboratory Analysis Method or SOP (cite references):

Methods 314.0 and 8321A-mod

Reason for change in Field Procedure, Analytical Variance, or Modification to Accepted SQAP:

Groundwater samples were not collected from the following wells for the following reasons:

- Akers Domestic well: Access Denied
- Port of Morrow Well: MW 13S: well was dry.
- Port of Morrow Well: MW 12S: well was dry.
- Port of Morrow Well: MW 16S: well was dry.
- Coyote Springs 2 Well: CSMW-5: Access Issues
- Three-Mile Canyon Farms: RDOC-3/SU-2: Access Issues – located in middle of crop circle.
- Three-Mile Canyon Farms: SU-4 (SUU A): well was dry.
- Portland General Electric: well was dry.

Groundwater samples were added based on additional information provided by property operators during the field sampling effort.

- PGE Monitoring Well: 107
- PGE Monitoring Well: 104
- PGE Monitoring Well: 008
- PGE Monitoring Well: 120

Variance from Field or Analytical Procedure:

No variance

Special Equipment, Materials, or Personnel Required:

None.

Initiators Name: _____ Date: 9/23/04

Project Approval: _____ Date: 9/23/04

QA Officer/Reviewer: _____ Date: 09/23/04

APPENDIX C

CORRECTED AND UNCORRECTED GPS COORDINATES

Appendix C—Corrected and Uncorrected GPS Coordinates
Boardman AFR FUDS PA/SI
Boardman, Oregon

Station ID	EPA Regional Tracking Number	Notes	GPS File Name	Station Coordinates	
				Latitude	Longitude
GW-DW001	04264350	Poe Residence	m062117a	45.8145548	-119.78207147
GW-DW003	04264351	Suter Residence	m062117b	45.81019668	-119.76966408
GW-MW015	04264352	Coyote Springs Monitoring Well: CSMW-10	m062121a	45.84858786	-119.67520799
GW-MW013	04264353	Coyote Springs Monitoring Well: CSMW-8	m062121b	45.84763319	-119.67386011
GW-MW012	04264354	Coyote Springs Monitoring Well: CSMW-7	m062123a4	45.84758048	-119.67335528
GW-MW014	04264355	Coyote Springs Monitoring Well: CSMW-9	m062200a	45.84769828	-119.672649
GW-MW011	04264356	Coyote Springs Monitoring Well: CSMW-6	m062201a	45.84728019	-119.6724693
GW-MW006	04264357	Port of Morrow Monitoring Well: MW-15s	m062215a	45.80652623	-119.62401322
GW-MW005	04264358	Port of Morrow Monitoring Well: MW-15	m062215a	45.80652623	-119.62401322
GW-MW007	04264359	Port of Morrow Monitoring Well: MW-16	m062217a	45.80645736	-119.65119916
GW-MW009	04264360	Port of Morrow Monitoring Well: MW-17	m062219a	45.80640331	-119.67409326
GW-MW003	04264361	Port of Morrow Monitoring Well: MW-12	m062220a	45.81700849	-119.68197273
GW-MW001	04264362	Port of Morrow Monitoring Well: MW-13	m062221a	45.82026119	-119.66434385
GW-MW002	04264363	Port of Morrow Monitoring Well: MW-14	m062222a	45.82060531	-119.64496799
GW-DW002	04264364	Galloway Residence	m062300a	45.81904989	-119.72340959
SS-PS003	04264365	Area C Surface Soil	m062315a	45.78544572	-119.82169356
SB-PS003	04264366	Area C Subsurface Soil	m062315a	45.78544572	-119.82169356
SS-PS005	04264367	Area C Surface Soil	m062315b	45.78521392	-119.82199102
SB-PS005	04264368	Area C Subsurface Soil	m062315b	45.78521392	-119.82199102
GW-DS003	04264369	PGE Drinking Water Well	m062503a	45.69779149	-119.8133532
SS-PS001	04264370	Area E Surface Soil	m062318a	45.74089612	-119.75523445
SB-PS001	04264371	Area E Subsurface Soil	m062318a	45.74089612	-119.75523445
SS-PS002	04264372	Area E Surface Soil	m062319a	45.74020249	-119.75763778
SB-PS002	04264373	Area E Subsurface Soil	m062319a	45.74020249	-119.75763778
GW-MW020	04264374	Three-Mile Canyon Farms Monitoring Well: SU-1	m062321a	45.72963043	-119.88682701
GW-MW017	04264376	Three-Mile Canyon Farms Monitoring Well: SU-3	m062323a	45.74328888	-119.88038341
GW-MW016	04264377	Three-Mile Canyon Farms Monitoring Well: RDOU-1	m062400a	45.78400273	-119.87706325
SW-CR001	04264378	Carty Reservoir Surface Water	m062414a	45.69178735	-119.80896258
GW-MW022	04264379	PGE Monitoring Well: 107	m062416a	45.70436543	-119.87138149
GW-MW023	04264380	PGE Monitoring Well: 104	m062417a	45.719482	-119.83362691
GW-MW024	04264381	PGE Monitoring Well: 008	m062418a	45.69442747	-119.82488883
GW-MW025	04264382	PGE Monitoring Well: 120	m062419a	45.67573771	-119.78527884
SD-BK001	04264383	Bankground Sediment	m062420a	45.62867616	-119.81101485
SS-BK001	04264384	Background Soil	m062420b	45.62851318	-119.8115427
GW-DS001	04264385	Port of Morrow Airport Well	m062422a	45.81521617	-119.80062214
GW-DS002	04264386	Port of Morrow Airport Irrigation Well	m062422b	45.81417485	-119.81127487
SW-SC001	04264387	Sixmile Canyon Creek Surface Water	m062422c	45.7958397	-119.86723801
SW-SC002	04264388	Sixmile Canyon Creek Surface Water	m062500b	45.7684793	-119.8522496
SD-SC002	04264389	Sixmile Canyon Creek Sediment	m062502a	45.74643752	-119.84875865
SW-SC004	04264390	Sixmile Canyon Creek Surface Water	m062502b	45.72526159	-119.85880924
SW-SC005	04264391	Sixmile Canyon Creek Surface Water	m062502c	45.70868516	-119.86812954
SW-SC006	04264392	Sixmile Canyon Creek Surface Water	m062503a	45.69779149	-119.8133532

Fact Sheet – FAQ *Updated* Oct. 2004

Perchlorate in the Lower Umatilla Basin Groundwater Management Area - Issues and Answers

State of Oregon
Department of Environmental Quality

Water Quality Division
Eastern Region
700 SE Emigrant Suite 330
Pendleton, OR 97801
Phone: (541) 278-4604
(800) 452-4011
Contact: Phil Richerson, Water Quality Division;
www.deq.state.or.us

Background
During the early 1990's, the Lower Umatilla Basin was identified as an area of elevated nitrate in groundwater. During spring 2004, DEQ and EPA conducted initial testing for perchlorate in addition to routine nitrate testing. Low concentrations of perchlorate were detected in over half of the water wells tested. In most of the wells that had perchlorate the concentration was below 4 parts per billion (ppb) a commonly used public health goal. Some wells, however, were above that level.

EPA and DEQ have completed some additional, limited investigations to help identify the potential source(s) of the perchlorate and to identify how widespread it is. A more complete investigation is planned for November or December 2004.

What is perchlorate?
Perchlorate is a form of salt. It can be a naturally occurring substance in the environment, or it can be manufactured for industrial use. Ammonium perchlorate and sodium perchlorate are examples of manufactured perchlorate salts. Perchlorate salts are used primarily as oxidizers in solid rocket fuel, missiles, and some explosive compositions. Less common uses of perchlorate include highway safety flares, fireworks, matches, some dyes, lubricating oils, electroplating and medical supplies.

Perchlorate can occur naturally in some mineral formations such as Chilean nitrates. Chilean nitrates have been used as a component in some fertilizers. Perchlorate easily dissolves in water and so can be carried into lakes and ponds, streams and rivers, and can migrate into the groundwater from overlying soils.

Is perchlorate a health risk?
Perchlorate disrupts iodine uptake in the thyroid gland and can interfere with thyroid hormone production. Due to possible adverse health effects, people should avoid using water containing perchlorate for drinking and cooking. Pregnant women, children, infants and individuals with thyroid disorders are considered to be the populations most sensitive to the effects of perchlorate.

At what level is perchlorate safe in drinking water?
There currently is no federal or Oregon drinking water standard for perchlorate. EPA Region 10 recommends those people whose drinking water contains greater than 4 parts per billion (ppb) of perchlorate seek suitable treatment or alternative sources of drinking water. An EPA draft health assessment of perchlorate is under review by the National Academy of Sciences (NAS) and could lead to even lower concentrations (1 ppb) as levels of concern. The NAS review is expected to be completed later this year. Texas uses an interim action level of 4 ppb. California recently set a public health goal of 6 ppb perchlorate. Advisory levels for perchlorate in other states are: Arizona, 14 ppb; Nevada, 18 ppb; New York, 5 to 18 ppb; Texas, 4 to 10 ppb; Massachusetts, 1 ppb; Maryland, 1 ppb; and New Mexico, 1 ppb.

Why am I hearing about perchlorate now?
The Lower Umatilla Basin Groundwater Management Area (GWMA) – a portion of northern Morrow and northwestern Umatilla Counties (including the Hermiston and Boardman areas) was established in 1990 as a result of demonstrated area wide nitrate contamination. The Oregon DEQ, with assistance from EPA, recently conducted a regional groundwater sampling event. The event was a repeat of sampling done in 1992 to characterize regional groundwater quality. This repeat sampling was intended to help identify changes in nitrate concentration since the establishment of the GWMA. Perchlorate was added to the analysis because it had been detected in some wells in the area. This sampling event found perchlorate in over half of the 133 wells sampled. In addition, DEQ and EPA have been testing for perchlorate in soils, ground water, and surface water in several smaller assessments in the area. These smaller

Last Updated: 10/1/04
By: Phil Richerson
DEQ 04-ER-011a

assessments have also shown perchlorate in about half the wells sampled.

To date, of all the wells where perchlorate has been detected, concentrations have ranged from 1 ppb to 25 ppb. The wells tested have included monitoring wells, irrigation wells, domestic (household water) wells, a community well, and a livestock well.

What is the extent of the affected area?
The sampling events that have been conducted to date were not designed to delineate the full extent of perchlorate occurrence. Rather, perchlorate was added to the area-wide GWMA analysis as a first screen to determine if perchlorate was generally present in the GWMA. The answer to that question appears to be yes. The other analyses have been more limited in geographic scope. In order to determine the appropriate next steps, DEQ is currently working with EPA and consulting with the Oregon Department of Health and Human Services (DHS) and the Agency for Toxic Substances and Disease Registry (ATSDR) to design additional monitoring studies to better define the extent of the contamination and identify possible sources.

How do I know if my well water contains perchlorate?
The only way to know if perchlorate is present is to have a sample of water from the well tested specifically for perchlorate. If your well was tested as part of the sampling event conducted by DEQ/EPA you should have received results of that testing (You would have signed an authorization form prior to the sample being taken. If you did not sign such a form your well was not tested by DEQ/EPA).

If your well was not included in the sampling event and you would like to have your water tested, you may contact private testing laboratories. Before you pay a lab to test for perchlorate, ask the lab if they can detect perchlorate and at what level. They should be able to reliably report values to below 4 ppb (4 parts per billion or 4 micrograms per liter). Specify that EPA Drinking Water Method 314.0 and all associated quality assurance procedures be used.

Three labs in Oregon are approved by the EPA to conduct perchlorate tests for public drinking water systems:

Analytical Consulting Lab.
245 S. Grape St.
Medford, OR, 97501,
(541) 770-5678

Umpqua Research Company
626 NE Division St.
Myrtle Creek, OR, 97457
541-863-2680

CH2M Hill Applied Sciences Lab.
2300 NW Walnut Blvd.
Corvallis, OR
541-752-4271

The cost of a test is $60-$90. For a complete EPA list of labs that have passed performance evaluations, visit http://www.epa.gov/safewater/standard/ucmr/aprvlabs.html#percanchor

What should I do if my well water contains perchlorate?
If perchlorate has been detected in your well, or in nearby wells, you may want to consider appropriate treatment or an alternate source of water for drinking and cooking.

Can perchlorate be removed from my drinking water? Yes, but before choosing a treatment option, consult with the various manufacturers and consider re-testing for perchlorate and for general water chemistry. This testing will confirm whether there is a need for treatment and help select a better treatment system.

Two types of treatment systems are currently used to treat perchlorate in water at the levels found in this geographic area: anion exchange resins and reverse osmosis systems. Information on the full range of treatment systems for perchlorate is available at: http://www.clu-in.org/contaminantfocus/default.focus/sec/perchlorate/cat/Treatment_Technologies/

In the reverse osmosis treatment method, water is forced through a semi-permeable polymer membrane, leaving behind dissolved salts that are unable to penetrate the membrane. The concentrate contains all rejected dissolved matter, including the perchlorate. Reverse osmosis treatment systems used for removal of perchlorate in water should be certified under the National Sanitation Foundation/American National Standards Institute (NSF/ANSI) Standard 58: Reverse Osmosis Drinking Water Treatment Systems. Information on these systems is available at: http://www.nsf.org/consumer/drinking_water/perchlorate_reduction.asp?program=WaterTre

The National Sanitation Foundation website (www.nsf.org) provides a list of reverse osmosis units that have been independently verified to reduce perchlorate.

With the anion exchange resin technique, perchlorate is replaced by an innocuous anion, usually chloride in the water. Different types of resins can be targeted specifically for the removal of perchlorate and nitrates from water. General water chemistry is useful to know, as other common ions present in water, such as sulfate, may affect the longevity of the resins. Information on this treatment method is available at:
http://purolite.biz/POU_POE_Perchlorate_Removal.pdf

What effect can perchlorate have on agriculture?
The effect on irrigated agriculture is still being studied. More research is needed.

Next steps
Initially, DEQ and EPA will be conducting additional sampling to confirm the results obtained so far, to investigate the extent of the affected area, and to identify potential sources of the perchlorate. The EPA and DEQ will be expanding our investigation of the distribution of perchlorate. In addition to the original investigation of perchlorate in the Lower Umatilla Groundwater Management Area, EPA has completed a preliminary assessment/site inspection of the Boardman Air Force Range Formerly Used Defense Site. Additional investigations are being planned within Umatilla and Morrow Counties later this fall.

As investigation into the regional groundwater progresses, DEQ will distribute additional information as it becomes available. This will allow people in the affected area to make informed decisions about their source of drinking water.

All well water users are encouraged to regularly test their own water for the presence of potential contaminants including, but not limited to, nitrate and perchlorate.

Where can I go to get more information?
For more information visit the perchlorate page on DEQ's web site at
http://www.deq.state.or.us/er/perchloratesites.htm
Updates to this fact sheet and other information related to perchlorate will be posted at that site as it becomes available.
For general information on drinking water in the Lower Umatilla Basin, visit the Oregon Department of Health and Human Services web site at:
http://www.dhs.state.or.us/publichealth/dwp/; or contact:

Gary Burnett
Oregon Department of Health and Human Services
700 SE Emigrant, Suite 240
Pendleton, OR 97801
(541) 276-8006 x352
Gary.F.Burnett@state.or.us

For information on DEQ investigations and sampling, contact:

John Dadoly
Oregon Department of Environmental Quality,
700 SE Emigrant, Suite 330, Pendleton, OR, 97801
(541) 278-4616
dadoly.john@deq.state.or.us

For more technical information on perchlorate occurrence and treatment, visit http://www.clu-in.org/contaminantfocus/default.focus/sec/perchlorate/cat/Overview/; or contact:

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EPA, Region 10
811 SW 6th Ave.
Portland, OR, 97204
(503) 326-3689
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Additional information can also be found at:
http://www.cfsan.fda.gov/~dms/clo4qa.html