



U.S. Army
Corps of Engineers
Omaha District



FINAL SITE INSPECTION REPORT

Central Oregon Gunnery Range

Lake County, OR

FUDS Property No. F10OR0170

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

Contract No. W912DY-04-D-0010
Delivery Order No. 003

September 2007



Shaw Environmental, Inc.
7604 Technology Way, Suite 300
Denver, CO 80237

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as official department of the Army position, policy, or decision, unless so designated by other documentation.

FINAL

SITE INSPECTION REPORT
Central Oregon Gunnery Range
FUDS Property No. F10OR0170

Formerly Used Defense Sites
Military Munitions Response Program

September 2007

Submitted to:

U.S. Department of the Army
U.S. Army Corps of Engineers, Omaha District

Prepared by:

Shaw Environmental, Inc.
7604 Technology Way, Suite 300
Denver, Colorado 80237

Contract No. W912DY-04-D-0010
Delivery Order No. 003

Prepared/Reviewed by:

Shaw Technical Lead:	Dale Landon
Shaw Project Chemist:	Tim Roth
Shaw Quality Control:	Paul Sadowski
Shaw Project Manager:	Peter Kelsall

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

Table of Contents

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

Table of Contents (Cont.)

	3.2.5	Rights of Entry.....	3-4
	3.3	Field Work	3-4
	3.4	Sampling and Analysis	3-5
	3.5	Laboratory Analysis and Data Quality Review.....	3-5
	3.6	Screening Values	3-6
	3.6.1	Background Data.....	3-6
	3.6.2	Human Health Screening	3-7
	3.6.3	Ecological Screening	3-7
	3.7	Variances from the SSWP	3-7
	3.8	Second TPP Meeting.....	3-7
4.0		Air to Air Gunnery Range	4-1
	4.1	History and Land Use	4-1
	4.2	Previous Investigations.....	4-1
	4.3	MEC Evaluation.....	4-1
	4.3.1	Field Observations and Historical Evidence of MEC	4-1
	4.3.2	MEC Risk Assessment.....	4-2
	4.4	Munitions Constituents Evaluation.....	4-2
	4.4.1	Terrestrial Pathway.....	4-2
	4.4.1.1	Comparison to Background Data	4-3
	4.4.1.2	Comparison to Human Health Screening Values	4-3
	4.4.1.3	Comparison to Ecological Screening Values.....	4-4
	4.4.2	Surface Water Pathway.....	4-4
	4.4.2.1	Comparison to Background.....	4-4
	4.4.2.2	Comparison to Human Health Screening Values	4-4
	4.4.2.3	Comparison to Ecological Screening Values.....	4-4
	4.4.3	Groundwater Pathway.....	4-5
	4.4.3.1	Comparison to Background.....	4-5
	4.4.4	Air Pathway	4-5
5.0		Summary and Conclusions	5-1
	5.1	Air to Air Gunnery Range	5-1
6.0		Recommendations	6-1
	6.1	Air to Air Gunnery Range	6-1
	6.2	Removal Actions.....	6-1
	6.3	Munitions Response Sites	6-1
7.0		References	7-1

List of Figures

Figure 1-1	Site Location Map
Figure 1-2	Original Site Layout
Figure 2-1	Current Aerial Photograph
Figure 2-2A	Parcel Map
Figure 2-2B	Parcel Map – Target Sites
Figure 2-3	Current Site Layout Topographic Map
Figure 2-4	Census Data within 4-Mile Radius
Figure 2-5	Sensitive Receptor Locations
Figure 2-6	Regional Surface Water Drainage
Figure 2-7	Groundwater Well Locations within a 4-Mile Radius of the FUDS Property
Figure 3-1	Site Inspection Areas of Concern
Figure 3-2	Sediment and Groundwater Background Sample Locations
Figure 3-3	Soil Background Sample Locations
Figure 4-1	Target Sites Reconnaissance
Figure 4-2	Metals Results, Target Sites
Figure 4-3	Explosive and Perchlorate Results, Target Sites
Figure 6-1	Munitions Response Site

List of Tables

Table 2-1	Munitions Information
Table 2-2	Army Checklist for Important Ecological Places
Table 3-1	Summary of Central Oregon Gunnery Range Background Values
Table 3-2	Human Health Screening Criteria for Soil/Sediment and Groundwater for Central Oregon Gunnery Range
Table 3-3	Ecological Soil and Sediment Screening Values for Central Oregon Gunnery Range
Table 4-1A	Comparison of South Target Area Soil Detected Analytical Results to Site Background, Human Health, and Ecological Screening Values
Table 4-1B	Comparison of North Target Area Soil Detected Analytical Results to Site Background, Human Health, and Ecological Screening Values
Table 4-2	Comparison of Sediment Detected Analytical Results to Site Background, Human Health, and Ecological Screening Values

List of Appendices

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

List of Acronyms

°F	degrees Fahrenheit
ADR	Automated Data Review
AOC	area of concern
ARC	Defense Environmental Programs Annual Report to Congress Fiscal Year 2006
ASR	Archives Search Report
BLM	Bureau of Land Management
CA	California
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COGR	Central Oregon Gunnery Range
CSM	conceptual site model
DERP	Defense Environmental Restoration Program
DMM	discarded military munitions
DoD	Department of Defense
DOI	Department of the Interior
DQO	data quality objective
EDR	Environmental Data Resources, Inc.
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESV	Ecological Screening Value
FR	Federal Register
ft	foot or feet
FUDS	Formerly Used Defense Sites
GPS	Global Positioning System
HRS	Hazard Ranking System
HTRW	hazardous, toxic, or radioactive wastes
IEP	Important Ecological Places
INPR	Inventory Project Report
MC	munitions constituents
MEC	munitions and explosives of concern
µg/L	microgram(s) per liter
mg/kg	milligram(s) per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAI	No Department of Defense Action Indicated

List of Acronyms (cont.)

NWO	Northwest Region (Omaha District Military Munitions Design Center)
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OR	Oregon
RAC	Risk Assessment Code
RI/FS	remedial investigation/feasibility study
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SOPs	Standard Operating Procedures
SSWP	Site-Specific Work Plan
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USC	United States Code
USGS	United States Geological Society
UTL	Upper Tolerance Limit
UTM	Universal Transverse Mercator
UXO	unexploded ordnance

Glossary of Terms

Comprehensive Environmental Response, Compensation, and Liability Act of 1980

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

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

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

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

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

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

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

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

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

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

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

Munitions Response Area (MRA) – Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples are former ranges and munitions burial areas. An MRA comprises one or more munitions response sites (32 CFR§179.3).

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

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

Range – A designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. The term includes firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas. The term also includes airspace areas designated for

military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration (10 USC 101(e)(1)(A) and (B)).

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

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

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

1 *Executive Summary*

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

10 *SI Objectives and Scope*

11 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further
12 response action under the Comprehensive Environmental Response, Compensation, and Liability
13 Act. The SI collects the minimum amount of information necessary to make this determination,
14 as well as it (i) determines the potential need for a removal action; (ii) collects or develops
15 additional data, as appropriate, for Hazard Ranking System scoring by the Environmental
16 Protection Agency; and (iii) collects data, as appropriate, to characterize the release for effective
17 and rapid initiation of the Remedial Investigation and Feasibility Study. An additional objective
18 of the MMRP SI is to collect the additional data necessary to complete the Munitions Response
19 Site Prioritization Protocol (MRSPP).

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

24 *Central Oregon Gunnery Range*

25 This report presents the results of an SI conducted at Central Oregon Gunnery Range (COGR),
26 FUDS property number F10OR0170, located approximately 50 miles north of Lakeview, Oregon
27 (OR) in Lake County, OR. COGR was commissioned in 1942 and was used primarily for air-to-
28 air and air-to-ground gunnery training. COGR was declared excess in June 1947 and transferred
29 to the Department of the Interior. The property has been since sold to the State Of Oregon and
30 private parties.

31 *Technical Project Planning*

32 The approach for the SI was developed by Shaw in consultation with site stakeholders. A
33 Technical Project Planning meeting conducted in July 2006 was attended by representatives from
34 the USACE - Seattle District, Oregon Department of Environmental Quality (ODEQ), Bureau of
35 Land Management (BLM) – Lakeview office, and Shaw. A representative from the USACE –

36 Omaha District was unable to attend this meeting. The stakeholders agreed to the approach and
37 identified one area of concern (AOC), the former Air to Air Gunnery Range. The AOC includes
38 the entire 795,057-acre FUDS, which includes the air-to-ground target sites.

39 *SI Field Activities*

40 SI field activities, conducted in February 2007, included a site reconnaissance to verify the site
41 conceptual site model. Samples were collected from surface soil, sediment, and groundwater.
42 Surface water was not present so proposed surface water samples were not collected.

43 *SI Recommendations*

44 Results of the SI provide the basis for conclusions and/or recommendations for further actions at
45 the Air to Air Gunnery Range AOC.

46 *Air to-Air Gunnery Range*

47 Based on historical evidence and results from the SI field activities, there are reports of scattered
48 occurrences of practice bombs within the COGR FUDS. However, no bomb target areas have
49 been reported or identified. The bombing may have been unregulated. MEC was identified in
50 1988 in the Christmas Valley area west of the COGR FUDS boundary. The SI currently being
51 conducted for the Northwest Maneuver Area FUDS will address this MEC occurrence.

52 Sample results indicated that all metals concentrations were below background concentrations.
53 The explosive nitrobenzene was detected in several samples at low concentrations below the
54 human health and ecological screening values. Based on the low risk for MEC and no MC
55 hazards, a recommendation for No Department of Defense Action Indicated (NDAI) is made for
56 the Air to Air Gunnery Range.

57 *Removal Actions*

58 There is no indication that a high MEC risk is present at COGR. No MEC was identified during
59 the SI or ASR field activities. There have only been reports of scattered occurrences of practice
60 bombs in the 795,057-acre site. A removal action is not recommended.

61 A recommendation is made that the area of the MRS in the MMRP Inventory should be
62 corrected to 795,057 acres. The MMRP Inventory incorrectly lists the area as 795.06 acres.

63 **1.0 Introduction**

64 This Site Inspection (SI) Report presents the results of an SI conducted at the Central Oregon
65 Gunnery Range (COGR) Formerly Used Defense Site (FUDS) located near Lakeview, Oregon
66 (OR). Shaw Environmental, Inc. (Shaw) has prepared this report for the U.S. Army Corps of
67 Engineers (USACE) in accordance with Task Order 003, issued under USACE Contract No.
68 W912DY-04-D-0010. Shaw is responsible for conducting SIs at FUDS in the northwest region
69 managed by the Omaha District Military Munitions Design Center (NWO) as directed by the
70 Performance Work Statement (Appendix A).

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

74 **1.1 Project Authorization**

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

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

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

92 **1.2 Site Name and Location**

93 COGR, property number F10OR0170, is located approximately 50 miles north of Lakeview, OR,
94 in Lake County (Figure 1-1). The COGR is included in the MMRP Inventory in the *Defense*
95 *Environmental Programs Annual Report to Congress (ARC) Fiscal Year 2006* (DoD, 2006) and

96 in the *Archives Search Report (ASR) Supplement* (USACE, 2004b), with one identified range as
97 follows:

Range Name	Range ID	Approximate Area (acres)	UTM Coordinates (meters)
Air to Air Gunnery Range	F10OR017001R01	795.06	N 4770451.8; E 720685.2

98 Coordinates for the ranges are in Universal Transverse Mercator (UTM), Zone 10N, NAD83.

99 Note that the acreage shown on the ARC (DoD, 2006) and a table in the ASR Supplement
100 (USACE, 2004b) are not correct due to an apparent typographical error. Figures in the ARC and
101 ASR Supplement are consistent with the following text from the ASR Supplement:

102 The range area is delineated as being the entire site property. The 795,057-acre range
103 was calculated based on the fact that the entire site could have been used for air-to-air
104 gunnery training.

105 The correct area should be 795,057 acres. Figure 1-2 shows the original site layout.

106 *1.3 Purpose, Scope, and Objectives of the Site Inspection*

107 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further
108 response action under CERCLA or not. The SI collects the minimum amount of information
109 necessary to make this determination, as well as it (i) determines the potential need for a removal
110 action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System
111 (HRS) scoring by Environmental Protection Agency (EPA); and (iii) collects data, as
112 appropriate, to characterize the release for effective and rapid initiation of the Remedial
113 Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to
114 collect the additional data necessary to complete the Munitions Response Site Prioritization
115 Protocol (MRSPP).

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

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

- 125 • There is no indication of MEC;
- 126 and

127 • MC contamination does not exceed screening levels determined from Technical
128 Project Planning (TPP).

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

130 • There is evidence of MEC hazard. MEC hazard may be indicated by direct
131 observation of MEC during the SI, by indirect evidence (e.g., a false crater
132 potentially caused by impact of unexploded ordnance [UXO]), or by a report of
133 MEC being found in the past without record that the area was subsequently
134 cleared;
135 or

136 • MC contamination exceeds screening levels determined from TPP.

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

138 • High MEC hazard is identified. Shaw will immediately report any MEC findings
139 so that USACE can determine the hazard in accordance with the MRSPP. An
140 example of a high hazard would be finding sensitive MEC at the surface in a
141 populated area with no barriers to restrict access;
142 or

143 • Elevated MC risk is identified. Identification of a complete exposure pathway
144 (e.g., confirming MC concentrations above health-based risk standards in a water
145 supply well) would trigger notification of affected stakeholders. Data would be
146 presented at a second TPP meeting regarding the possible need for a removal
147 action.

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

152 ***1.4 Munitions Response Site Prioritization Protocol***

153 The MRSPP was published as a rule on October 5, 2005 (70 FR 58028). This rule implements
154 the requirement established in section 311(b) of the National Defense Authorization Act for
155 Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each
156 location in the DoD's inventory of defense sites known or suspected of containing UXO,
157 discarded military munitions, or MC (70 FR 58016).

158 Draft MRSPP scoring sheets for the munitions response sites (MRSs) identified in this SI Report
159 are included in Appendix K. The MRSPP scoring will be updated on an annual basis to
160 incorporate new information.

161 *2.0 Property Description and History*

162 The setting, history, and use of COGR are described in the following sections. Unless otherwise
163 referenced, this information is taken from the ASR (USACE, 1995).

164 *2.1 Historical Military Use*

165 COGR (Figure 2-1) was used primarily for air-to-air and air-to-ground gunnery training. Air-to-
166 air gunnery training used towed targets; however, no remnants of these targets have been
167 reported.

168 Two air-to-ground target sites are located on the eastern border of the FUDS near Alkali Lake
169 (Figure 2-1). Rounds of .50-caliber and 20 millimeter (mm) ammunition have been found in
170 both target sites. The southern target site is a circular mound, approximately 15 feet (ft) high,
171 and covering an area of approximately 10 acres. The ASR identified the remnants of seven
172 wood structures, presumably targets, which were located on the mound in an east-west line. The
173 layout seems to represent a convoy. These wooden structure remnants were not observed during
174 the SI field work. The northern target site is triangular in appearance, and situated on a naturally
175 occurring rise.

176 There is also evidence that COGR may have been used for practice bombing purposes. Scattered
177 occurrences of AN-MK 5, AN-MK 23, and AN-MK 43 practice bombs have been reported
178 throughout the FUDS by a Bureau of Land Management (BLM) archeologist. No bombing
179 target locations have been identified and the bombing practice possibly was unregulated.

180 It was reported that a portion of the FUDS near Alkali Lake was used for .50-caliber machine
181 gun training and firing at airborne targets. In addition, in 1943 a local newspaper, the Lake
182 County Examiner reported that rockets were fired from the same location. These activities may
183 have been associated with the Northwest Maneuvers conducted in 1943. The Northwest
184 Maneuvers Area is a separate, and significantly larger (8 million acres) FUDS project, that fully
185 encompasses the COGR.

186 The COGR was declared excess in June 1947 and transferred to the Department of the Interior
187 (DOI). Some of the property has since been sold to the State of Oregon or private parties

188 *2.2 Munitions Information*

189 The types of munitions used at COGR were .50-caliber machine gun and 20 mm ball M55A1,
190 MK1. As stated above, there is evidence that AN-MK 5, AN-MK 23, and AN-MK 43 practice
191 bombs were also used at COGR. No bombing targets have been identified. Table 2-1 contains a
192 list of the munitions and associated MC reportedly used at the FUDS.

193 **2.3 Ownership History**

194 Between 1942 and 1943, the Army acquired 737,000 acres of public domain land and 58,056.77
195 acres of lease lands for the former COGR, totaling 795,056.77 acres. In June 1947, the site was
196 declared excess. Public lands were retransferred in November 1947 and the leases cancelled in
197 January 1948.

198 Presently, the majority of the acreage comprising the former COGR is open public land
199 administered by the DOI and managed by the BLM. The remaining acreage is comprised of
200 some individual private holdings within the site boundaries. Figure 2-1 shows the current land
201 use from an aerial photograph perspective. Parcel ownership within the identified range areas is
202 shown on Figures 2-2A and 2-2B. Property ownership is identified by an index number, located
203 within a parcel rather than a name on the figures. The property owner name is available on
204 request from the USACE Seattle District office.

205 **2.4 Physical Setting**

206 **2.4.1 Topography and Vegetation**

207 The elevation of the area ranges from approximately 4,100 ft near Alkali Lake on the east
208 boundary to nearly 6,000 ft at St. Patrick Mountain to the west. The area is a relatively flat
209 region characterized by sand dunes and alkali lakes. Elevated features are predominantly
210 volcanic in origin. Figure 2-3 shows the topography of the COGR area.

211 **2.4.2 Land Use**

212 The former range is situated on 795,057 acres, and is currently used for agricultural purposes and
213 grazing on open range land. Current landowners include private citizens, the BLM, and the State
214 of Oregon. Access to the FUDS is uncontrolled. However, a small parcel of land, near and
215 including the two target sites, is fenced with barbed wire to control access to the Alkali Lake
216 Disposal Site.

217 The Alkali Lake Disposal Site is located adjacent to and south of the southern target site (Figure
218 2-2B). The site is a hazardous waste disposal site consisting of a series of 12 shallow unlined
219 disposal trenches each approximately 400 ft long. The site is owned by the State of Oregon.
220 Wastes disposed include herbicide residue, metallic chloride waste, paint and paint solvent, and
221 dioxins/furans. There is an approximately 2,000-ft-long groundwater plume (phenols, dioxins,
222 and 2,4-toluenediamine) extending to the west-northwest. The site is currently monitored by the
223 Oregon Department of Environmental Quality (ODEQ).

224 **2.4.3 Nearby Population**

225 The nearest incorporated community to the former COGR is Lakeview, OR, with an estimated
226 population of 2,474 (U.S. Census, 2000) (Figure 2-4). Lake County, OR, has a population of
227 7,422 with an average of 0.9 people per square mile (U.S. Census, 2000). There are no schools
228 located within 4 miles of the FUDS (Figure 2-5). Estimated population (2000 census) within a

229 4-mile radius of the COGR FUDS property boundary is 409. The estimated numbers of housing
230 units and households within a 4-mile radius are 277 and 177, respectively.

231 *2.4.4 Climate*

232 The climate in the area of the FUDS area is semi-arid. It is warm and dry in the summer and
233 cool and dry in the winter. The wettest months are generally January and December with the
234 driest months being July and August. The highest monthly average temperature is 84.2 degrees
235 Fahrenheit (°F) in July and the lowest monthly average temperature is 19.0°F in January.
236 Lakeview's average annual precipitation is 14.93 inches per year, with an average annual
237 snowfall of 57 inches.

238 *2.4.5 Area Water Supply*

239 The COGR is located within the Summer Lake and Lake Abert Watersheds. Because of the flat
240 topography, there is little developed stream drainage (Figure 2-6) and most precipitation collects
241 in shallow ponds and lakes that evaporate in the summer. Much of the water in the area lakes is
242 alkaline in chemistry, as a result of the high evaporative rates in the summer and low stream
243 inflows/outflows.

244 There are numerous private groundwater wells within the 795,057-acre COGR (Figure 2-7).
245 Most of the wells are used for irrigation purposes and are completed in deep aquifers. Several
246 shallow water-bearing zone groundwater monitoring wells are located near the target sites at
247 Alkali Lake Disposal Site.

248 *2.4.6 Geologic and Hydrogeologic Setting*

249 The COGR lies within the Walla Walla Plateaus section of the Columbia Intermontane
250 Physiographic Province.

251 *2.4.6.1 Bedrock Geology*

252 The bedrock of the area consists of late Cenozoic basalt flows that are interspersed with rhyolitic
253 and rhyolite volcanic structures. The bedrock forms a wide, high lava plateau. The area of the
254 FUDS is heavily faulted, with northwest trending faults with scarps that have been eroded but are
255 visible from the air. The faults are collectively named the Brothers Fault Zone. South of the
256 fault line the lava plateau is broken into large block faulted mountains and valleys, and north of
257 the fault line the lava plateau is mostly unbroken by faulting (Alt and Hyndman, 1990).

258 *2.4.6.2 Overburden Soils*

259 The surface, in the area of the FUDS, consists primarily of various rock outcroppings, most of
260 which are composed of basalt. Where present, the soils in the area are thin. The soils near the
261 target sites are primarily Playas soil type.

262 *2.4.6.3 Hydrogeology*

263 Depth to shallow groundwater near the target sites is approximately 6 ft, based on groundwater
264 monitoring studies at the Alkali Lake Disposal Site. The shallow groundwater is saline and

265 alkaline in chemistry. Depth to fresh water is much deeper (250 ft below ground surface), within
266 and below the basalt bedrock. Groundwater from the deeper fresh water artesian water-bearing
267 zone is thought to feed portions of the Hutton Springs located approximately 3,500 ft north of the
268 two target sites.

269 Some surface water to shallow groundwater communication is likely. However, an upward
270 groundwater flow gradient from the deep aquifer to the shallow water-bearing zone would
271 prevent the downward migration of any impacted surface water or shallow groundwater into
272 deeper water-bearing units with higher groundwater quality.

273 *2.4.7 Sensitive Environments*

274 The COGR is currently used for agricultural purposes and grazing on open range land. Located
275 approximately 3,500 ft north of the air-to-ground gunnery target is Hutton Springs (Figure 2-5),
276 which provides habitat for a federal and state threatened subspecies, the Hutton Tui Chub. In
277 addition the Western Snowy Plover, a state listed species, also uses the COGR. While the use of
278 the land for agricultural purposes and grazing would not qualify the area as a 'sensitive
279 environment,' the presence of this habitat within the FUDS qualifies this site as an Important
280 Ecological Place (IEP) or Sensitive Environment as defined by USACE (2006) or EPA (1997)
281 and shown in Table 2-2.

282 *2.5 Previous Investigations for MEC and MC*

283 There have been no previous investigations for MC performed at COGR. Previous MEC
284 evaluations are summarized in the following sections.

285 *2.5.1 Inventory Project Report*

286 In 1993, a DERP FUDS Inventory Project Report (INPR) was conducted for the COGR. The
287 findings determined that the site had been formerly used by the DoD and was therefore eligible
288 under the DERP program (USACE, 1993). A Risk Assessment Code (RAC) of 5 was assigned
289 to the COGR during the INPR.

290 *2.5.2 Archives Search Report*

291 The USACE completed an ASR in 1995, which compiled available information on the COGR.
292 The emphasis of the ASR was the types and areas of ordnance use and disposal at site. The ASR
293 included a visit to the site in August of 1995. The primary purpose of the site visit was to assess
294 the presence of MEC through non-intrusive means. Interviews, historical research, and site
295 reconnaissance confirmed that small and medium arms (.50-caliber and 20 mm) were used at the
296 FUDS (USACE, 1995). The ASR mentioned that practice bombing may have occurred at the
297 COGR but no additional information was provided. The focus of the ASR field visit was the two
298 target mounds identified in the INPR (USACE, 1993). At each of the two target sites, .50-caliber
299 rounds were found. No other munitions were found during the ASR site visit.

300 **2.5.3 ASR Supplement**

301 The USACE completed an ASR Supplement in 2004 that identified the entire FUDS as one
302 range. A RAC score of 4 was assigned to the range (USACE, 2004b).

303 **2.5.4 Other Investigations**

304 A letter sent from USACE to DOI in 1947 stated that “The lands had been examined and have
305 been cleared of all explosives or explosive objects reasonably possible to detect by visual
306 inspection” (USACE, 1995).

307 In 1988, the 34th Ordnance Detachment at the Sierra Army Depot, in Herlong, California,
308 disposed by detonation an AN-MK 43 practice bomb, near the town of Christmas Valley, OR.
309 This location is outside but near the COGR FUDS northwest boundary (approximately 2 miles).
310 However, the practice bomb may be related to the unregulated practice bombing that occurred at
311 COGR. MEC occurrences near COGR have been reported. These occurrences will be addressed
312 in the Northwest Maneuver Area FUDS SI currently being conducted.

313 **2.6 Other Land Uses that May Have Contributed to Contamination**

314 The Alkali Lake Disposal Site is located adjacent to and south of the southern target site (Figure
315 2-1). The site is a hazardous waste disposal site consisting of a series of 12 shallow unlined
316 disposal trenches each approximately 400 ft long. About 25,000 drums of pesticide
317 manufacturing wastes were disposed here in the late 1960s and early 1970s. Wastes disposed
318 include herbicide residue, metallic chloride waste, paint and paint solvent, and dioxins/furans.
319 There is an approximately 2,000-ft-long groundwater plume extending to the west-northwest.
320 The primary contaminants are phenols, dioxins, and 2,4-toluenediamine. The site is currently
321 monitored by the ODEQ (ODEQ, 2007).

322 **2.7 Past Regulatory Activities**

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

324 **2.8 Previous MEC Finds**

325 A .50-caliber ammunition belt was found in the northern portion of the FUDS in 1990. In 1988,
326 the 34th Ordnance Detachment at the Sierra Army Depot, in Herlong, California, disposed by
327 detonation an AN-MK 43 practice bomb, near the town of Christmas Valley, Oregon. This
328 location is outside but near the COGR FUDS northwest boundary. As noted above, the AN-MK-
329 43 practice bomb may have been related to practice bombing at COGR FUDS. Therefore, it will
330 be addressed in the Northwest Maneuver Area FUDS SI.

331 **3.0 SI Tasks and Findings**

332 SI tasks conducted for this FUDS property involved compiling and reviewing historical reports
333 and information, and using this information in the subsequent TPP and overall SI process.
334 Following the TPP meeting, the a *Site-Specific Work Plan (SSWP)* (Shaw, 2006c) was prepared
335 to define the SI field activities necessary to collect the information needed to address the data
336 gaps and data quality objectives (DQOs). Field work was conducted at the site the week of
337 February 13, 2007.

338 **3.1 Technical Project Planning**

339 TPP involved compiling and reviewing historical reports and information to identify data gaps
340 and develop a path forward. A TPP meeting for the former COGR was held at the BLM offices
341 in Lakeview, OR, on July 17, 2006. Representatives from the USACE – Seattle District, ODEQ,
342 BLM – Lakeview office, and Shaw were in attendance. A representative from the USACE –
343 Omaha District was unable to attend this meeting.

344 Shaw reviewed the site information and presented a summary of the site and the proposed
345 approach for the SI, addressing reconnaissance for MEC and sampling for MC. All parties were
346 in general agreement with the approach, but reserved judgment until the Draft TPP
347 Memorandum was issued. Specific discussions included:

348 **Types of MEC used at the Site:** The archeologist for BLM pointed out that scattered
349 occurrences of practice bombs had been identified throughout the range. An inert example was
350 shown to the meeting participants and the practice bomb appeared to be an AN-MK 23 or AN-
351 MK 43 type. The archeologist indicated that anecdotal accounts suggest that pilots would target
352 small playa lakes (ponds) within the range for unregulated bombing practice.

353 **Area of Concern (AOC):** Historical and physical evidence indicate that air-to-air and air-to-
354 ground gunnery practice and unregulated bombing practice occurred over much of 795,057-acre
355 FUDS property. Consequently, the entire FUDS is considered to be an AOC, consistent with the
356 ASR Supplement. However it was agreed during the TPP meeting that the SI field effort would
357 focus on the two target sites located near Alkali Lake where air-to-ground gunnery practice
358 occurred, because these specific locations (northern and southern target sites) were the most
359 likely to be affected by former munitions activity within the expansive AOC. Figure 3-1 shows
360 the single AOC and the two target sites.

361 The BLM archeologist discussed that he had walked most of FUDS and had found projectiles
362 and casings (mostly .50-caliber and very few 20 mm) throughout the FUDS. He also noted that
363 he had found a few discarded .50-caliber ammunition belts within the range. He has prepared
364 several archeological reports that include discussions of the density of munitions. Follow-up
365 discussions were held with the BLM archeologist. He stated that it appears that the Army pilots

366 would use the barren playa lakes as targets for practice bombing and strafing with .50-caliber
367 guns. These occurrences were scattered throughout the COGR area. Because collectors have
368 picked up munitions debris as souvenirs, fewer practice bombs are being discovered now than at
369 previous times. He has never seen munitions other than expended practice bombs or 20 mm and
370 .50-caliber bullets and casings.

371 ODEQ discussed the fact that the COGR lies within the Northwest Maneuver Area FUDS that
372 was used in 1943 by the U.S. Army. Several of the reported training areas within COGR (e.g.,
373 Alkali Lake machine gun and rocket firing, the sand dune area in the northern portion of the
374 COGR with UXO finds [AN-MK-43 practice bomb]) are likely from activity during the
375 Northwest Maneuver Area operations. It was agreed that those locations would not be included
376 in the COGR SI but would be addressed in the Northwest Maneuver Area FUDS SI project.

377 **Pathways:** ODEQ indicated that because of the arid environment and likely blowing dust and
378 sand problem, the air pathway should be addressed using the soil data.

379 **Background:** ODEQ indicated that a soil background study is currently being completed for the
380 south central and southeastern part of Oregon, and that that data would be made available for use
381 as background soil data. The data has been received from the ODEQ (from the *National*
382 *Geochemical Survey Database* [USGS, 2006]) and utilized in the SI Report.

383 **General Discussion:** A report was prepared by the Oregon National Guard in 1991 evaluating
384 the use of a portion of the COGR as a new practice bombing range for the Guard (no copy
385 available). In 1987, the Sierra Army Depot Explosive Ordnance Disposal (EOD) unit responded
386 to a UXO find in the northern portion of the COGR. USACE agreed to follow up with the Sierra
387 Army Depot to obtain the report. A copy of the report was provided to Shaw by USACE
388 following the TPP Meeting. The UXO disposed was an AN-MK 43 practice bomb and was
389 located off COGR FUDS property north of Christmas Valley. A copy of the disposal reported is
390 provided in Appendix L.

391 TPP Meeting results were documented in the *Final Technical Project Planning Memorandum*
392 (TPP Memorandum) (Shaw, 2006b), which was issued final on November 1, 2006, after
393 incorporating comments from the stakeholders. The proposed technical approach was defined in
394 the SSWP (Shaw, 2006c), which was issued final on December 19, 2006, after incorporating
395 comments from the stakeholders.

396 A more complete discussion of the TPP meeting is contained in Appendix B. As discussed
397 during the TPP meeting and documented in the TPP Memorandum (Shaw, 2006b), the following
398 project objectives and DQOs were developed.

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

401 DQO #1 – Utilizing trained UXO personnel and handheld magnetometers, a visual search of the
402 air-to-ground gunnery range will be conducted searching for physical evidence to indicate the
403 presence of MEC (ammunition belts, MEC on the surface, munitions debris, and soil
404 discoloration indicative of explosives). The visual search will consist of a meandering path
405 survey along trails and in accessible areas. The following decision rules will apply:

- 406 • The following reconnaissance results would support a recommendation for further action
407 with respect to MEC:
 - 408 • Direct evidence is found of the presence of MEC, other than incidental small and
409 medium arms rounds, or evidence of potential MEC that is inconsistent with the air-
410 to-ground gunnery range CSM (e.g., debris from munitions other than small and
411 medium arms).
 - 412 • Direct evidence of MEC is not found, but abundant munitions debris and/or magnetic
413 anomalies, other than from small or medium arms, are identified suggesting a
414 potential for the presence of unexploded spotting charges or other MEC.
- 415 • The following reconnaissance results would support a recommendation for NDAI with
416 respect to MEC:
 - 417 • Direct evidence of MEC is not found; isolated munitions debris and/or magnetic
418 anomalies consistent with either the air-to-air or the air-to-ground gunnery range
419 CSM are identified.
 - 420 • No evidence of MEC, munitions debris, or magnetic anomalies is identified.
- 421 • If there is indication of an imminent MEC hazard, the site may be recommended for a
422 removal action.

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

425 DQO#2 – Soil, sediment, surface water, and groundwater samples will be collected and analyzed
426 as proposed in Table 3 of the TPP Memorandum (Shaw, 2006b; Appendix B). Analytical results
427 will be compared to screening values for human health and ecological risk assessment, and to
428 background values for naturally occurring substances. The following decision rules will apply:

- 429 • If sample results are less than human health and ecological screening values (ESVs), the
430 site will be recommended for NDAI relative to MC.
- 431 • If sample results exceed both human health screening values and background values, the
432 site will be recommended for additional investigation.
- 433 • If sample results do not exceed human health screening values but do exceed both ESVs
434 and background values, additional evaluation of the data will be conducted in conjunction
435 with the stakeholders to determine if additional investigation is warranted.

436 **3.2 Additional Records Research**

437 **3.2.1 Coordination with State Historic Preservation Office**

438 The State Historic Preservation Office (SHPO) was contacted in order to determine if any areas
439 of cultural or archaeological significance have been identified in or in proximity to the AOCs at
440 this FUDS. According to the SHPO, no previous cultural resource surveys have been completed
441 near the project area. However, the SHPO recommended “extreme caution” during ground
442 disturbing activities because the project area is located in an area perceived to have a high
443 probability for possessing archaeological sites and/or buried human remains (OR SHPO, 2006).

444 **3.2.2 Coordination with Natural Resources Offices**

445 The Oregon Department of Fish and Wildlife (ODFW) was contacted to determine if there are
446 threatened or endangered species in the area that might be potentially impacted by field
447 inspection activities. According to the ODFW, the Hutton Tui Chub and Western Snowy Plover
448 are federally- and state-listed threatened species that occur in the area. However, based on
449 Shaw’s description of the work and time of year it will be conducted, the ODFW did not
450 anticipate any impact to these species (ODFW, 2006).

451 **3.2.3 Historical Aerial Photographs**

452 Limited historical photography is available for the COGR. The ASR reviewed aerial
453 photographs from 1954 and reported that no evidence of ordnance or munitions was identified
454 during the review of these aerial photos. Shaw was not able to obtain copies of the 1954 aerial
455 photographs. The two target sites are visible in recent (1994 and 2005) aerial photographs. The
456 available historical aerial photographs are provided in Appendix L.

457 **3.2.4 Environmental Database Search**

458 A search of available environmental records was conducted by Environmental Data Resources
459 Inc. (EDR) on June 8, 2006 (EDR, 2006). The government records search met the requirements
460 of ASTM Standard Practice for Environmental Site Assessments (ASTM, 2006). Search results
461 indicated the AOCs did not appear on mapped sites in known federal, state, or local ASTM or
462 ASTM Supplemental databases (Appendix L). Additional information on the databases searched
463 and the results for surrounding properties is included in the EDR report found in Appendix L.

464 **3.2.5 Rights of Entry**

465 Prior to mobilizing to the site, the Project Manager for the USACE Seattle District office
466 obtained the Right of Entry from the BLM, State of Oregon, and private landowners for the
467 property where the SI field activities were performed.

468 **3.3 Field Work**

469 SI field activities, conducted the week of February 13, 2007, included site reconnaissance,
470 collection of surface soil, sediment, and groundwater samples at the air-to-ground gunnery

471 targets. The following conditions were recorded in the field log book (Appendix D) and/or by
472 digital photographs (Appendix E):

- 473 • Presence or absence of evidence of MEC;
- 474 • Changes, if any, in sample location because of field constraints;
- 475 • Vegetative cover; and
- 476 • Presence or absence of water for sediment and surface water samples, and other
477 conditions encountered that impacted sample collection.

478 **3.4 *Sampling and Analysis***

479 Sampling included collection of surface soil, sediment, and groundwater samples. Samples were
480 collected and analyzed in accordance with the SSWP (Shaw, 2006a) using the standard operating
481 procedures (SOPs) from the *Type I Work Plan, Site Inspections at Multiple Sites, NWO Region*
482 (Shaw, 2006a).

483 **3.5 *Laboratory Analysis and Data Quality Review***

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

486 The data review process compares sample results to pre-established criteria referenced in the
487 Sampling and Analysis Plan, (Shaw, 2006a, Appendix E) to confirm that the data are of
488 acceptable technical quality. GPL provided Shaw with a Level 4 data package including
489 “Contract Laboratory Program (CLP)-Like” summary forms, Staged Electronic Data
490 Deliverables Stage 2b (version Draft 5.0), and Automated Data Review (ADR) compatible A1,
491 A2, and A3 files for all sample delivery groups. Shaw conducted a data assessment on all
492 samples collected in support of this SI. One hundred percent of the analytical data have been
493 reviewed based on EPA CLP *National Functional Guidelines for Organic Data Review* (EPA,
494 1999), and EPA CLP *National Functional Guidelines for Inorganic Data Review* (EPA, 2004).
495 ADR software (version 8.1) was used to assist in the data validation process for all areas with the
496 exception of initial calibration blanks, continuing calibration blanks, interference check
497 standards, serial dilutions, internal standards, and second-column confirmation, which were
498 reviewed manually. Data were evaluated against specific criteria to verify the achievement of all
499 precision, accuracy, representativeness, completeness, comparability, and sensitivity goals
500 established to meet the project DQOs.

501 The overall quality of the data collected is discussed in the Analytical Data QA/QC Report
502 (Appendix G). Results of the analyses as discussed in this evaluation are indicative of the media
503 analyzed with the exceptions of some perchlorate and explosive results. Perchlorate in one
504 sample (NWO-033-6002) was qualified as “J” estimated as a result of low continuing calibration
505 verification and acceptance criteria for isotope ratios. Nitrobenzene results in several samples
506 were qualified as “J” estimated as a result of confirmation column relative percent difference

507 exceeding acceptance criteria. Explosive analytes in several samples were qualified as “J”
508 estimated or “UJ” not detected with estimated detection limit because surrogate spike recoveries
509 were reported as outside QC criteria. No data were qualified “R” as unusable. Overall, the data
510 reflect expected site conditions and they are fully usable for their intended purpose.

511 *3.6 Screening Values*

512 The following subsections describe the development of screening values for this SI.

513 *3.6.1 Background Data*

514 Background sample locations are shown in Figures 3-2 and 3-3.

515 A soil background concentration data set for the COGR area was obtained from the United States
516 Geological Survey (USGS), National Geochemical Survey database
517 (<http://tin.er.usgs.gov/geochem/>) (USGS, 2006) and was used to calculate site background
518 concentrations. The data set is a compilation of soil samples collected by the USGS and others
519 from locations in the COGR vicinity. Background soil sample locations are shown on Figure 3-
520 3. Twenty-four samples were used in the calculations. The soil background locations were
521 selected from locations nearby to COGR that were similar in type to those present at the FUDS,
522 based on the information available in the database. Background sediment and groundwater
523 sampling locations are shown on Figure 3-2.

524 The background soil sample analytical results were used to calculate background metal soil
525 concentrations using published EPA Guidance (1989, 1992, 1994, 1995b, and 2006). The
526 background concentrations are either a 95th upper tolerance limit (UTL) for normally and
527 lognormally distributed analytes or the 95th percentile for nonparametric distributed analytes.
528 The background soil sample analytical results are provided in Appendix L. Table 3-1 lists the
529 soil and sediment metal background concentrations used in this report. A summary of the soil
530 background calculations is presented in Appendix L.

531 One background sediment sample (NWO-033-5001) was collected from the COGR vicinity
532 (Figure 3-2) and analyzed for metals. One background groundwater sample (NWO-033-6002)
533 was collected from an upgradient well and analyzed for perchlorate. The sediment and
534 groundwater analytical results are presented in Appendix G.

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

- 543 1. If the sample measurement is less than or equal to the sample quantitation limit, no
544 observed release is established.
- 545 2. If the sample measurement is greater than or equal to the sample quantitation limit,
546 then an observed release is established as follows:
- 547 • If the background concentration is not detected (or is less than the detection limit),
548 an observed release is established when the sample measurement equals or exceeds
549 the sample quantitation limit.
 - 550 • If the background concentration equals or exceeds the detection limit, an observed
551 release is established when the sample measurement is three times or more above
552 the background concentration.

553 In the discussions that follow in Section 4, these criteria are used to determine whether a release
554 of MC has occurred in sediment and groundwater regardless of whether the analyte is considered
555 a hazardous substance. However, these criteria are not applied for soils because a statistically
556 based determination of background has been established, and an exceedance of the 95th UTL or
557 95th percentile, depending on the individual analyte, is used to establish a release of MC.

558 **3.6.2 Human Health Screening**

559 Human health screening values for soil and sediment analytical results were established using the
560 EPA Region 9 Preliminary Remediation Goals for Residential Soil. Note that in recent meetings
561 with ODEQ for other FUDS, they indicated that EPA Region 6 Preliminary Remediation Goals
562 should be used for all new sites in Oregon. Table 3-2 lists the human health screening values
563 that were agreed to during the TPP process.

564 **3.6.3 Ecological Screening**

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

572 **3.7 Variances from the SSWP**

573 There were two variances to the SSWP (Shaw, 2006c). The first was to change the name of the
574 field team leader. The second was to change the downgradient well sampling location when the
575 original proposed well could not be accessed. Copies of the variances are provided in Appendix
576 D.

577 **3.8 Second TPP Meeting**

578 A second TPP Meeting was held on September 6, 2007 via teleconference. Results of the SI
579 were reviewed. All parties indicated that they concurred with the conclusions and

580 recommendations of the SI. A copy of the meeting agenda and minutes are included in
581 Appendix B.

582 4.0 *Air to Air Gunnery Range*

583 The findings for MEC and MC are discussed in the following sections.

584 4.1 *History and Land Use*

585 While the AOC is termed the Air to Air Gunnery Range, there were two primary uses for the
586 AOC. These were air-to-air gunnery training that occurred over much of the 795,057-acre site
587 and the air-to-ground gunnery training that was focused on two targets located on the eastern
588 border of the AOC adjacent to Alkali Lake (Figure 3-1). As discussed in Section 3.1, the entire
589 COGR is one AOC and the SI field activities focused on the two air-to-ground gunnery targets.
590 Figure 4-1 shows the location of the air-to-ground gunnery target sites. Unregulated practice
591 bombing at scattered locations also occurred at the FUDS and practice bombs have been found.

592 There was also a reported use of the AOC for ground-to-air gunnery practice and machine gun
593 and rocket firing in 1943, about the time of the Northwest Maneuvers. The location of the
594 ground-to-air gunnery training and machine gun and rocket firing was reported as being at Camp
595 Alkali, which was a Civilian Conservation Corps camp during the 1930s and early 1940s. These
596 activities will be evaluated in the SI for the Northwest Maneuver Area FUDS.

597 Currently, the site is used primarily for livestock grazing. Use of the range for agricultural
598 purposes (i.e., grazing and farming) will likely continue into the foreseeable future. In addition
599 to agricultural use, some off-road recreational use occurs.

600 4.2 *Previous Investigations*

601 In 1995, the ASR field team identified remnants of targets at the southern target site arranged in
602 a pattern that resembled a military convoy.

603 4.3 *MEC Evaluation*

604 The ASR identified that the AOC was used for air-to-air and air-to-ground gunnery practice.
605 The air-to-air portion would have used towed targets. No aerial target remnants have been
606 reported. The air-to-ground practice is supported by the wooden targets on the southern and
607 northern target sites. Although not identified in the ASR or ASR Supplement, AN-MK 5, AN-
608 MK 23, and AN-MK 43 practice bombs have also been found throughout the FUDS as reported
609 by the BLM archeologist at the TPP meeting. However, no bombing targets have been
610 identified. Conversations with a longtime BLM archeologist indicated that he had not observed
611 any evidence of bombing targets. DoD records indicate that small arms and medium caliber
612 munitions (.50-caliber, and 20 mm ammunition) were used at the FUDS.

613 4.3.1 *Field Observations and Historical Evidence of MEC*

614 A visual reconnaissance of the air-to-ground gunnery target sites was conducted during the
615 collection of samples to identify evidence of former range activities (e.g., surface debris or

616 stressed vegetation). The visual reconnaissance was supplemented with a Fisher all-metal
617 detector to identify any metallic items that may be present. The Fisher unit was chosen due to
618 the high-iron content basaltic rock that may cause false indications of buried items on a typical
619 magnetometer. The paths walked during the visual reconnaissance were recorded using a hand-
620 held Global Positioning System (GPS) unit and are shown on Figure 4-1. No MEC was
621 identified during the SI field work. Two spent .50-caliber rounds were identified during field
622 work.

623 Historically, MEC has not been reported at the target sites. For the COGR FUDS in general,
624 bombs described as AN-MK 5, AN-MK 23, and AN-MK 43 practice bombs have been found at
625 scattered locations. None were located during SI field work.

626 **4.3.2 MEC Risk Assessment**

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

632 Access to COGR is unrestricted to the public. COGR is used primarily for recreation and leased
633 grazing. Because of reports of practice bombs at COGR, it is possible that undetonated practice
634 bombs that do not contain a sensitive fuze are present at COGR. Other than the reports of
635 practice bombs, the only other munitions use was small arms. The MEC risk for this area is
636 considered to be low, based on the following:

- 637 • COGR is a large area of over 795,000 acres;
- 638 • The unfenced area is used for limited farming, grazing, and limited recreational use;
- 639 • There are limited reports of practice bombs by the BLM archeologist; and
- 640 • No bombing targets have been identified.

641 **4.4 Munitions Constituents Evaluation**

642 MC consist of metals (chromium, copper, iron, lead, molybdenum, and nickel), explosives, and
643 perchlorate (Table 2-1)

644 **4.4.1 Terrestrial Pathway**

645 Terrestrial receptors may be exposed to MC because soil was directly affected by firing at
646 targets. Three surface soil samples from the south target (NWO-033-0001, NWO-033-0002, and
647 NWO-033-0003) and three from the north target (NWO-033-0004, NWO-033-0005, NWO-033-
648 0006, and field duplicate NWO-033-0007) were proposed and collected. Samples were analyzed
649 for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, and nickel
650 using EPA SW-846 Method 6020A. The metals list was based on the metals expected to be

651 present in munitions used at COGR (primarily steel and sheet metal). Aluminum and manganese
652 were included as they may be used in geochemical comparison of site soil concentrations to
653 background. Note that only chromium, copper, lead, and nickel are CERCLA hazardous
654 substances.

655 One sample from each target site, NWO-033-0001 from the south target and NWO-033-0004
656 and field duplicate NWO-033-0007 from the north target, was also analyzed for explosives,
657 including nitroglycerin, using EPA SW-846 Method 8330A. Sample locations are shown in
658 Figure 4-2.

659 The surface soil sample locations were collected from the upper 6 inches of soil and were
660 composited using the wheel method as described in the *Final Type I Work Plan* (Shaw, 2006a).

661 *4.4.1.1 Comparison to Background Data*

662 The detected metals were compared to the soil background concentrations. The comparison is
663 shown on Tables 4-1A and 4-1B. Molybdenum exceeded background concentration of 6.9
664 milligrams per kilogram (mg/kg) in soil samples NWO-033-0002 (149 mg/kg) at the south target
665 and NWO-033-0004 (32.4 mg/kg), NWO-033-0006 (20.9 mg/kg), and field duplicate NWO-033-
666 0007 (29.1 mg/kg) at the north target. The high concentrations of molybdenum are not thought
667 to be related to munitions. Molybdenum can be present in small quantities of steel (a few
668 percent). However, if the elevated molybdenum concentrations were due to steel in munitions,
669 elevated concentrations of iron should also be present. However, iron concentrations in all
670 samples were well below the background concentration (Tables 4-1A and 4-1B)

671 Nitrobenzene was detected at estimated quantities (0.049 J mg/kg and 0.043 J mg/kg) between
672 the method detection limit and the laboratory reporting limit in sample NWO-033-0004 and its
673 field duplicate NWO-033-0007, respectively. Nitrobenzene was the only explosive compound
674 detected. Shaw has observed similar results at other FUDS and has required the laboratory to
675 perform additional data review. Although the laboratory has confirmed the presence of
676 nitrobenzene, the results are still open to question. The half-life of nitrobenzene was reported as
677 56 days in an aerobic soil column (Kincannon, 1985). Therefore, nitrobenzene associated with
678 military activities at a site more than 60 years before sample collection would have degraded to
679 non-detectable concentrations. Nitrobenzene has many industrial uses, in particular, for the
680 manufacture of aniline, which is used in rubbers, dyes, photographic chemicals, urethane foams,
681 pharmaceuticals, explosives, petroleum refining, phenolics, herbicides, and fungicides (Sax and
682 Lewis, 1987), and may also be found in pesticides (EPA, 1995a). However, it is not clear how
683 these industrial uses can explain the distribution at COGR.

684 *4.4.1.2 Comparison to Human Health Screening Values*

685 Soil analytical results are only compared to human health screening values if background
686 concentrations are exceeded. Molybdenum exceeded the background value and the human

687 health screening value of 390 mg/kg in one sample. The nitrobenzene detections of 0.049 J
688 mg/kg and 0.043 J mg/kg were below the human health screening value of 20 mg/kg.

689 *4.4.1.3 Comparison to Ecological Screening Values*

690 Soil analytical results are only compared to ESVs if background concentrations are exceeded.
691 Molybdenum exceeded the ESV of 2 mg/kg. Note that the site background value of 6.9 mg/kg
692 also exceeded the ESV. The nitrobenzene detections of 0.049 J mg/kg and 0.043 J mg/kg were
693 below the ESV of 2.4 mg/kg.

694 A SLERA was completed for COGR and concluded that molybdenum was a metal of ecological
695 concern (Appendix L). The SLERA concluded that adverse ecological effects to birds and small
696 mammals may be possible.

697 *4.4.2 Surface Water Pathway*

698 One sediment sample from each target (South – NWO-033-1001 and North – NWO-033-1002)
699 was proposed and collected. The discrete samples were analyzed for select metals using EPA
700 SW-846 Method 6020A and explosives, including nitroglycerin, using EPA SW-846 Method
701 8330A.

702 In accordance with the SSWP (Shaw, 2006c), two surface water samples were planned,
703 contingent on the presence of surface water at the target locations. No surface water was found
704 and no samples were collected.

705 *4.4.2.1 Comparison to Background*

706 The detected metals were compared to the sediment background concentrations. The
707 comparisons are shown on Table 4-2. No metals concentrations significantly exceeded the
708 sediment background concentration (three times the maximum background sediment sample
709 concentration).

710 Nitrobenzene was detected at estimated quantities between the method detection limit and the
711 laboratory reporting limit in sample NWO-033-0004 (0.029 J mg/kg) and its field duplicate
712 NWO-033-0007 (0.041 J mg/kg). As discussed above in Section 4.4.1.1, the detections of
713 nitrobenzene are suspect due to short half-life of the compound.

714 *4.4.2.2 Comparison to Human Health Screening Values*

715 No detected metals concentrations significantly exceeded (three times the maximum background
716 concentration) background concentrations and, therefore, no comparison to human health
717 screening values was completed.

718 Detections of nitrobenzene were below the human health screening value of 20 mg/kg.

719 *4.4.2.3 Comparison to Ecological Screening Values*

720 No detected metals concentrations significantly exceeded (three times the maximum background
721 concentration) background concentrations and, therefore, no comparison to ESVs was

722 completed.

723 Detections of nitrobenzene were below the ESV of 32 mg/kg.

724 **4.4.3 Groundwater Pathway**

725 One groundwater sample (NWO-033-3001) was collected from the Alkali Lake Disposal Site
726 groundwater monitoring well located downgradient of the south target (Figure 4-3). The well is
727 sampled annually by the ODEQ to monitor groundwater plume movement from the Alkali Lake
728 Disposal Site. The sample was analyzed for perchlorate only, using DataChem Laboratory
729 internal standard operating procedure LCMS-CL04-Rev. 2 (see Analytical Data QA/QC Report
730 provided in Appendix G). As agreed in the TPP Memorandum (Shaw, 2006b) metals were not
731 analyzed because of the relatively low mobility of metals in the semi-arid environment at the
732 COGR. The contaminated groundwater plume from the adjacent disposal site runs under both
733 target sites.

734 The groundwater sample was collected using a peristaltic pump. The sample was filtered using a
735 0.2-micron filter prior to filling the sample container.

736 **4.4.3.1 Comparison to Background**

737 Perchlorate was the only analyte for the groundwater sample. Perchlorate was not detected in the
738 sample above the reporting limit of 0.122 microgram per liter ($\mu\text{g/L}$). The COGR background
739 value for perchlorate is 0.229 $\mu\text{g/L}$. Because there was no perchlorate detected, comparison to
740 human health and ESV is not completed. Perchlorate is a naturally occurring chemical as well
741 manufactured for industrial uses. Naturally occurring perchlorate has been found in arid
742 environments, dry lake beds, and evaporative mineral deposits (ITRC, 2005) such as occurs at
743 COGR and Alkali Lake.

744 **4.4.4 Air Pathway**

745 Air is a potential pathway, because of the potential of entrainment of metals and explosives in
746 wind blown dust. The potential inhalation of soil particles is included in the development of
747 health-based screening values for soil.

748 **5.0 Summary and Conclusions**

749 The conclusions of the SI are presented in this section. Recommendations for further action are
750 presented in Section 6.0. An updated CSM is presented in Appendix J.

751 In the MMRP Inventory in the ARC (DoD, 2006) and in the ASR Supplement (USACE, 2004b),
752 the site has one identified range as follows:

Range Name	Range ID	Approximate Area (acres)	UTM Coordinates (meters)
Air to Air Gunnery Range	F10OR017001R01	795.06	N 4770451.8; E 720685.2

753 Coordinates for the ranges are in UTM, Zone 10N, NAD83.

754 Note that the acreage shown on the ARC (DoD, 2006) and a table in the ASR Supplement
755 (USACE, 2004b) are not correct due to an apparent typographical error. Figures in the ARC and
756 ASR Supplement are consistent with the following text from the ASR Supplement:

757 The range area is delineated as being the entire site property. The 795,057-acre range
758 was calculated based on the fact that the entire site could have been used for air-to-air
759 gunnery training.

760 **5.1 Air to Air Gunnery Range**

761 The entire COGR FUDS is one AOC. Because of the large land area and that most of the FUDS
762 was used for air-to-air gunnery practice and only small portion of the area was used for air-to-
763 ground target practice, field investigations were focused on the air-to-ground gunnery targets.

764 The BLM archeologist reported that he has observed scattered occurrences over the 795,057 acre
765 site of AN-MK5, AN-MK23, and AN-MK-43 practice bombs. No evidence of MEC was found
766 during the SI field activities. Spent .50-caliber rounds were identified during SI field work.
767 Based on this, the risk associated with potential MEC is low.

768 Six surface soil samples, one sediment sample, and one groundwater sample were collected from
769 the south and north target sites. Analytes included select metals and explosives in soil and
770 sediment, and perchlorate in groundwater. Molybdenum exceeded the site background
771 concentration, human health screening value, and ESV in soil samples. A SLERA was
772 completed that concluded Molybdenum may adversely effect birds and small mammals. Low
773 levels of nitrobenzene were detected in soil samples from the north target and in sediment
774 samples from both the south and north targets. All nitrobenzene detections were well below
775 human health and ESVs.

776 **6.0 Recommendations**

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

779 **6.1 Air to Air Gunnery Range**

780 Based on historical evidence and results from the SI field activities, there are reports of scattered
781 occurrences of practice bombs within the COGR FUDS. However, no bomb target areas have
782 been reported or identified. The bombing may have been unregulated.

783 Sample results indicated that only molybdenum exceeded the soil background, human health
784 screening value, and ESV. A SLERA was completed that identified molybdenum as a metal of
785 ecological concern. However, because molybdenum is not a CERCLA hazardous substance and
786 in accordance with USACE guidance, a recommendation for additional investigations based on
787 molybdenum alone cannot be made. The explosive nitrobenzene was detected in several samples
788 at low concentrations below the human health screening values and ESVs. Based on the low risk
789 for MEC and no MC hazards, a recommendation for NDAI is made for the Air to Air Gunnery
790 Range.

791 **6.2 Removal Actions**

792 Section 1.3 identified as one of the decision rules, evaluation of whether a removal action is
793 warranted. A removal action would be warranted if a high MEC hazard or elevated MC risk was
794 identified. There is no indication that a high MEC risk is present at COGR. No MEC was
795 identified during the SI or ASR field activities. There have been reports of scattered occurrences
796 of practice bombs in 795,057 acre site.

797 **6.3 Munitions Response Sites**

798 Results of the SI field activities provide the basis for identifying MRSs and for scoring each
799 MRS using the MRSP.

800 Based on the use and physical distribution of the AOC at COGR, one MRS is identified (Figure
801 6-1):

802 1. MRS #1 – Air to Air Gunnery Range.

803 This MRS consists of the entire Central Oregon Gunnery Range FUDS property. A
804 recommendation is made that the area of the MRS in the MMRP Inventory should be corrected
805 to 795,057 acres.

806 7.0 References

- 807 10 USC 101. *Chapter 1 – Definitions, Sec. 101 Definitions*. U.S. Government Printing Office.
808 January 20, 2004. Website: [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=
809 browse_usc&docid=Cite:+10USC101](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+10USC101).
- 810 10 USC 2701 et seq. *Chapter 160 – Environmental Restoration, Sec. 2701 Environmental
811 restoration program*. U.S. Government Printing Office. January 20, 2004. Website:
812 [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=
813 Cite:+10USC2701](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+10USC2701).
- 814 10 USC 2710 et seq. *Chapter 160 – Environmental Restoration, Sec. 2710 Inventory of
815 unexploded ordnance, discarded military munitions, and munitions constituents at defense sites
816 (other than operational ranges)*. U.S. Government Printing Office. January 3, 2005. Website:
817 [http://frwebgate2.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=33328023600+0+0+0&
818 WAISaction=retrieve](http://frwebgate2.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=33328023600+0+0+0&WAISaction=retrieve).
- 819 32 CFR 179.3. 2006. *Munitions Response Site Prioritization Protocol (MRSPP) – Definitions*.
820 July 1, 2006. http://www.access.gpo.gov/nara/cfr/waisidx_06/32cfr179_06.html.
- 821 40 CFR 300. *National Oil and Hazardous Substances Pollution Contingency Plan*. 59 Federal
822 Register (FR) 47416, September 15, 1994.
- 823 42 USC 9601. *Hazardous Substances Releases, Liability, and Compensation*. U.S. Government
824 Printing Office. January 7, 2003. Website: [http://frwebgate5.access.gpo.gov/cgi-
825 bin/waisgate.cgi?WAISdocID=209840153119+0+0+0&WAISaction=retrieve](http://frwebgate5.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=209840153119+0+0+0&WAISaction=retrieve)
- 826 70 FR 58016. Federal Register, Vol. 70, No. 192. *Rules and Regulations – Munitions Response
827 Site Prioritization Protocol, Preamble*. Codified 32 CFR Part 179. October 5, 2005.
- 828 70 FR 58028. Federal Register, Vol. 70, No. 192. *Munitions Response Site Prioritization
829 Protocol, Final Rule*. Codified 32 CFR Part 179. October 5, 2005.
- 830 Alt, David D. and Donald W. Hyndman. 1990. *Roadside Geology of Oregon*. Mountain Press
831 Publishing Co., Missoula, Montana.
- 832 ASTM International (ASTM). 2007. ASTM E 1527-05, *Standard Practice for Environmental
833 Site Assessments: Phase I Environmental Site Assessment Process*.
- 834 Department of Defense (DoD). 2001. *Management Guidance for the Defense Environmental
835 Restoration Program*. September 2001.
- 836 Department of Defense (DoD). 2006. *Defense Environmental Programs Annual Report to
837 Congress Fiscal Year 2006*. Website: <http://deparc.egovservices.net/deparc/do/home>.

838 Environmental Data Resources, Inc. (EDR). 2006. *The EDR Radius Map with GeoCheck[®]*,
839 *Central Oregon Gun Range, Silver Lake, OR 97638*. Inquiry Number: 1692345.2s. June 08,
840 2006.

841 Executive Order 12580. 1987. *Superfund Implementation*. 52 FR 2923. January 23, 1987.
842 Website: <http://www.archives.gov/federal-register/codification/executive-order/12580.html>.

843 Executive Order 13016. 1996. *Amendment to Executive Order No. 12580*. 61 FR 45871.
844 August, 28, 1996. Website: [http://www.archives.gov/federal-register/executive-](http://www.archives.gov/federal-register/executive-orders/1996.html)
845 [orders/1996.html](http://www.archives.gov/federal-register/executive-orders/1996.html).

846 Interstate Technology & Regulatory Council, Perchlorate Team (ITRC). 2005. *Perchlorate:*
847 *Overview of Issues, Status, and Remedial Options*. September, Washington DC.

848 Kincannon, D.F. and Y.S. Lin. 1985. "Microbial Degradation of Hazardous Wastes by Land
849 Treatment." In: Bell, J. M. ed. *Proceedings of the 40th Industrial Waste Conference*. Boston,
850 Massachusetts: Butterworth-Heinemann, pp 607–619.

851 Oregon Department of Environmental Quality (ODEQ). 2007. *Environmental Cleanup Site*
852 *Information (ECSI) Database Site Summary Report, Details for Site ID 291, Alkali Lake*
853 *Disposal Site*. May 23, 2007. Website:
854 <http://www.deq.state.or.us/wmc/ecsi/ecsidetail.asp?seqnbr=291>.

855 Oregon Department of Fish and Wildlife (ODFW). 2006. Letter from Christopher Carey (OR
856 DFW) to Dale Langdon (Shaw). RE: Endangered and Threatened Species at Alkali Lake FUDS.
857 November 2, 2006.

858 Oregon State Historic Preservation Office (OR SHPO). 2006. Letter from Dennis Griffin (OR
859 SHPO) to Lisa Stahl (Shaw). RE: SHPO Case No.06-2596, Boardman/Central OR Gunnery
860 Range. November 1, 2006.

861 Sax, N. Irving and Richard J. Lewis, Sr. (Sax and Lewis). 1987. *Hawley's Condensed Chemical*
862 *Dictionary*. Van Nostrand Reinhold Company. New York, New York.

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

866 Shaw Environmental, Inc. (Shaw). 2006b. *Final Technical Project Planning Memorandum,*
867 *Central Oregon Gunnery Range, FUDS ID F10OR0170*. Prepared for U.S. Army Corps of
868 Engineers. November 1, 2006.

869 Shaw Environmental, Inc. (Shaw). 2006c. *Final Site-Specific Work Plan, Central Oregon*
870 *Gunnery Range, FUDS ID F10OR0170*. Prepared for U.S. Army Corps of Engineers.
871 December 19, 2006.

872 U.S. Army Corps of Engineers (USACE). 1993. *Inventory Project Report (INPR) and Findings*
873 *and Determinations for Central Oregon Air to Air Gunnery Range*. USACE – Portland District.
874 May 27, 1993.

875 U.S. Army Corps of Engineers (USACE). 1995. *Archives Search Report Findings, Central*
876 *Oregon Air to Air Gunnery Range Military Reservation, Lake County, Oregon*. July 1995.

877 U.S. Army Corps of Engineers (USACE). 2003. *Explosives Safety Submission*. Engineer
878 Pamphlet 385-1-95b.

879 U.S. Army Corps of Engineers (USACE). 2004a. *Defense Environmental Restoration Program*
880 *(DERP) Formerly Used Defense Sites (FUDS) Program Policy*. Engineer Regulation (ER) 200-
881 3-1. May 10, 2004.

882 U.S. Army Corps of Engineers (USACE). 2004b. *Archives Search Report Supplement, Central*
883 *Oregon Gunnery Range*. 26 November, 2004.

884 U.S. Army Corps of Engineers (USACE). 2005. *Formerly Used Defense Sites (FUDS) Military*
885 *Munitions Response Program (MMRP) Site Inspections. Program Management Plan*. February
886 2005.

887 U.S. Army Corps of Engineers (USACE). 2006. *Screening-Level Ecological Risk Assessments*
888 *for FUDS MMRP Site Inspections*. Prepared by USACE HTRW CX. August 11, 2006.

889 U.S. Census. 2000. Website: <http://www.census.gov/main/www/cen2000.html>.

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

893 U.S. Environmental Protection Agency (EPA). 1992. *Statistical Analysis of Ground-Water*
894 *Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance*. Environmental
895 Statistics and Information Division, Office of Policy, Planning, and Evaluation, EPA/530/R-
896 93/003. July 1992.

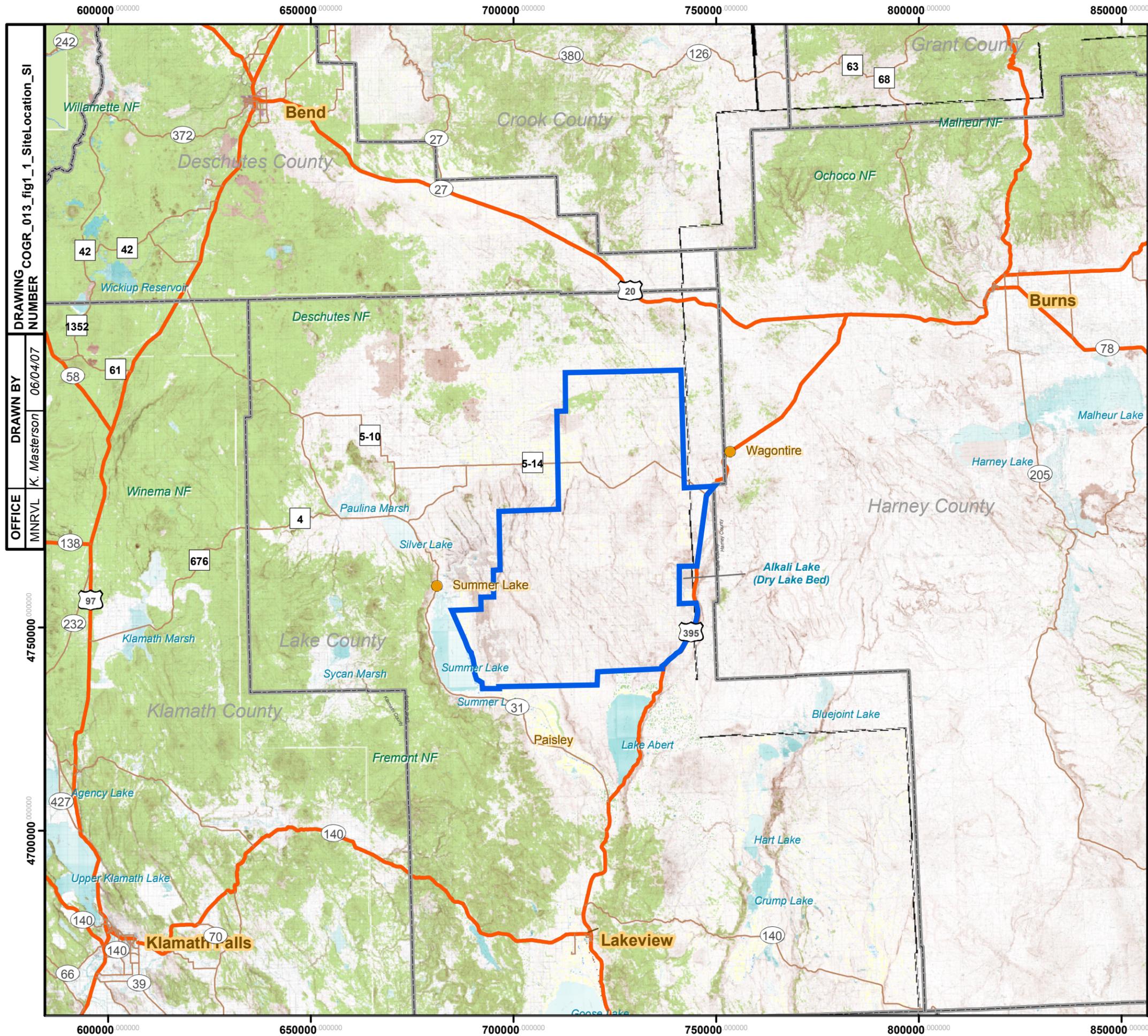
897 U.S. Environmental Protection Agency (EPA). 1994. *Statistical Methods for Evaluating the*
898 *Attainment of Cleanup Standards*. Environmental Statistics and Information Division, Office of
899 Policy, Planning, and Evaluation, EPA/230/R-94/004. June 1994.

900 U.S. Environmental Protection Agency (EPA). 1995a. *Nitrobenzene OPT Chemical Fact Sheet*
901 *Final*. EPA 749-F-95-015. February 1995.

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

- 905 U.S. Environmental Protection Agency (EPA). 1997. *Ecological Risk Assessment Guidance for*
906 *Superfund: Process for Designing and Conducting Ecologic I Risk Assessments* (ERAGS). EPA
907 540-R-97-006, OSWER Directive # 9285.7-25. June 1997.
- 908 U.S. Environmental Protection Agency (EPA). 1999. *Contract Laboratory Program (CLP):*
909 *National Functional Guidelines for Organic Data Review*. EPA 540-R-99-008, OSWER
910 Directive # 9240.1-05A-P. October 1999.
- 911 U.S. Environmental Protection Agency (EPA). 2004. *Contract Laboratory Program (CLP):*
912 *National Functional Guidelines for Inorganic Data Review*. EPA 540-R-04-004, OSWER
913 Directive # 9240.1-45. October 2004.
- 914 U.S. Environmental Protection Agency (EPA). 2006. *Data Quality Assessment: Statistical*
915 *Methods for Practitioners*. Office of Environmental Information, EPA/240/B-06/003. February
916 2006.
- 917 U.S. Geological Survey (USGS). 2006. *The National Geochemical Survey Database*. Website:
918 <http://tin.er.usgs.gov/geochem/>.

Figures



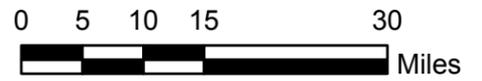
DRAWING COGR_013_fig1_1_SiteLocation_SI
 NUMBER
 DRAWN BY
 K. Masterson
 DATE
 06/04/07
 OFFICE
 MNRVL

Legend

- Central Oregon Gunnery Range
- Approximate FUDS Property

NOTES:
 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.

4850000
 4800000
 4750000
 4700000



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 1-1
SITE LOCATION MAP
 CENTRAL OREGON GUNNERY RANGE



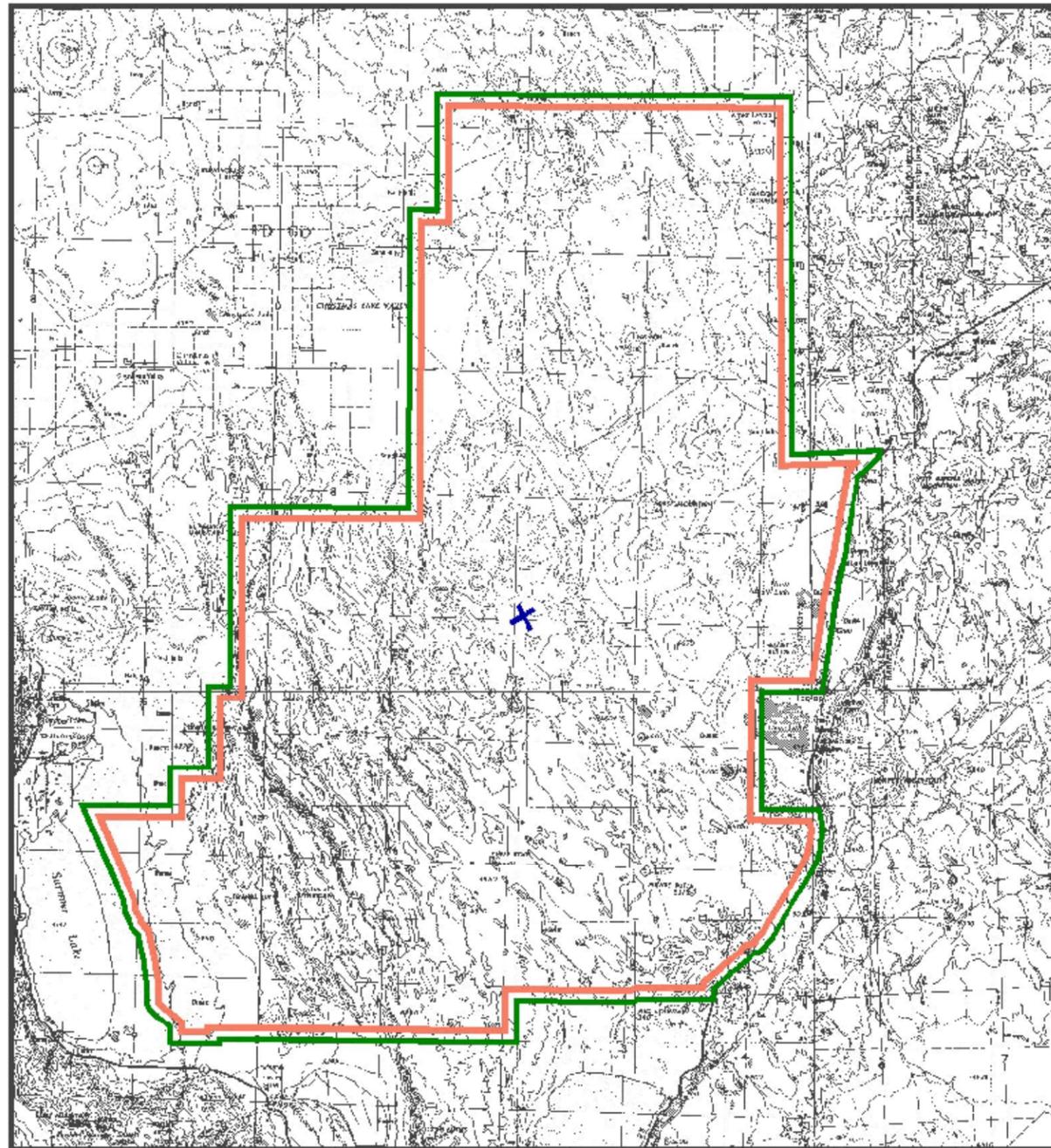
690000 720000 750000 780000 810000

DRAWING COGR_014_fig1_2_OriginalSiteLayout_SI
NUMBER

OFFICE MNRVL
DRAWN BY K. Masterson
DATE 06/04/07

47700
4740000

4710000



NOTE: ALL CENTROIDS AND UTMs OF RANGES WERE DERIVED FROM NAD27 PROJECTED QUADS, USING THE BENTLEY PRODUCT MICROSTATION AND Z/I IMAGING COORDINATE SYSTEM OPERATIONS. ALL CONVERSIONS OF DATUMS AND MAPS USED FOR THIS PROJECT WERE PERFORMED USING THE ACCURATE NAD27 UTMs AND CORPSCON 5.11.08 CONVERSION PROGRAM.

LEGEND

UTM ZONE 10
X UTM COORDINATES (NAD27)
X= 720778.8 m E
Y= 4770254.3 m N
43°03' 17.8 " N
120°17'16.8 " W

X UTM COORDINATES (NAD83)
X= 720685.2 m E
Y= 4770451.8 m N
43°03' 16.8 " N
120°17'24.5 " W

APPROXIMATE RANGE BOUNDARY
TOTAL ACREAGE = 795,057 Ac

APPROXIMATE PROPERTY BOUNDARY



0 35,000 70,000
APPROXIMATE SCALE IN FEET



U.S. ARMY CORPS OF ENGINEERS
ST. LOUIS DISTRICT

CENTRAL OREGON A-A GUNNERY RANGE, OR
FUDS PROPERTY NO. F100R017001
CTT MAP

AIR-TO-AIR GUNNERY RANGE

PROJ. DATE 2501
24 MAR 2003 10:14
PLATE NO. R01

\\saw\c\proj\014\fig1_2_OriginalSiteLayout_SI\fig1_2_OriginalSiteLayout_SI.dgn

4830000

4800000

4770000

4740000

4710000

NOTES:
1) FUDS property boundary, range boundaries, and original site layout image, were derived from the Central Oregon Gunnery Range ASR and ASR Supplement (USACE, 2004).



20666666673333 16
Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



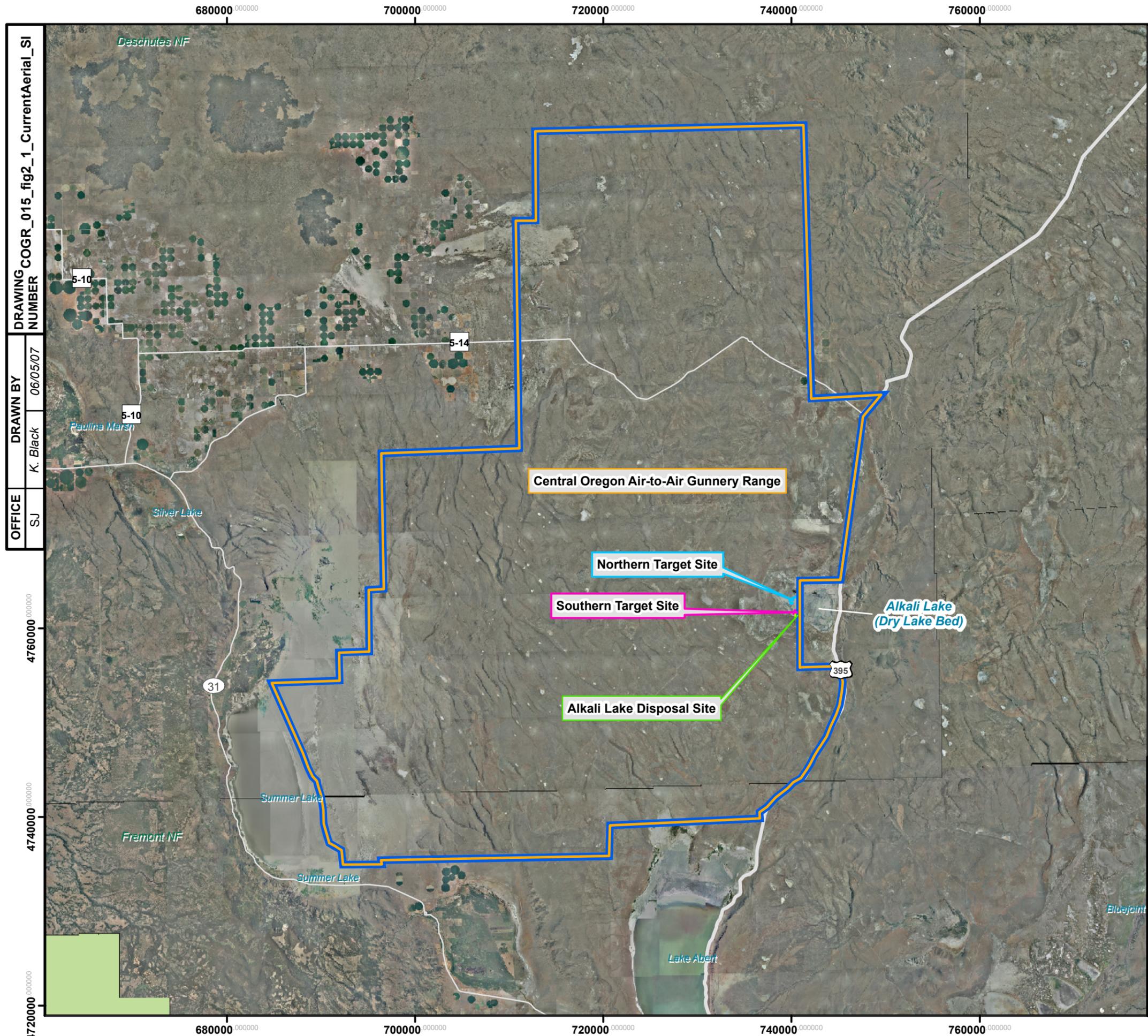
U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 1-2
ORIGINAL SITE LAYOUT

CENTRAL OREGON GUNNERY RANGE



690000 720000 750000 780000 810000

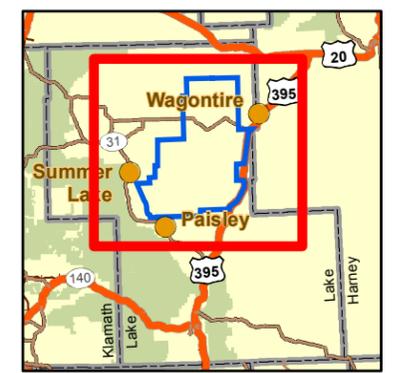


DRAWING COGR_015_fig2_1_CurrentAerial_SI
 NUMBER
 DRAWN BY
 K. Black 06/05/07
 OFFICE
 SJ

Legend

- Central Oregon Gunnery Range
Approximate FUDS Boundary
- Central Oregon Air-to-Air
Gunnery Range AOC
- Alkali Lake Disposal Site
- Northern Target Site
(Focus Area within AOC)
- Southern Target Site
(Focus Area within AOC)

NOTES:
 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.



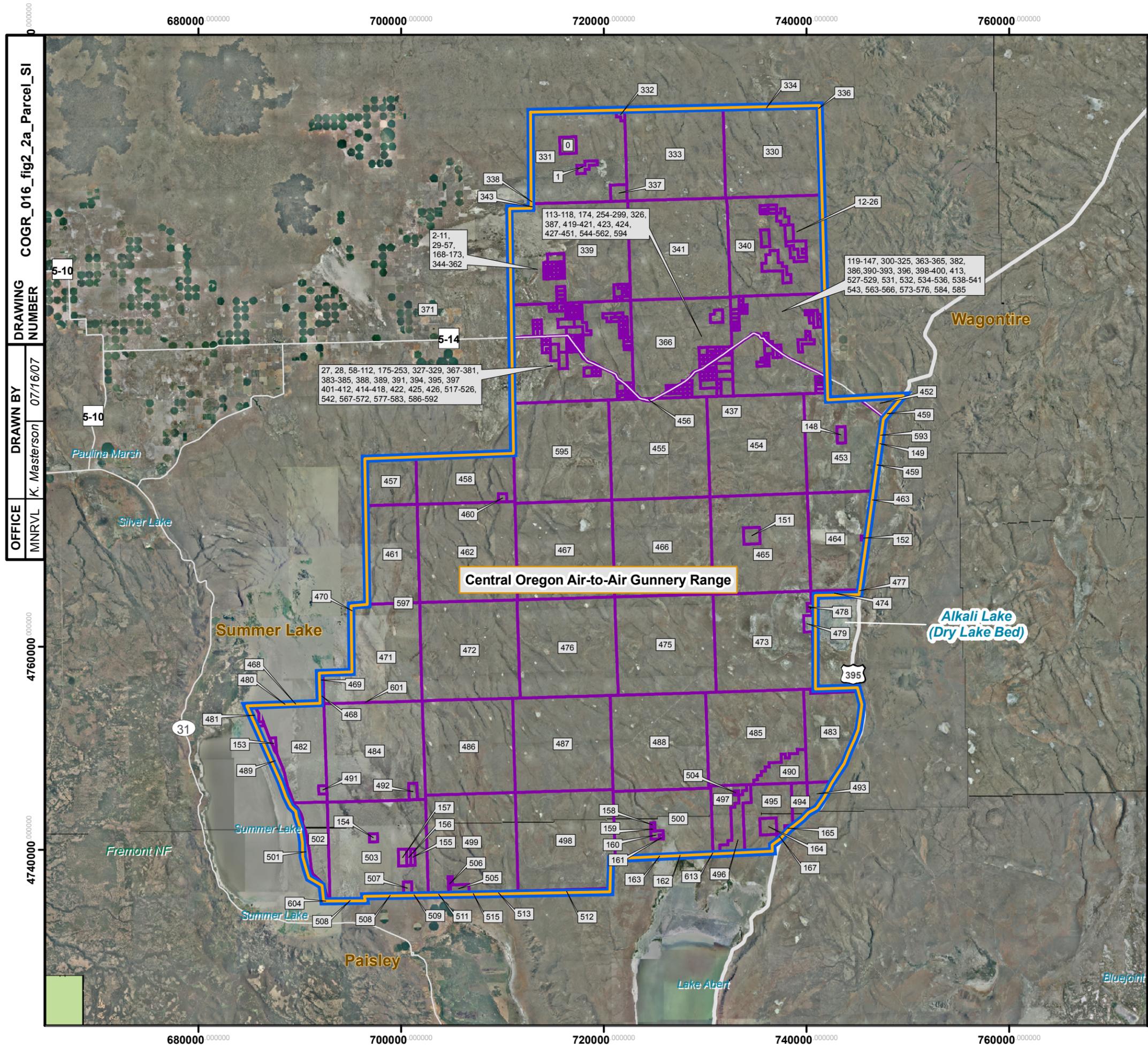
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 2-1
CURRENT AERIAL PHOTOGRAPH
 CENTRAL OREGON GUNNERY RANGE



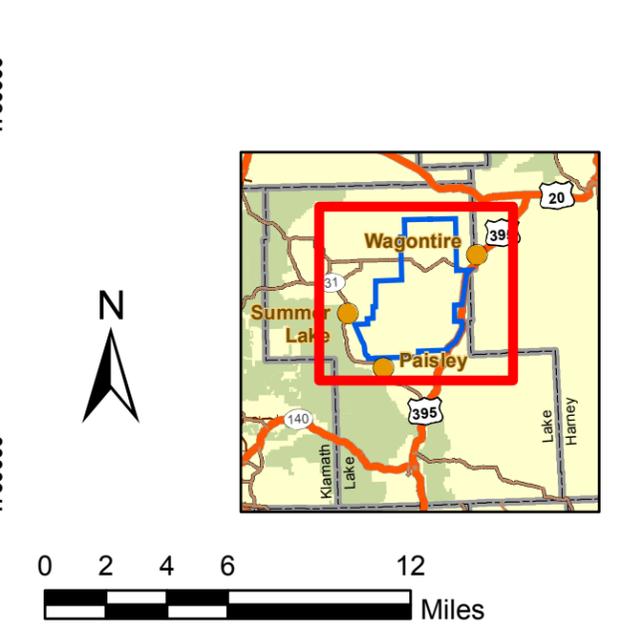


Legend

- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Parcel Boundary with Owner Identifier
- Central Oregon Air-to-Air Gunnery Range AOC

NOTES:

- 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
- 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.
- 3) Property owner name available from USACE-Seattle District.



 U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

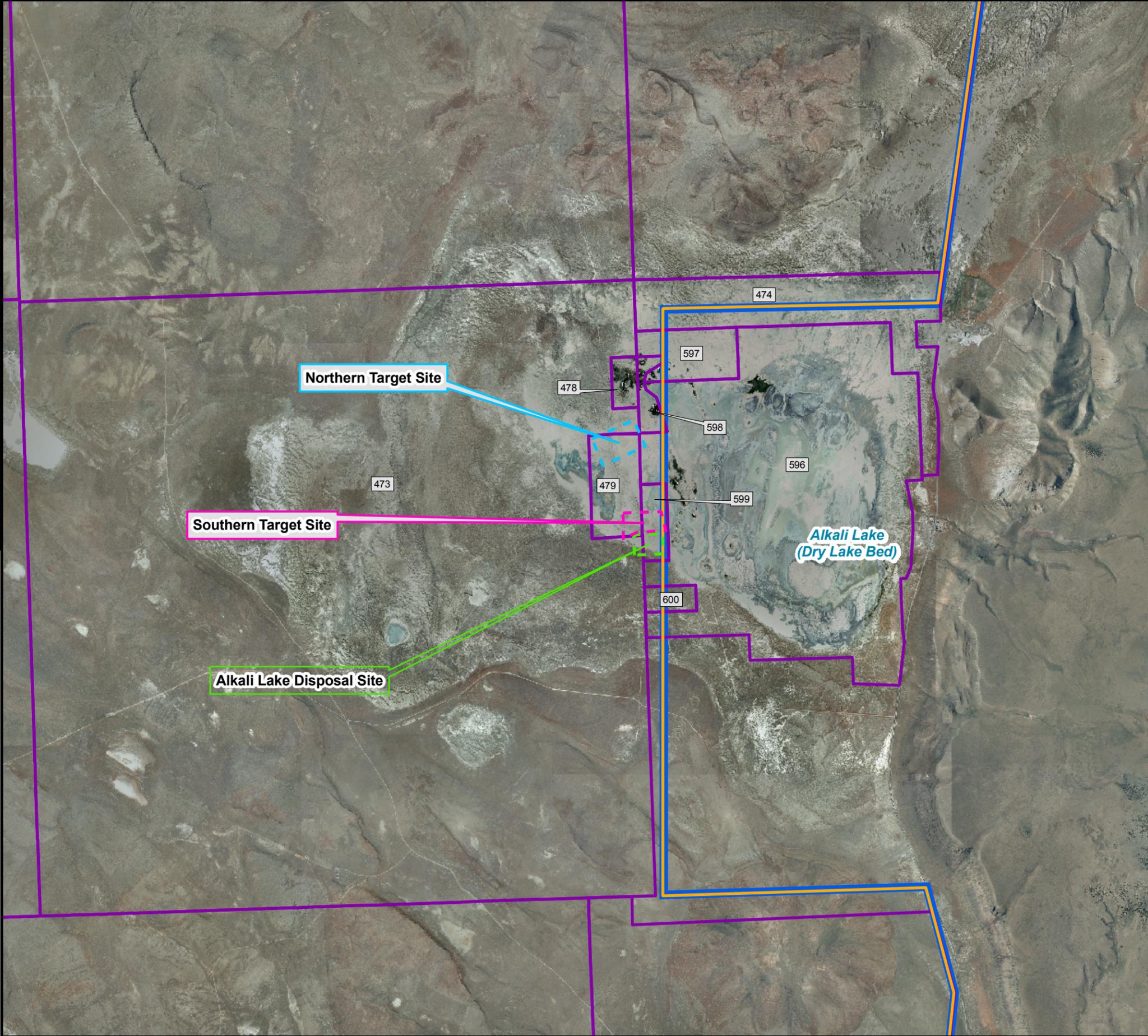
FIGURE 2-2A
PARCEL MAP
CENTRAL OREGON GUNNERY RANGE

 Shaw Environmental, Inc.

DRAWING COGR_017_fig2_2b_Parcel_Target_SI
NUMBER

DRAWN BY
K. Masterson 07/17/07

OFFICE
MNRVL



Legend

- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Parcel Boundary with Identifier
- Alkali Lake Disposal Site
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)

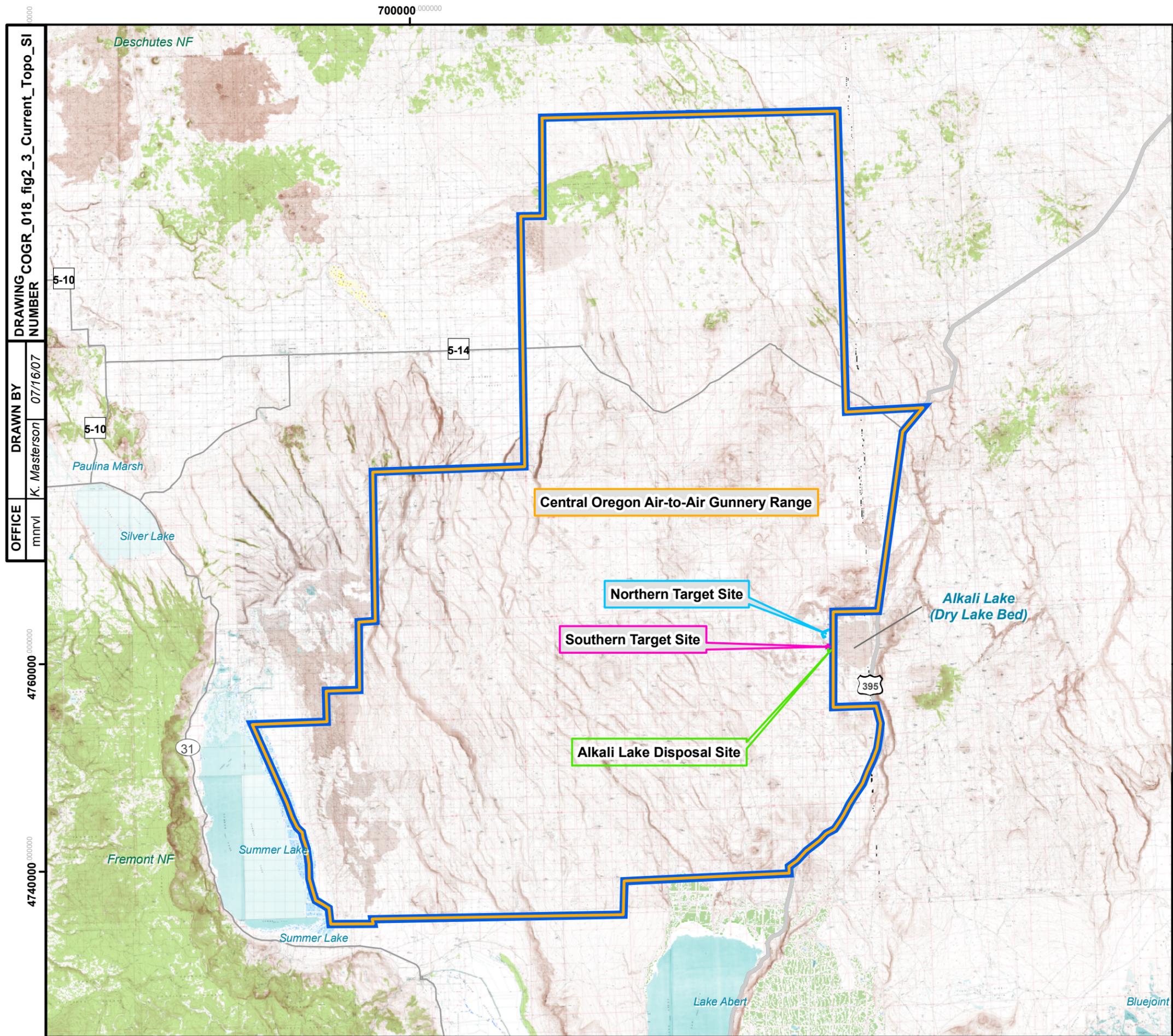
NOTES:
1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.
3) Property owner name available from USACE Seattle District.

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

 U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 2-2B
PARCEL MAP - TARGET SITES
CENTRAL OREGON GUNNERY RANGE

 Shaw® Shaw Environmental, Inc.

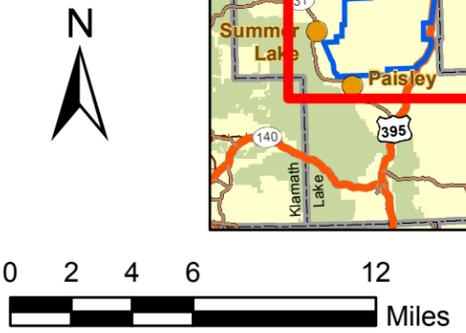
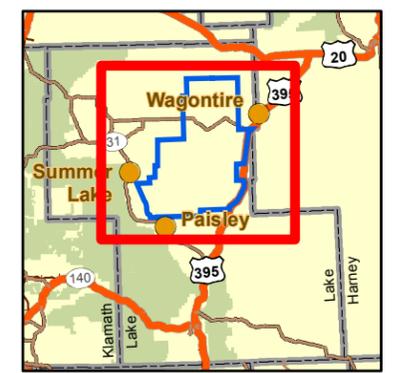


DRAWING COGR_018_fig2_3_Current_Topo_SI
 NUMBER
 DRAWN BY
 K. Masterson 07/16/07
 OFFICE
 mnrvl

Legend

- Central Oregon Gunnery Range Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Alkali Lake Disposal Site
- Southern Target Site (Focus Area within AOC)
- Northern Target Site (Focus Area within AOC)

NOTES:
 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
 2) Topographic map (Lake County and Harney County) obtained from the U.S. Department of Agriculture, Service Center Agencies, 2001.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

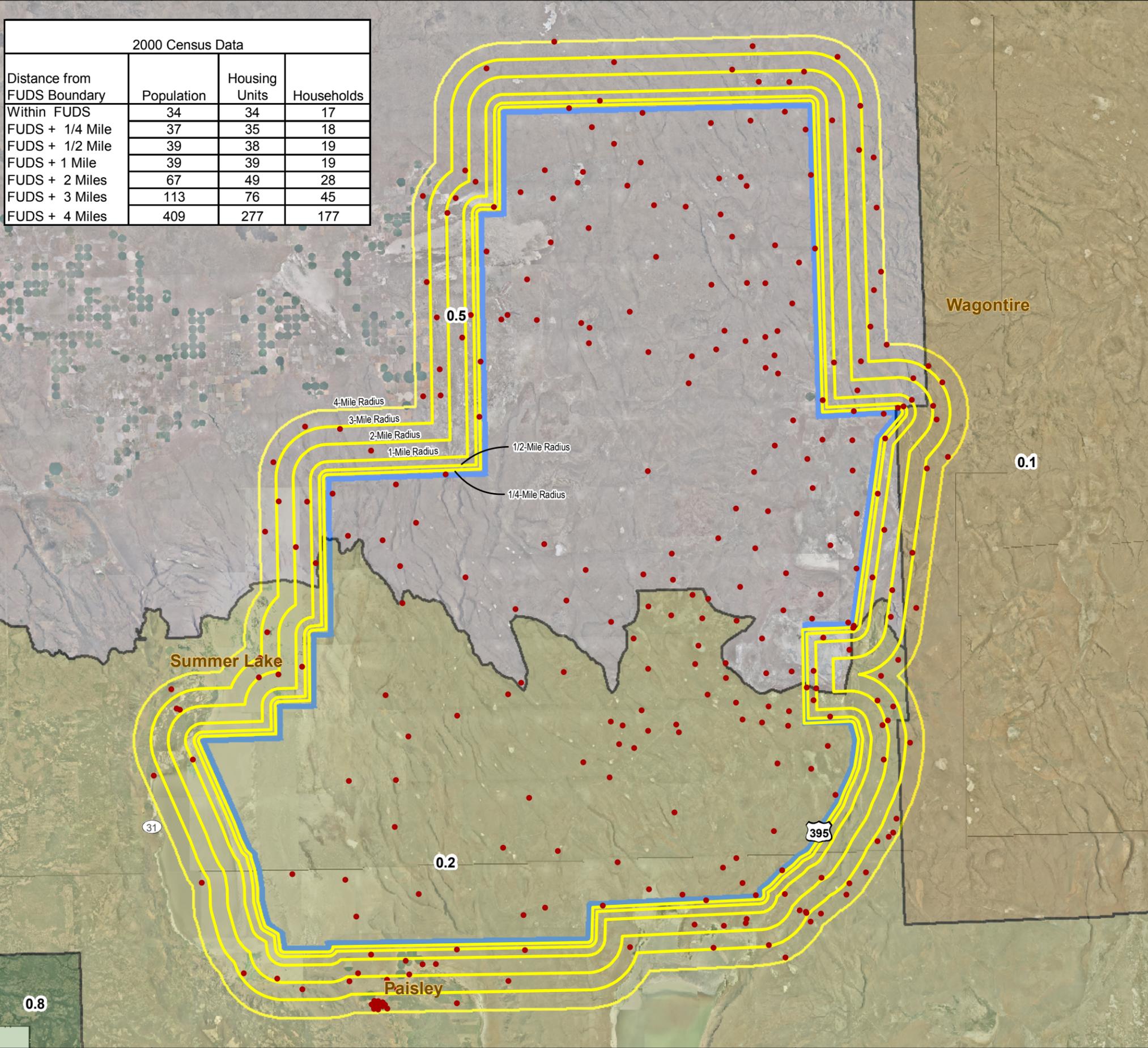
FIGURE 2-3
CURRENT SITE LAYOUT
TOPOGRAPHIC MAP
 CENTRAL OREGON GUNNERY RANGE

Shaw® Shaw Environmental, Inc.

DRAWING NUMBER COGR_019_fig2_4_Demographics_SI

OFFICE: MNRVL
 DRAWN BY: K. Masterson
 DATE: 06/04/07

2000 Census Data			
Distance from FUDS Boundary	Population	Housing Units	Households
Within FUDS	34	34	17
FUDS + 1/4 Mile	37	35	18
FUDS + 1/2 Mile	39	38	19
FUDS + 1 Mile	39	39	19
FUDS + 2 Miles	67	49	28
FUDS + 3 Miles	113	76	45
FUDS + 4 Miles	409	277	177



Legend

- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Block Group Census Population (2000)**
 - 390 - 629
 - 630 - 867
 - 868 - 1106
 - 1107 - 1583
- Census Block Centroid Unit
- 0.5 People per Square Mile

- NOTES:
- 1) FUDS property boundary was derived from the Central Oregon Gunnery Range ASR Supplement.
 - 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.
 - 3) Lake County Population density is 0.9 and 0.9 persons per sq. mile for 2000 and 2004, respectively.

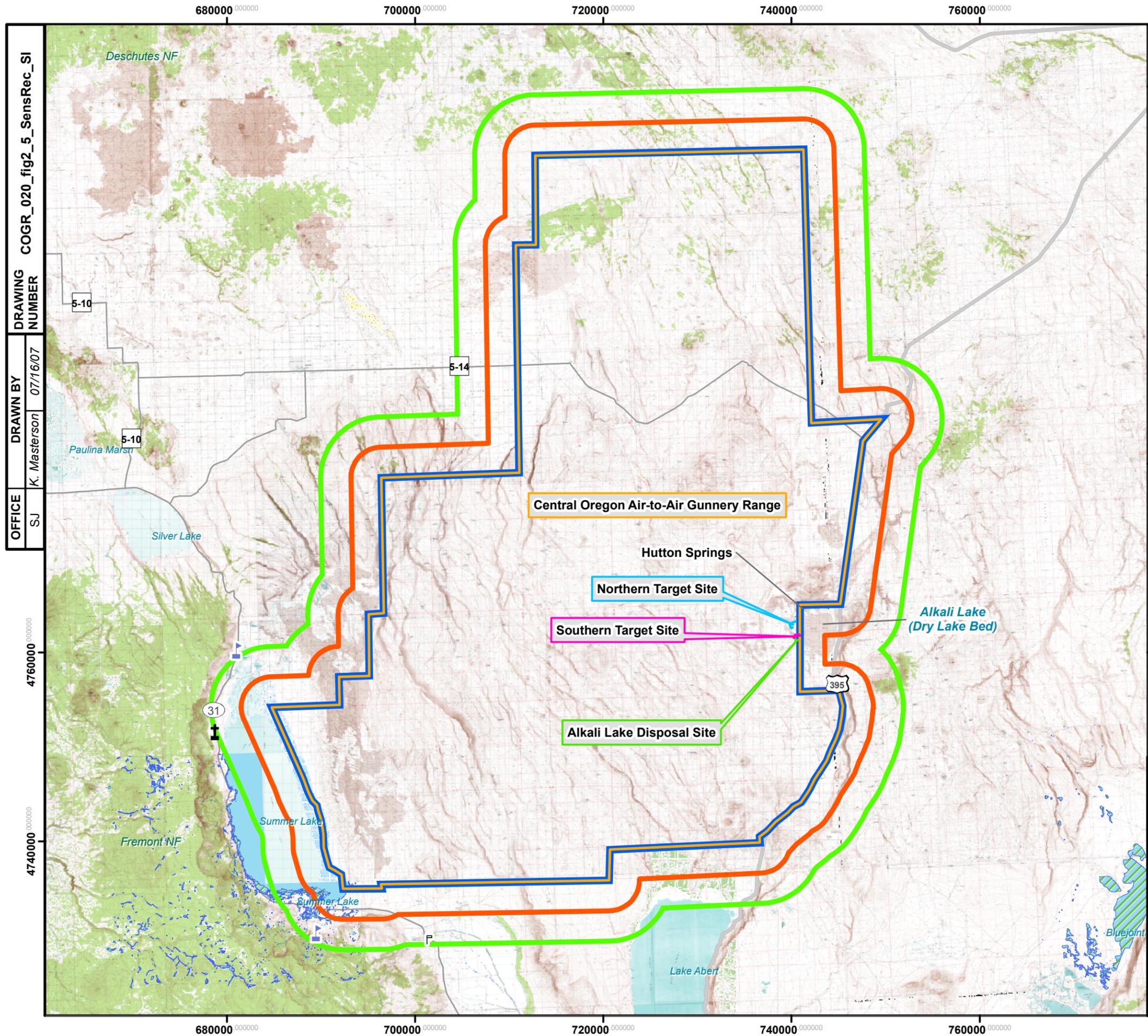
0 2.5 5 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 2-4
CENSUS DATA WITHIN 4-MILE RADIUS
 CENTRAL OREGON GUNNERY RANGE

Shaw Environmental, Inc.



OFFICE: SJ
 DRAWN BY: K. Masterson
 DRAWING NUMBER: 07/16/07
 COGR_020_fig2_5_SensRec_SI

Legend

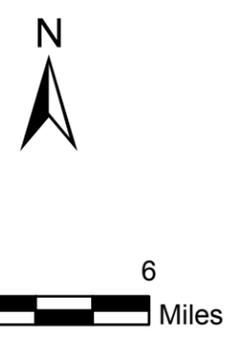
- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Alkali Lake Disposal Site
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)
- 2-Mile Radius from Central Oregon Gunnery Range FUDS Boundary
- 4-Mile Radius from Central Oregon Gunnery Range FUDS Boundary
- School
- Cemetery
- Ranger Station

Wetland Type

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other

NOTES:

- 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
- 2) Topographic map (Lake County and Harney County) obtained from the U.S. Department of Agriculture, Service Center Agencies, 2001.
- 3) Wetland area data obtained from U.S. Fish and Wildlife Service, 200605, NWIDBA.CONUS_wet_poly: Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31., U.S. Fish and Wildlife Service, Branch of Habitat Assessment, Washington, D.C..

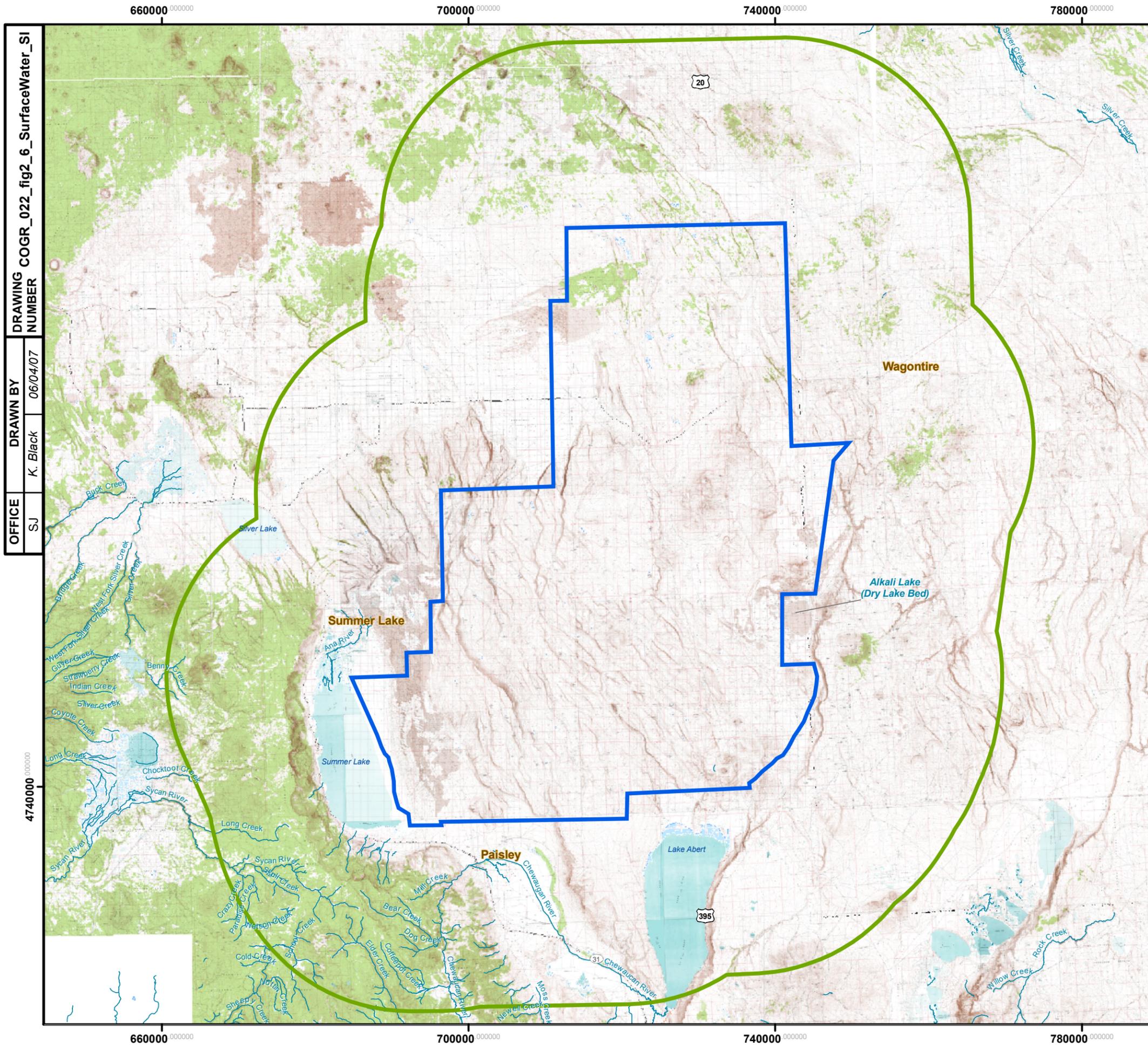


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 2-5
SENSITIVE RECEPTOR LOCATIONS
 CENTRAL OREGON GUNNERY RANGE

Shaw Environmental, Inc.



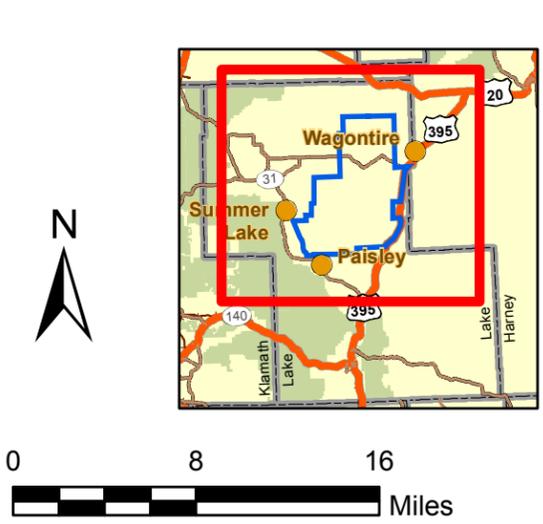
OFFICE: SJ
 DRAWN BY: K. Black
 DATE: 06/04/07
 DRAWING NUMBER: COGR_022_fig2_6_SurfaceWater_SI

Legend

- Central Oregon Gunnery Range Approximate FUDS Boundary
- 15-Mile Radius from Central Oregon Gunnery Range FUDS Boundary

NOTES:

- 1) FUDS property boundary was derived from the Central Oregon Gunnery Range ASR Supplement.
- 2) Topographic map (Lake County, Deschutes County, and Harney County) obtained from the U.S. Department of Agriculture, Service Center Agencies, 2001.



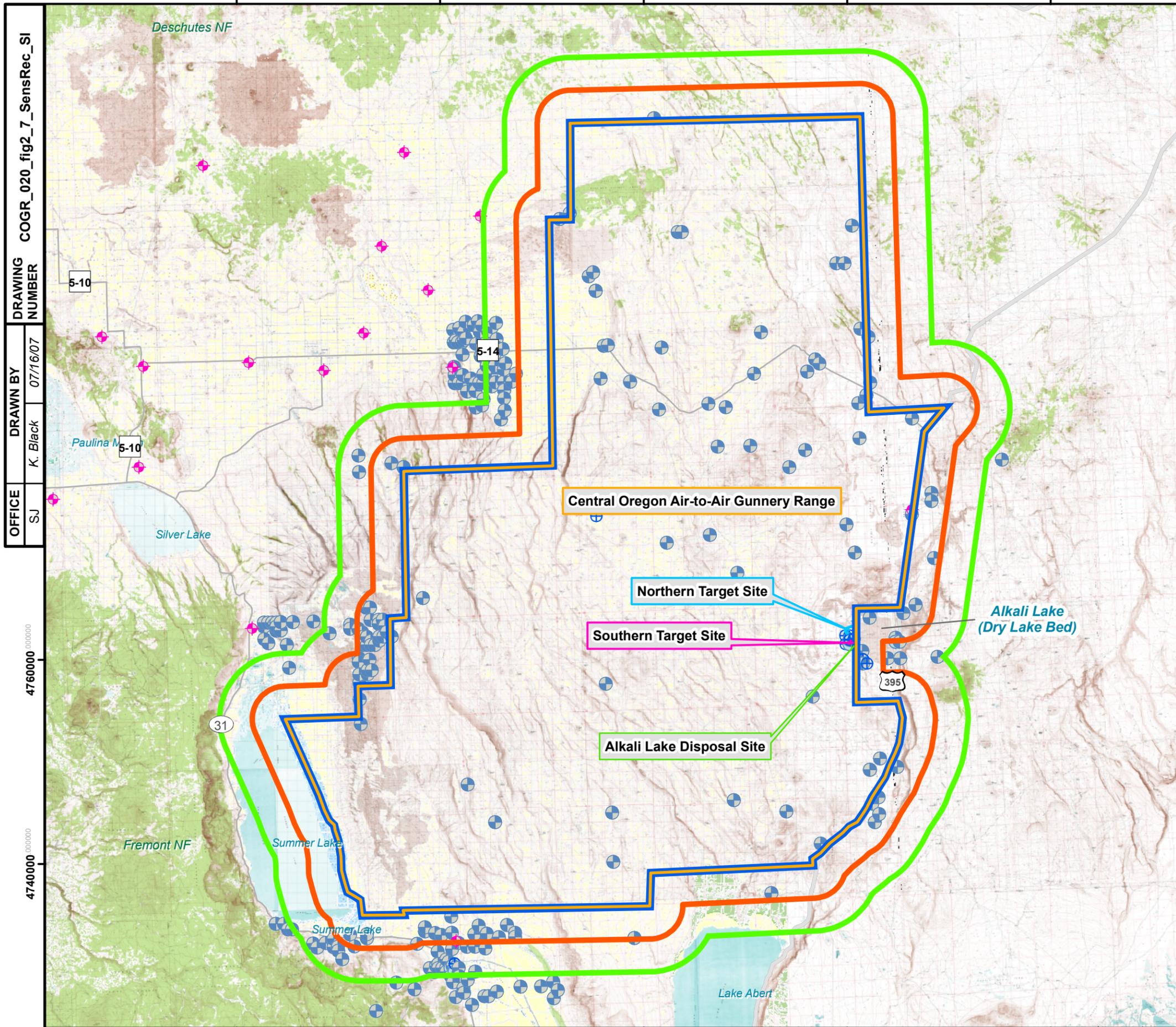
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 2-6
REGIONAL SURFACE WATER DRAINAGE

CENTRAL OREGON GUNNERY RANGE

Shaw Environmental, Inc.



680000 000000 700000 000000 720000 000000 740000 000000 760000 000000

4820000 000000
4800000 000000
4780000 000000
4760000 000000
4740000 000000

Deschutes NF

Paulina N

Silver Lake

Summer Lake

Summer Lake

Lake Abert

Central Oregon Air-to-Air Gunnery Range

Northern Target Site

Southern Target Site

Alkali Lake Disposal Site

Alkali Lake (Dry Lake Bed)

395

31

5-10

5-14

5-10

5-10

COGR_020_fig2_7_SensRec_SI

DRAWING NUMBER

DRAWN BY

K. Black

07/16/07

OFFICE

SJ

Legend

- Central Oregon Gunnery Range Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Alkali Lake Disposal Site
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)
- 4-Mile Radius from Central Oregon Gunnery Range FUDS Boundary
- 2-Mile Radius from Central Oregon Gunnery Range FUDS Boundary

Well (Water Resources Dept, ESRI Shape file)

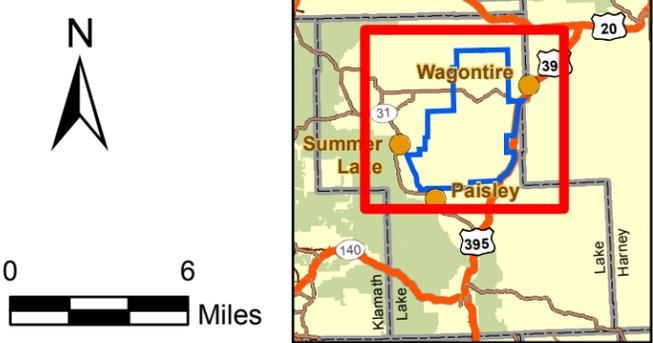
- Groundwater Well

Well (Water Resources Dept, Well Log Database)

- Geotechnical Well
- Monitoring Well
- Water Supply Well

NOTES:

- 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR Supplement.
- 2) Topographic map (Lake County and Harney County) obtained from the U.S. Department of Agriculture, Service Center Agencies, 2001.
- 3) Well data were obtained from the Oregon Water Resource Department. Well location obtained from the Well Log Database are plotted in the center of either the Township/Range/Section, Township/Range/Section/Quarter, or Township/Range/Section/Quarter/Quarter depending on available Public Land Survey information.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

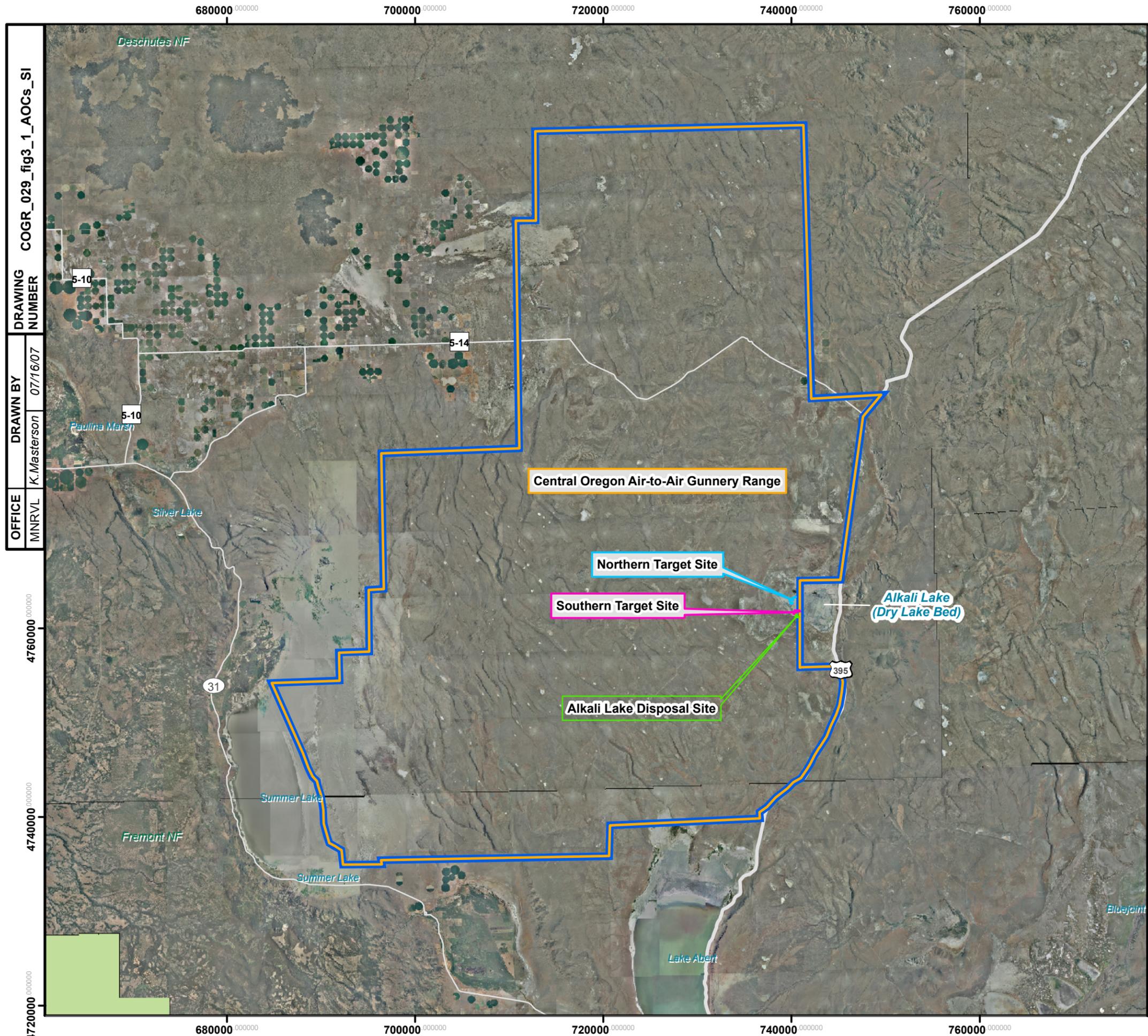


U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 2-7
GROUNDWATER WELL LOCATIONS WITHIN A 4 MILE RADIUS OF THE FUDS PROPERTY
CENTRAL OREGON GUNNERY RANGE



Shaw® Shaw Environmental, Inc.



COGR_029_fig3_1_AOCs_SI
 DRAWING NUMBER
 DRAWN BY
 OFFICE
 MNRVL
 K.Masterson
 07/16/07

Legend

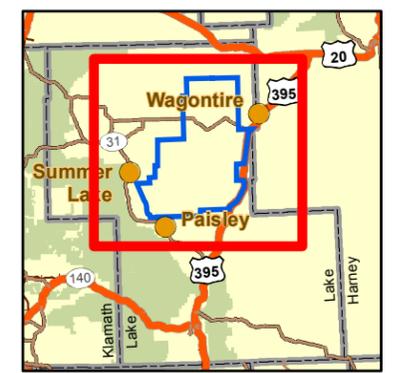
- Central Oregon Gunnery Range Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)
- Alkali Lake Disposal Site

NOTES:

- 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
- 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.



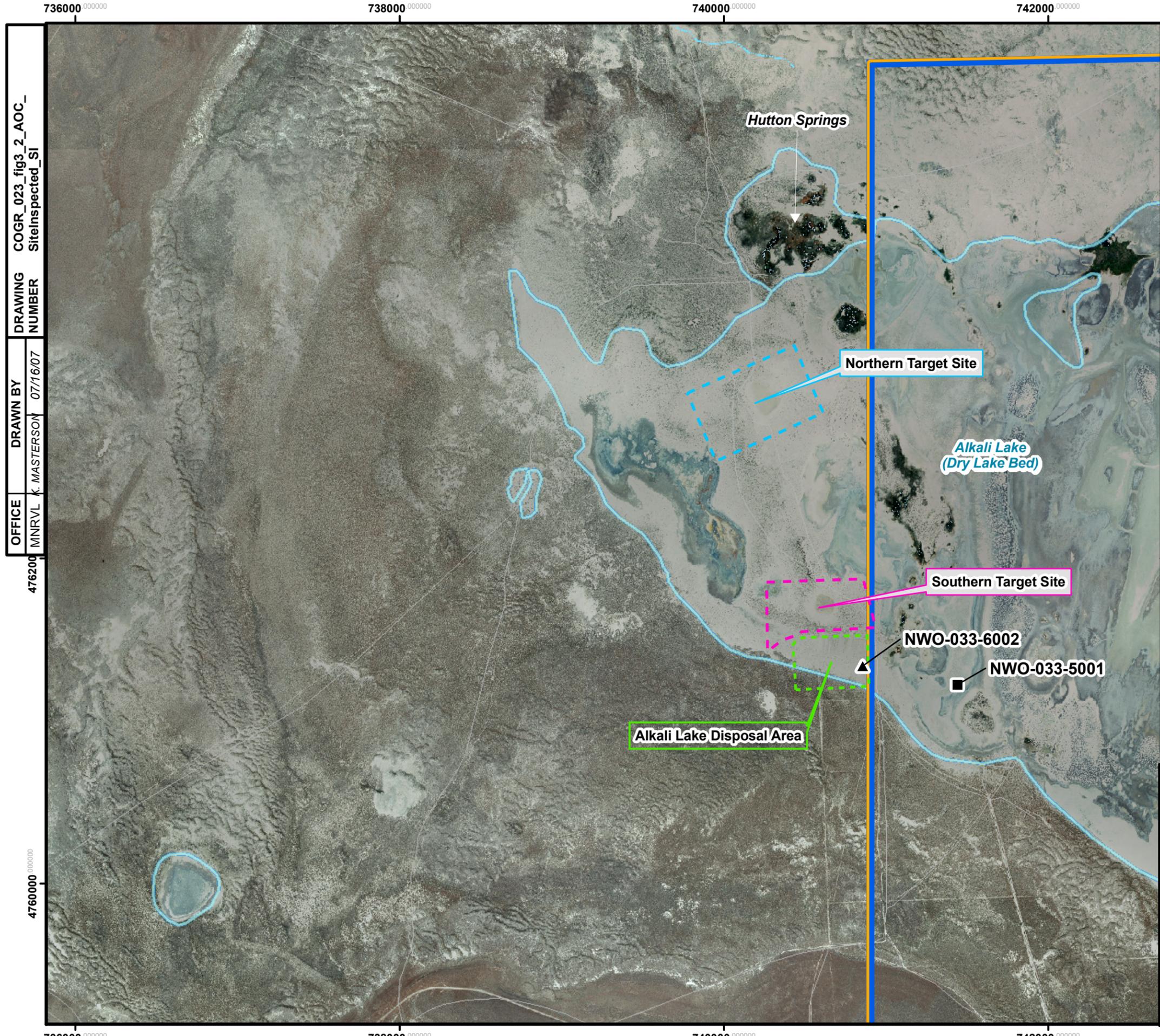
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 3-1
SITE INSPECTION
AREAS OF CONCERN
CENTRAL OREGON GUNNERY RANGE

Shaw Environmental, Inc.



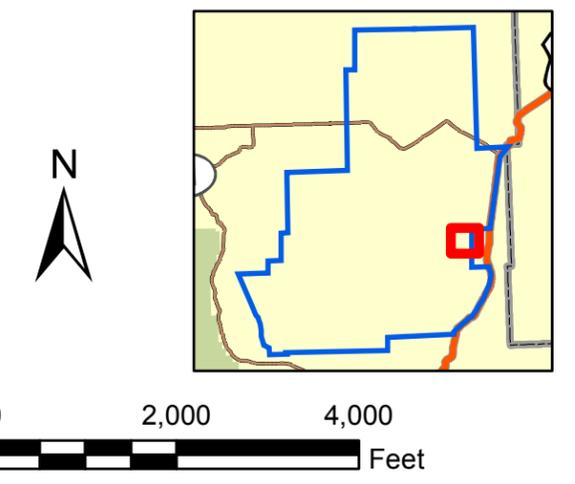
OFFICE: MNRVL K. MASTERSON
 DRAWN BY: 07/16/07
 DRAWING NUMBER: COGR_023_fig3_2_AOC_SiteInspected_SI

Legend

- Central Oregon Gunnery Range Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Alkali Lake Disposal Site
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)
- Lake Boundary
- Background Groundwater Sample
- Background Sediment Sample

NOTES:

- 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
- 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.

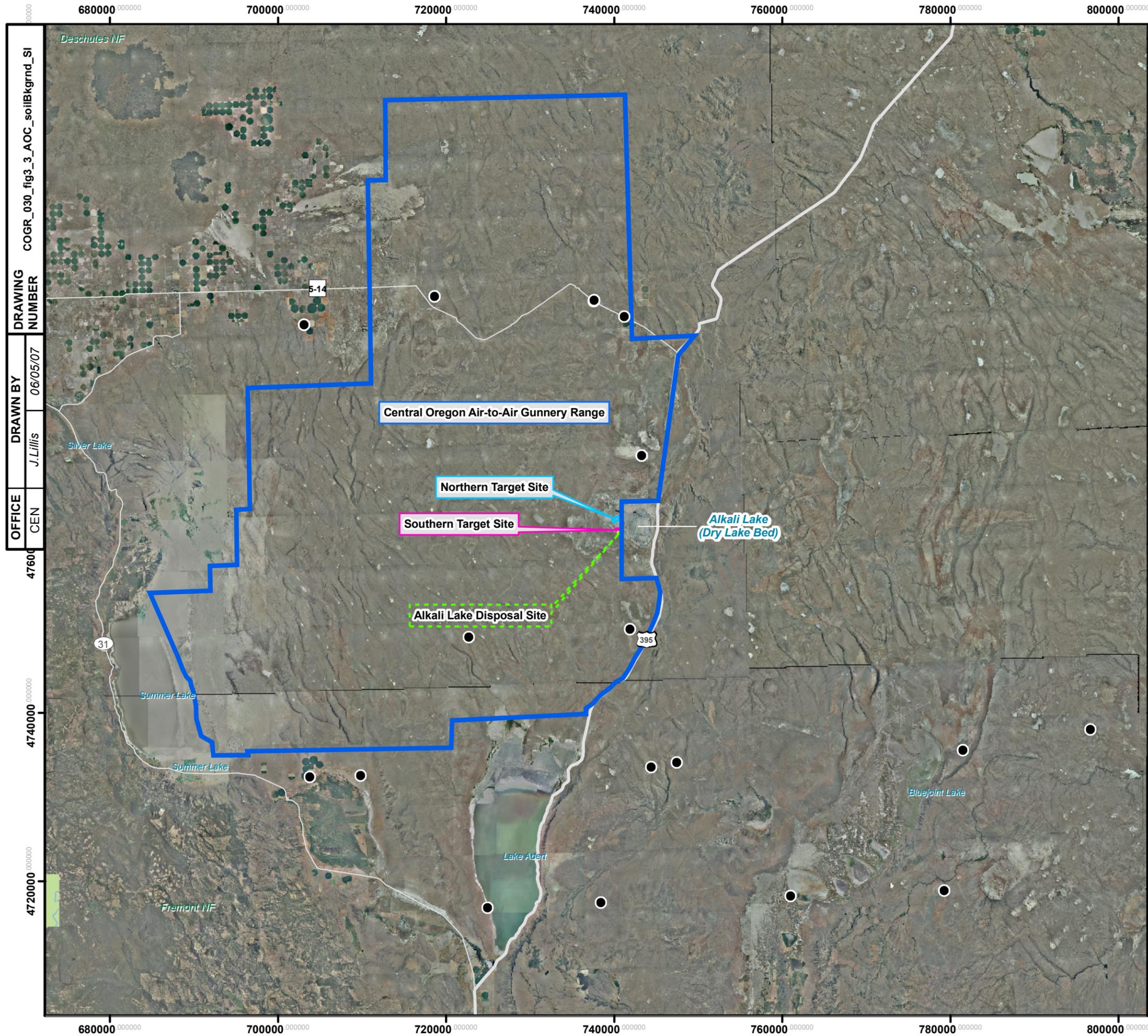


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 3-2
SEDIMENT AND GROUNDWATER
BACKGROUND SAMPLE LOCATIONS
 CENTRAL OREGON GUNNERY RANGE



680000 000000 700000 000000 720000 000000 740000 000000 760000 000000 780000 000000 800000 000000

4820000 000000
4800000 000000
4780000 000000
4760000 000000
4740000 000000
4720000 000000

COGR_030_fig3_3_AOC_soilBkgnd_SI
DRAWING NUMBER
DRAWN BY J.Lillis 06/05/07
OFFICE CEN

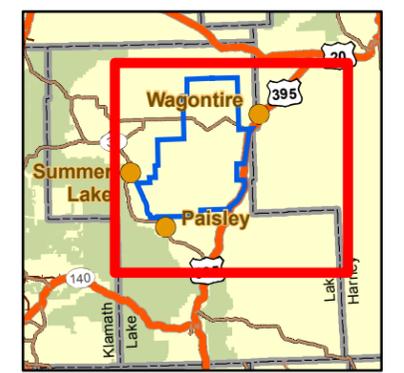
Legend

- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Northern Target Site
- Southern Target Site
- Alkali Lake Disposal Site
- Background Soil Sample

NOTES:
 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 3-3
SOIL BACKGROUND
SAMPLE LOCATIONS

CENTRAL OREGON GUNNERY RANGE





OFFICE: MNRV/LK
 DRAWN BY: MASTERSON
 DRAWING NUMBER: COGR_024_fig4_1_AOC_Recon_SI
 DATE: 06/05/07

Legend

- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Alkali Lake Disposal Site
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)
- Lake Boundary
- Reconnaissance Path Driven
- Reconnaissance Path Walked
- Photograph Location
- Background Groundwater Sample
- Background Sediment Sample
- Groundwater Sample
- Sediment Sample
- Soil Sample

NOTES:
 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.

North arrow pointing up.

Scale bar: 0, 1,000, 2,000 Feet

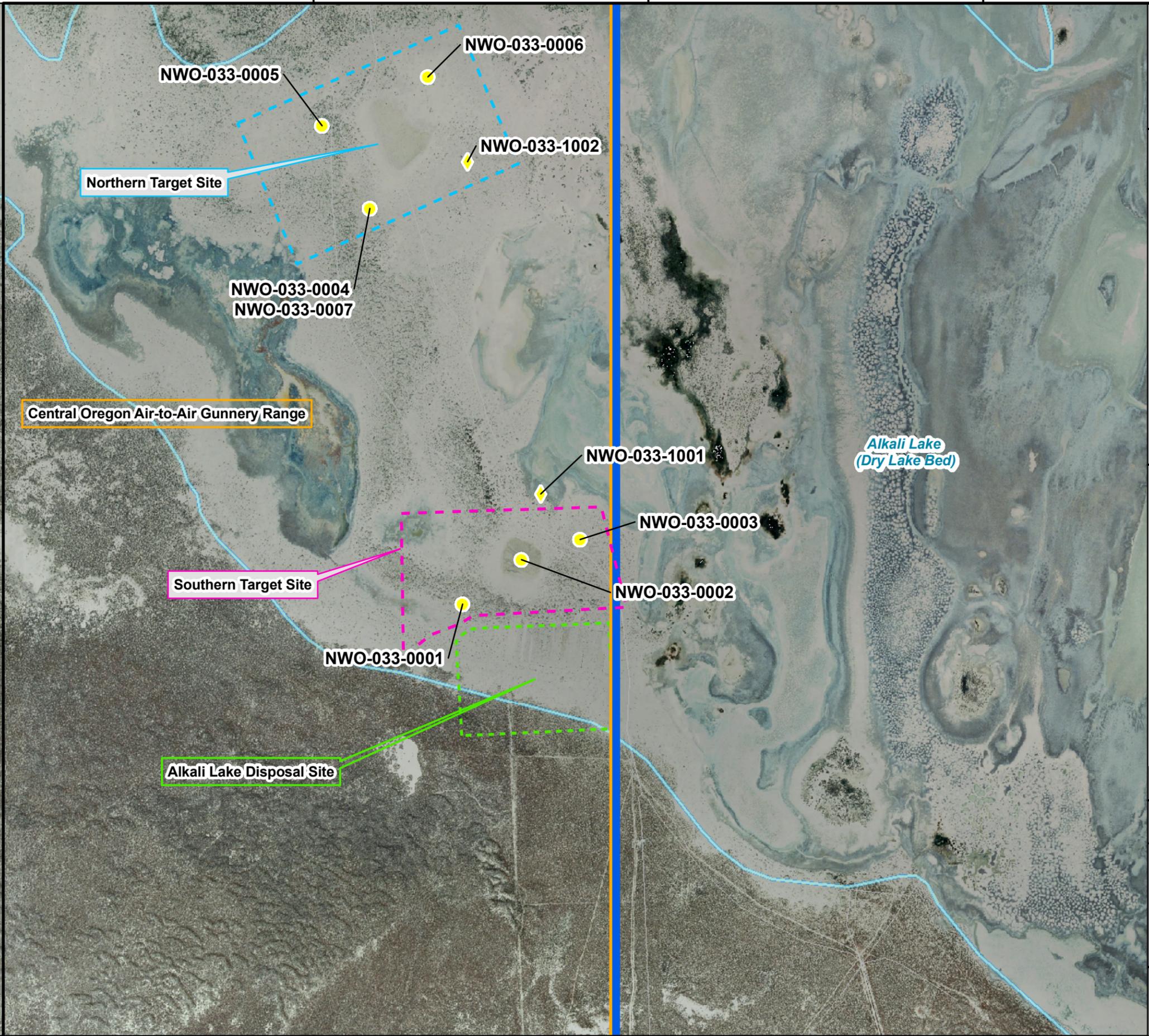
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 4-1
TARGET SITES RECONNAISSANCE
 CENTRAL OREGON GUNNERY RANGE

Shaw® Shaw Environmental, Inc.

DRAWING COGR_025_fig4_2_AOC_Metals_SI
 NUMBER
 OFFICE MNRVLA MASTERSON 07/16/07
 DRAWN BY



Legend

- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Alkali Lake Disposal Site
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)
- Lake Boundary
- Sediment Sample Results were less than Background or Ecological or Human Health Screening Levels
- Soil Sample Results were less than Background or Ecological or Human Health Screening Levels

NOTES:

- 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
- 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.

4762000

4763000

0 1,000 2,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 4-2
METALS RESULTS
TARGET SITES
 CENTRAL OREGON GUNNERY RANGE

Shaw® Shaw Environmental, Inc.

4761000

740000

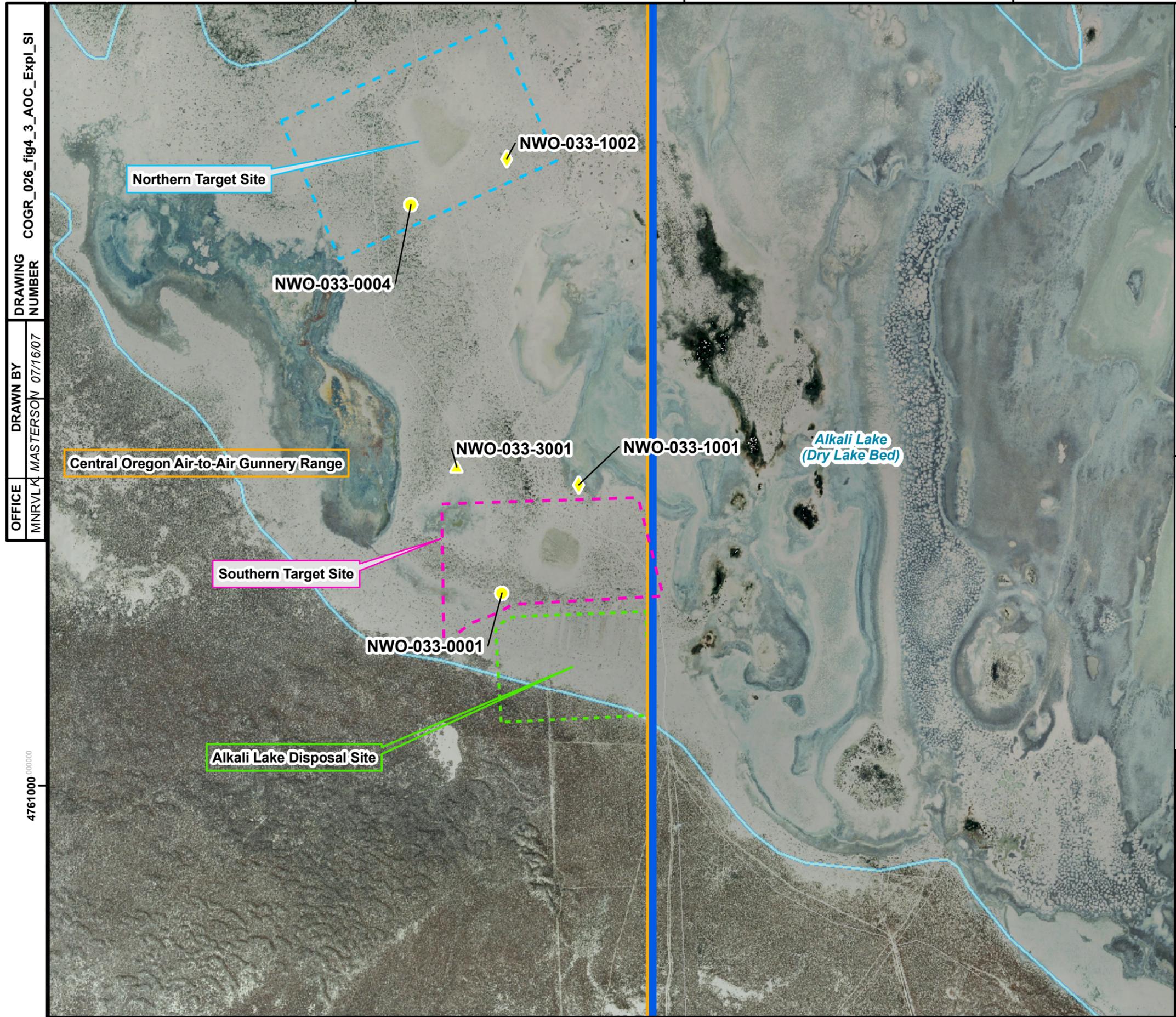
741000

742000

740000

741000

742000



OFFICE: MNRV/LK
 DRAWN BY: MASTERSON
 DRAWING NUMBER: COGR_026_fig4_3_AOC_Expl_SI

Legend

- Central Oregon Gunnery Range
- Approximate FUDS Boundary
- Central Oregon Air-to-Air Gunnery Range AOC
- Alkali Lake Disposal Site
- Northern Target Site (Focus Area within AOC)
- Southern Target Site (Focus Area within AOC)
- Lake Boundary
- Groundwater Perchlorate Results were less than Background or Ecological or Human Health Screening Levels
- Sediment Explosives Sample Results were less than Background or Ecological or Human Health Screening Levels
- Soil Explosives Sample Results were less than Background or Ecological or Human Health Screening Levels

NOTES:

- FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
- Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.

4761000

4762000

4763000

0 1,000 2,000 Feet

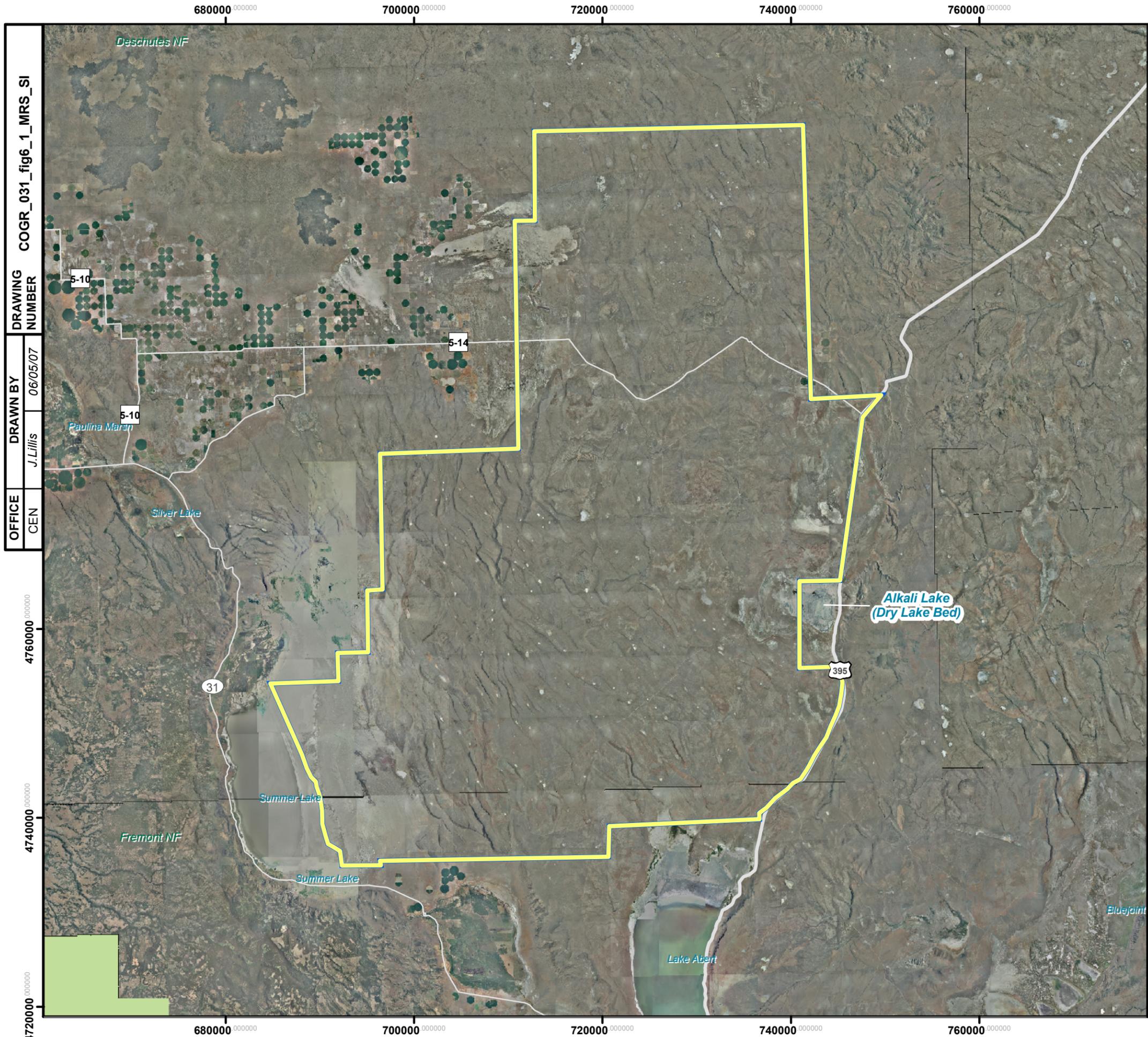
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 4-3
EXPLOSIVES AND PERCHLORATE RESULTS
TARGET SITES

CENTRAL OREGON GUNNERY RANGE

Shaw® Shaw Environmental, Inc.

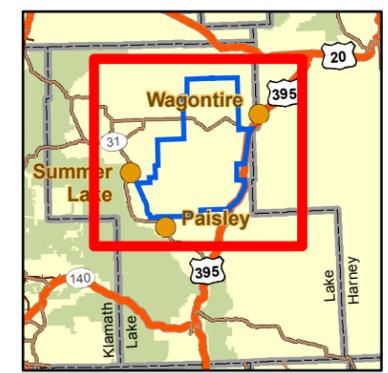


OFFICE: CEN
 DRAWN BY: J. Lillis
 DRAWING NUMBER: 06/05/07
 COGR_031_fig6_1_MRS_SI

Legend

 Munitions Response Site No. 1

NOTES:
 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.
 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2005.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 6-1
MUNITIONS RESPONSE SITE
 CENTRAL OREGON GUNNERY RANGE



Tables

**Table 2-1
Munitions Information
Central Oregon Gunnery Range**

Area of Concern	Munitions	Munitions Constituents
Air to Air Gunnery Range	.50-caliber machine gun	Lead, single- (nitrocellulose) or double-base (nitrocellulose and nitroglycerin) propellant, perchlorate
	20 mm ball M55A1, MK1	Steel (chromium, copper, iron, molybdenum, and nickel), double-base (nitrocellulose and nitroglycerin) propellant
	AN-MK 5, AN-MK 23, and AN-MK 43 practice bombs	Cast iron (iron), sheet metal (iron), 10-gauge shotgun shell with single- (nitrocellulose) or double-base (nitrocellulose and nitroglycerin) propellant, red and white phosphorus

Table 2-2
Army Checklist for Important Ecological Places ^a
Central Oregon Gunnery Range

		Yes / No	Comments
1	Locally important ecological place identified by the Integrated Natural Resource Management Plan, BRAC Cleanup Plan or Redevelopment Plan, or other official land management plans	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
2	Critical habitat for Federal designated endangered or threatened species	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
3	Marine Sanctuary	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
4	National Park	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
5	Designated Federal Wilderness Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
6	Areas identified under the Coastal Zone Management Act	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
7	Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
8	Critical areas identified under the Clean Lakes Program	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
9	National Monument	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
10	National Seashore Recreational Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
11	National Lakeshore Recreational Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
12	Habitat known to be used by Federal designated or proposed endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Threatened or endangered species that may be present at the Site area include the Hutton Tui Chub. Other Federally listed species may occasionally use portions of the COGR.
13	National preserve	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
14	National or State Wildlife Refuge	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
15	Unit of Coastal Barrier Resources System	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
16	Coastal Barrier (undeveloped)	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
17	Federal land designated for protection of natural ecosystems	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
18	Administratively Proposed Federal Wilderness Area	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
19	Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

Table 2-2 (Cont.)

		Yes / No	Comments
20	Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
21	Terrestrial areas utilized for breeding by large or dense aggregations of animals	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
22	National river reach designated as Recreational	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
23	Habitat known to be used by state designated endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Threatened or endangered species that may be present at the Site area include the Hutton Tui chub and the Western Snowy Plover Other State listed species may occasionally use portions of the COGR.
24	Habitat known to be used by species under review as to its Federal endangered or threatened status	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
25	Coastal Barrier (partially developed)	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
26	Federally designated Scenic or Wild River	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
27	State land designated for wildlife or game management	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
28	State-designated Scenic or Wild River	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
29	State-designated Natural Areas	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
30	Particular areas, relatively small in size, important to maintenance of unique biotic communities	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
31	State-designated areas for protection or maintenance of aquatic life	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
32	Wetlands	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
33	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Soils very thin due to volcanic character, assumed to be fragile landscape.

^a Based on EPA, 1990, 55 FR 51624, Table 4-23 – Sensitive Environments Rating Values, Dec. 14, 1990; EPA, 1997, ERAGS, Exhibit 1-1 List of Sensitive Environments

**Table 3-1
Summary of Central Oregon Gunnery Range Background Values ^a**

Analyte	Soil Background Concentration 95th UTL/95th Percentile ^b (Based on 24 Samples) (mg/kg)	Sediment Background Concentration (Based on 1 Sample ^c) (mg/kg)	Groundwater Background Concentration (Based on 1 Sample ^c) (µg/L)
Chromium	81	11.4	NA
Copper	54	9.9	NA
Iron	65,200	8,060	NA
Lead	29	2	NA
Molybdenum	6.9	30.9	NA
Nickel	48	8.1	NA
Perchlorate	NA	NA	0.229

Note: 95th UTLs are provided for analytes with normal or lognormal distributions. 95th percentiles are provided for analytes with distributions that are neither normal nor lognormal, or that have greater than 15 percent nondetects (per EPA, 1989).

mg/kg – milligrams per kilogram

UTL – Upper tolerance limit

NA – sample not analyzed for parameter

^a United States Geological Survey. National Geochemical Survey Database. 2006.

^b Supporting calculations for soil background values are provided in Appendix L.

^c Background sample analytical results provided in Appendix G.

Table 3-2
Human Health Screening Criteria for Soil/Sediment and Groundwater
for Central Oregon Gunnery Range ^a

Analyte	Abbreviation	Soil/Sediment Human Health Screening Values (mg/kg)	Groundwater Human Health Screening Values (µg/L)
Explosives			
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	4.4	0.61
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	3,100	1,800
2,4,6-Trinitrotoluene	2,4,6-TNT	16	2.2
1,3,5-Trinitrobenzene	1,3,5-TNB	1,800	1,100
1,3-Dinitrobenzene	1,3-DNB	6.1	3.6
2,4-Dinitrotoluene	2,4-DNT	0.72	0.099
2,6-Dinitrotoluene	2,6-DNT	0.72	0.099
2-Amino-4,6-dinitrotoluene	2-Am-DNT	12	7.3
2-Nitrotoluene	2-NT	0.88	0.049
3-Nitrotoluene	3-NT	730	120
4-Amino-2,6-dinitrotoluene	4-Am-DNT	12	7.3
4-Nitrotoluene	4-NT	12	0.66
Nitrobenzene	NB	20	3.4
Nitroglycerin	NG	35	NVA
Pentaerythritol tetranitrate	PETN	0.50	NVA
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	610	360
Metals/Inorganics			
Chromium ^b	Cr	210	100
Copper	Cu	3,100	1,300
Iron	Fe	23,000	11,000
Lead	Pb	400	15
Molybdenum	Mo	390	180
Nickel	Ni	1,600	730
Perchlorate		NVA	24

mg/kg – milligrams per kilogram

µg/L – micrograms per liter

NVA – no value available

^a Selection of human health screening values is provided in the Final TPP Memorandum (Shaw, 2006) in Appendix B of this SI Report.

^b Total chromium values used.

**Table 3-3
Ecological Soil and Sediment Screening Values for Central Oregon Gunnery Range ^a**

Analyte	Abbreviation	Soil Ecological Screening Value (mg/kg)	Sediment Ecological Screening Value (mg/kg)
Metals/Inorganics			
Chromium (total)	Cr	0.4	37
Copper	Cu	50	10
Iron	Fe	10	20
Lead	Pb	16	35
Molybdenum	Mo	2	NVA
Nickel	Ni	30	18
Explosives			
2,4-Dinitrotoluene	2,4-DNT	1.28	0.29
2,6-Dinitrotoluene	2,6-DNT	0.0328	1.9
2-Amino-4,6-Dinitrotoluene	2-Am-4,6-DNT	2.1	7.0
4-Amino-2,6-Dinitrotoluene	4-Am-2,6-DNT	0.73	1.9
1,3-Dinitrobenzene	1,3-DNB	0.655	0.067
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	27	0.047
Nitrobenzene	NB	8	32
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	7.5	0.13
1,3,5-Trinitrobenzene	1,3,5-TNB	0.376	0.024
2,4,6-Trinitrotoluene	2,4,6-TNT	6.4	0.92
2-Nitrotoluene	2-NT	2.0	5.6
3-Nitrotoluene	3-NT	2.4	4.9
4-Nitrotoluene	4-NT	4.4	10
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	0.99	100
Pentaerythritol tetranitrate	PETN	8600	120,000
Nitroglycerin	NG	71	1,700

mg/kg = milligrams per kilogram
NVA = No value available

^a Selection of ecological screening values is provided in the Final TPP Memorandum (Shaw, 2006) in Appendix B of this SI Report.

Table 4-1A
Comparison of South Target Area Soil Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Central Oregon Gunnery Range

Location						033A001		033A002		033A003	
Sample Date						13-Feb-07		13-Feb-07		13-Feb-07	
Sample Number						NWO-033-0001		NWO-033-0002		NWO-033-0003	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ
Explosives	Nitrobenzene	mg/kg	No criteria	2.4	20	< 0.006	U	NA		NA	
Metals	Chromium	mg/kg	81	.4	210	<i>34.4</i>		<i>18.7</i>		<i>27.7</i>	
Metals	Copper	mg/kg	54	50	3100	18.9		19.9		17.4	
Metals	Iron	mg/kg	65200	10	23000	<i>15400</i>		<i>14800</i>		<i>14100</i>	
Metals	Lead	mg/kg	29	16	400	3.3		3.3		3.3	
Metals	Molybdenum	mg/kg	6.9	2	390	0.51	J	149		0.54	J
Metals	Nickel	mg/kg	48	30	1600	17		16.6		15.6	

Notes:

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

PQL - practical quantitation limit

MDL - method detection limit

mg/kg - milligram per kilogram

VQ - validation qualifier

NA - not analyzed

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

UJ - The compound/analyte was analyzed for, but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

Table 4-1B
Comparison of North Target Area Soil Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Central Oregon Gunnery Range

Location						033A005		033A005		033A006		033A007	
Sample Date						13-Feb-07		13-Feb-07		13-Feb-07		13-Feb-07	
Sample Number						NWO-033-0004		NWO-033-0007		NWO-033-0005		NWO-033-0006	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5		0 to 0.5		0 to 0.5	
Sample Purpose						REG		FD		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Explosives	Nitrobenzene	mg/kg	No criteria	2.4	20	0.049	J	0.043	J	NA		NA	
Metals	Chromium	mg/kg	81	.4	210	<i>24</i>		<i>24</i>		<i>16</i>		<i>23.9</i>	
Metals	Copper	mg/kg	54	50	3100	20		19.8		14.6		26.2	
Metals	Iron	mg/kg	65200	10	23000	<i>14800</i>		<i>14900</i>		<i>12400</i>		<i>19300</i>	
Metals	Lead	mg/kg	29	16	400	3.7		3.7		2.7		4.3	
Metals	Molybdenum	mg/kg	6.9	2	390	32.4		29.1		2.1	J	20.9	
Metals	Nickel	mg/kg	48	30	1600	16.4		16.5		12.4		22.1	

Notes:

[**Bold**] - Result exceeds Site Inspection Background 95th UTL / 95th Percentile

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[Underline] - Result exceeds EPA Region 9 PRG - Residential Soil

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

PQL - practical quantitation limit

MDL - method detection limit

mg/kg - milligram per kilogram

VQ - validation qualifier

NA - not analyzed

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

UJ - The compound/analyte was analyzed for, but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.

Table 4-2
Comparison of Sediment Detected Analytical Results to Site Background,
Human Health, and Ecological Screening Values
Central Oregon Gunnery Range

Location							033A004	033A008			
Sample Date							13-Feb-07	13-Feb-07			
Sample Number							NWO-033-1001	NWO-033-1002			
Sample Depth (bgs) (ft)							0 to 0.5	0 to 0.5			
Sample Purpose							REG	REG			
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	
Explosives	Nitrobenzene	mg/kg	No criteria	No criteria	32	20	0.029	J	0.041	J	
Metals	Aluminum	mg/kg	8680	26040	280	76000	<i>10800</i>		<i>10800</i>		
Metals	Chromium	mg/kg	11.4	34.2	37	210	18		11.1		
Metals	Copper	mg/kg	9.9	29.7	10	3100	<i>12.4</i>		<i>10.7</i>		
Metals	Iron	mg/kg	8060	24180	20	23000	<i>10300</i>		<i>9400</i>		
Metals	Lead	mg/kg	2	6	35	400	2.6		2.7		
Metals	Molybdenum	mg/kg	30.9	92.7	No criteria	390	2.5	J	10.9		
Metals	Nickel	mg/kg	8.1	24.3	18	1600	10.3		8.9		

Notes:

[**Bold Face**] - Result exceeds "3x" Maximum Concentration from Media Background Sample

[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level

[UNDERLINED] - Result exceeds EPA Region 9 PRG - Residential Soil

bgs - below ground surface

ft - feet

USEPA - Environmental Protection Agency

PRG - Preliminary Remediation Goal

PQL - practical quantitation limit

MDL - method detection limit

REG - regular sample

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

U - Not detected. The compound/analyte was analyzed for, but not detected above the associated reporting limit.

J - The compound/analyte was positively identified; the reported value is the estimated concentration of the constituent detected in the sample analyzed.

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be verified based on the data provided, 4. To indicate not to use a particular result in the event of a reanalysis.

UJ - The compound/analyte was analyzed for, but not detected above the established reporting limit. However, review and evaluation of supporting QC data and/or sampling and analysis process have indicated that the reporting limit may be inaccurate or imprecise. The nondetect result should be estimated.