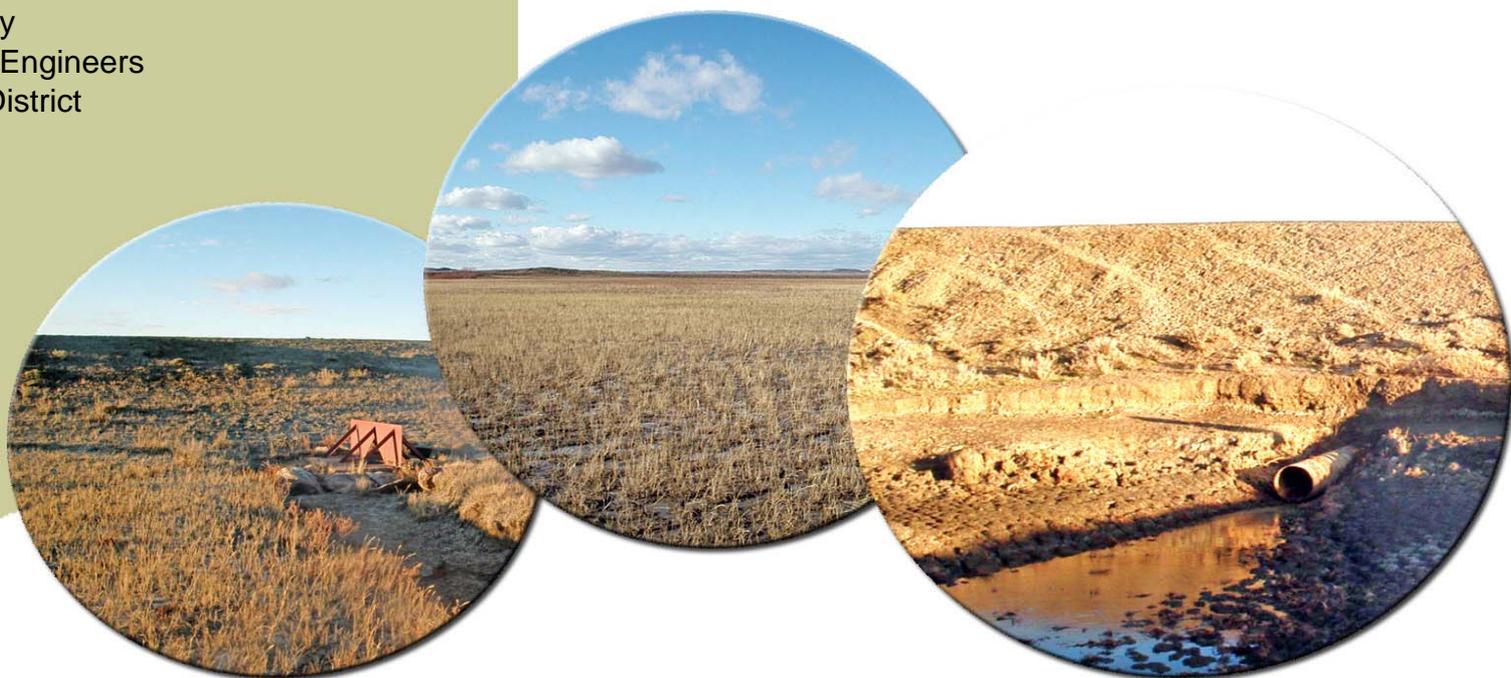




U.S. Army  
Corps of Engineers  
Omaha District



# DRAFT 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

July 2007



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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.

DRAFT FINAL

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Military Munitions Response Program

July 2007

Submitted to:

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

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## List of Acronyms

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°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
MRSP	Munitions Response Site Prioritization Protocol
NCP	National Contingency Plan
NDAI	No Department of Defense Action Indicated

## *List of Acronyms (cont.)*

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NWO	Northwest Region (Omaha District Military Munitions Design Center)
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OR	Oregon
PSAP	Program Sampling and Analysis Plan
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
TCRA	time-critical removal action
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*

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### **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*

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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.

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

55 *Removal Actions*

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

59 A recommendation is made that the area of the MRS in the MMRP range inventory should be  
60 corrected to 795,057 acres.

## 61 **1.0 Introduction**

---

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

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

### 72 **1.1 Project Authorization**

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

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

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

### 90 **1.2 Site Name and Location**

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

94 in the *Archives Search Report (ASR) Supplement* (USACE, 2004b), with one identified range as  
95 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

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

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

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

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

### 104 *1.3 Purpose, Scope, and Objectives of the Site Inspection*

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

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

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

- 123 • There is no indication of MEC;  
124 and

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

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

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

134                   • MC contamination exceeds screening levels determined from TPP.

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

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

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

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

#### 150 ***1.4 Munitions Response Site Prioritization Protocol***

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

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

## 159 *2.0 Property Description and History*

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

### 162 *2.1 Historical Military Use*

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

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

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

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

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

### 186 *2.2 Munitions Information*

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

191 **2.3 Ownership History**

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

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

203 **2.4 Physical Setting**

204 **2.4.1 Topography and Vegetation**

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

209 **2.4.2 Land Use**

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

215 The Alkali Lake Disposal Site is located adjacent to and south of the southern target site (Figure  
216 2-2B). The site is a hazardous waste disposal site consisting of a series of 12 shallow unlined  
217 disposal trenches each approximately 400 ft long. Wastes disposed include herbicide residue,  
218 metallic chloride waste, paint and paint solvent, and dioxins/furans. There is an approximately  
219 2,000-ft-long groundwater plume (phenols, dioxins, and 2,4-toluenediamine) extending to the  
220 west-northwest. The site is currently monitored by the ODEQ.

221 **2.4.3 Nearby Population**

222 The nearest incorporated community to the former COGR is Lakeview, OR, with an estimated  
223 population of 2,474 (U.S. Census, 2000) (Figure 2-4). Lake County, OR, has a population of  
224 7,422 with an average of 0.9 people per square mile (U.S. Census, 2000). There are no schools  
225 located within 4 miles of the FUDS (Figure 2-5). Estimated population (2000 census) within a

226 4-mile radius of the COGR FUDS property boundary is 409. The estimated numbers of housing  
227 units and households within a 4-mile radius are 277 and 177, respectively.

#### 228 *2.4.4 Climate*

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

#### 235 *2.4.5 Area Water Supply*

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

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

#### 245 *2.4.6 Geologic and Hydrogeologic Setting*

246 The COGR lies within the Walla Walla Plateaus section of the Columbia Intermontane  
247 Physiographic Province.

##### 248 *2.4.6.1 Bedrock Geology*

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

##### 255 *2.4.6.2 Overburden Soils*

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

##### 259 *2.4.6.3 Hydrogeology*

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

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

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

#### 270 *2.4.7 Sensitive Environments*

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

#### 278 *2.5 Previous Investigations for MEC and MC*

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

##### 281 *2.5.1 Inventory Project Report*

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

##### 286 *2.5.2 Archives Search Report*

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

296 **2.5.3 ASR Supplement**

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

299 **2.5.4 Other Investigations**

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

303 In 1988, the 34<sup>th</sup> Ordnance Detachment at the Sierra Army Depot, in Herlong, California,  
304 disposed by detonation an AN-MK 43 practice bomb, near the town of Christmas Valley, OR.  
305 This location is outside but near the COGR FUDS northwest boundary (approximately 2 miles).  
306 However, the practice bomb may be related to the unregulated practice bombing that occurred at  
307 COGR.

308 **2.6 Other Land Uses that May Have Contributed to Contamination**

309 The Alkali Lake Disposal Site is located adjacent to and south of the southern target site (Figure  
310 2-1). The site is a hazardous waste disposal site consisting of a series of 12 shallow unlined  
311 disposal trenches each approximately 400 ft long. About 25,000 drums of pesticide  
312 manufacturing wastes were disposed here in the late 1960’s and early 1970’s. Wastes disposed  
313 include herbicide residue, metallic chloride waste, paint and paint solvent, and dioxins/furans.  
314 There is an approximately 2,000-ft-long groundwater plume extending to the west-northwest.  
315 The primary contaminants are phenols, dioxins, and 2,4-toluenediamine. The site is currently  
316 monitored by the ODEQ (ODEQ, 2007).

317 **2.7 Past Regulatory Activities**

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

319 **2.8 Previous MEC Finds**

320 A .50-caliber ammunition belt was found in the northern portion of the FUDS in 1990. In 1988,  
321 the 34<sup>th</sup> Ordnance Detachment at the Sierra Army Depot, in Herlong, California, disposed by  
322 detonation an AN-MK 43 practice bomb, near the town of Christmas Valley, Oregon. This  
323 location is outside but near the COGR FUDS northwest boundary. It may have been related to  
324 practice bombing at COGR FUDS.

## 325 3.0 *SI Tasks and Findings*

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

### 332 3.1 *Technical Project Planning*

333 TPP involved compiling and reviewing historical reports and information to identify data gaps  
334 and develop a path forward. A TPP meeting for the former COGR was held at the BLM offices  
335 in Lakeview, OR, on July 17, 2006. Representatives from the USACE – Seattle District, Oregon  
336 Department of Environmental Quality (ODEQ), BLM – Lakeview office, and Shaw were in  
337 attendance. A representative from the USACE – Omaha District was unable to attend this  
338 meeting.

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

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

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

356 The BLM archeologist discussed that he had walked most of FUDS and had found projectiles  
357 and casings (mostly .50-caliber and very few 20 mm) throughout the FUDS. He also noted that  
358 he had found a few discarded .50-caliber ammunition belts within the range. He has prepared  
359 several archeological reports that include discussions of the density of munitions. Follow up

360 discussions were held with the BLM archeologist. He stated that it appears that the Army pilots  
361 would use the barren playa lakes as targets for practice bombing and strafing with .50-caliber  
362 guns. These occurrences were scattered throughout the COGR area. Because collectors have  
363 picked up munitions debris as souvenirs, fewer practice bombs are being discovered now than at  
364 previous times. He has never seen munitions other than expended practice bombs or 20 mm and  
365 .50-caliber bullets and casings.

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

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

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

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

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

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

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

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

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

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

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

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

431 **3.2 Additional Records Research**

432 **3.2.1 Coordination with State Historic Preservation Office**

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

439 **3.2.2 Coordination with Natural Resources Offices**

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

446 **3.2.3 Historical Aerial Photographs**

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

452 **3.2.4 Environmental Database Search**

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

459 **3.2.5 Rights of Entry**

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

463 **3.3 Field Work**

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

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

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

### 473 **3.4 *Sampling and Analysis***

474 Sampling included collection of surface soil, sediment, and groundwater samples. Samples were  
475 collected and analyzed in accordance with the SSWP (Shaw, 2006a) using the standard operating  
476 procedures (SOPs) from the *Type 1 Work Plan, Site Inspections at Multiple Sites, NWO Region*  
477 (Shaw, 2006a).

### 478 **3.5 *Laboratory Analysis and Data Quality Review***

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

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

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

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

### 506 *3.6 Screening Values*

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

#### 508 *3.6.1 Background Data*

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

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

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

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

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

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

548 In the discussions that follow in Section 4, these criteria are used to determine whether a release  
549 of MC has occurred in sediment and groundwater regardless of whether the analyte is considered  
550 a hazardous substance. However, these criteria are not applied for soils because a statistically  
551 based determination of background has been established, and an exceedance of the 95<sup>th</sup> UTL or  
552 95<sup>th</sup> percentile, depending on the individual analyte, is used to establish a release of MC.

### 553 **3.6.2 Human Health Screening**

554 Human health screening values for soil and sediment analytical results were established using the  
555 EPA Region 9 Preliminary Remediation Goals for Residential Soil. Table 3-2 lists the human  
556 health screening values that were agreed to during the TPP process.

### 557 **3.6.3 Ecological Screening**

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

### 565 **3.7 Variances from the SSWP**

566 There were no variances to the SSWP (Shaw, 2006c).

### 567 **3.8 Second TPP Meeting**

568 A second TPP Meeting is planned after the Draft Final SI Report is issued to present the SI  
569 findings to stakeholders and reach consensus regarding conclusions.

## 570 **4.0 Air to Air Gunnery Range**

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

### 572 **4.1 History and Land Use**

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

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

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

### 588 **4.2 Previous Investigations**

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

### 591 **4.3 MEC Evaluation**

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

#### 601 **4.3.1 Field Observations and Historical Evidence of MEC**

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

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

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

#### 614 **4.3.2 MEC Risk Assessment**

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

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

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

#### 629 **4.4 Munitions Constituents Evaluation**

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

##### 632 **4.4.1 Terrestrial Pathway**

633 Terrestrial receptors may be exposed to MC because soil was directly affected by firing at  
634 targets. Three surface soil samples from the south target (NWO-033-0001, NWO-033-0002, and  
635 NWO-033-0003) and three from the north target (NWO-033-0004, NWO-033-0005, NWO-033-  
636 0006, and field duplicate NWO-033-0007) were proposed and collected. Samples were analyzed  
637 for select metals (aluminum, chromium, copper, iron, lead, manganese, molybdenum, and nickel  
638 using EPA SW-846 Method 6020A. The metals list was based on the metals expected to be

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

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

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

#### 649 *4.4.1.1 Comparison to Background Data*

650 The detected metals were compared to the soil background concentrations. The comparison is  
651 shown on Tables 4-1A and 4-1B. Molybdenum exceeded background concentration of 6.9  
652 milligrams per kilogram (mg/kg) in soil samples NWO-033-0002 (149 mg/kg) at the south target  
653 and NWO-033-0004 (32.4 mg/kg), NWO-033-0006 (20.9 mg/kg), and field duplicate NWO-033-  
654 0007 (29.1 mg/kg) at the north target. Molybdenum is not a CERCLA hazardous substance and  
655 in accordance with USACE guidance additional comparisons to human health screening values  
656 and ESVs or recommendations for additional investigations are not made.

657 Nitrobenzene was detected at estimated quantities (0.049 J mg/kg and 0.043 J mg/kg) between  
658 the method detection limit and the laboratory reporting limit in sample NWO-033-0004 and its  
659 field duplicate NWO-033-0007, respectively. Nitrobenzene was the only explosive compound  
660 detected. Shaw has observed similar results at other FUDS and has required the laboratory to  
661 perform additional data review. Although the laboratory has confirmed the presence of  
662 nitrobenzene, the results are still open to question. The half-life of nitrobenzene was reported as  
663 56 days in an aerobic soil column (Kincannon, 1985). Therefore, nitrobenzene associated with  
664 military activities at a site more than 60 years before sample collection would have degraded to  
665 non-detectable concentrations. Nitrobenzene has industrial uses and may be found in pesticides  
666 (EPA, 1995a), but it is not clear that this can explain the distribution at COGR.

#### 667 *4.4.1.2 Comparison to Human Health Screening Values*

668 Soil analytical results are only compared to human health screening values if background  
669 concentrations are exceeded. Because there were no exceedances (other than molybdenum  
670 discussed above), no comparison to metals human health screening values is completed. The  
671 nitrobenzene detections of 0.049 J mg/kg and 0.043 J mg/kg were below the human health  
672 screening value of 20 mg/kg.

673 **4.4.1.3 Comparison to Ecological Screening Values**

674 Soil analytical results are only compared to ESVs if background concentrations are exceeded.  
675 Because there were no exceedances (other than molybdenum discussed above) no comparison to  
676 metals ESVs is completed. The nitrobenzene detections of 0.049 J mg/kg and 0.043 J mg/kg  
677 were below the ESV of 2.4 mg/kg.

678 A SLERA was completed for COGR and concluded that molybdenum was a metal of ecological  
679 concern. However, because molybdenum is not a CERCLA hazardous substance, no  
680 recommendations for additional investigations are made based on a molybdenum exceedance.

681 **4.4.2 Surface Water Pathway**

682 One sediment sample from each target (South – NWO-033-1001 and North – NWO-033-1002)  
683 was proposed and collected. The discrete samples were analyzed for select metals using EPA  
684 SW-846 Method 6020A and explosives, including nitroglycerin, using EPA SW-846 Method  
685 8330A.

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

689 **4.4.2.1 Comparison to Background**

690 The detected metals were compared to the sediment background concentrations. The  
691 comparisons are shown on Table 4-2. No metals concentrations significantly exceeded the  
692 sediment background concentration (three times the maximum background sediment sample  
693 concentration).

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

698 **4.4.2.2 Comparison to Human Health Screening Values**

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

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

703 **4.4.2.3 Comparison to Ecological Screening Values**

704 No detected metals concentrations significantly exceeded (three times the maximum background  
705 concentration) background concentrations and, therefore, no comparison to ESVs was  
706 completed.

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

708 **4.4.3 Groundwater Pathway**

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

718 The groundwater sample was collected using a peristaltic pump. The sample was filtered using a  
719 0.2-micron filter prior to filling the sample container.

720 **4.4.3.1 Comparison to Background**

721 Perchlorate was the only analyte for the groundwater sample. Perchlorate was not detected in the  
722 sample above the reporting limit of 0.122 microgram per liter ( $\mu\text{g/L}$ ). The COGR background  
723 value for perchlorate is 0.229  $\mu\text{g/L}$ . Because there was no perchlorate detected, comparison to  
724 human health and ESV is not completed.

725 **4.4.4 Air Pathway**

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

729 **5.0 Summary and Conclusions**

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

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

<b>Range Name</b>	<b>Range ID</b>	<b>Approximate area (acres)</b>	<b>UTM Coordinates (meters)</b>
Air to Air Gunnery Range	F10OR017001R01	795.06	N 4770451.8; E 720685.2

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

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

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

741 **5.1 Air to Air Gunnery Range**

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

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

749 Six surface soil samples, one sediment sample, and one groundwater sample were collected from  
750 the south and north target sites. Analytes included select metals and explosives in soil and  
751 sediment, and perchlorate in groundwater. There were no exceedances of soil or sediment  
752 background values for metals. Because there were no exceedances of metals background  
753 concentrations (other than for molybdenum), no comparison to human health or ESVs was  
754 completed. Low levels of nitrobenzene were detected in soil samples from the north target and  
755 in sediment samples from both the south and north targets. All nitrobenzene detections were  
756 well below human health and ESVs. A SLERA was completed for COGR and concluded that

757 molybdenum was a metal of ecological concern. However, because molybdenum is not a  
758 CERCLA hazardous substance, no further evaluation was completed.

## 759 **6.0 Recommendations**

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

### 762 **6.1 Air to Air Gunnery Range**

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

766 Sample results indicated that all metals concentrations were below background concentrations.  
767 An exception to this was for molybdenum, which did exceed the background value, and a  
768 SLERA was completed that identified molybdenum as a metal of ecological concern. However,  
769 because molybdenum is not a CERCLA hazardous substance and in accordance with USACE  
770 guidance, a recommendation for additional investigations based on molybdenum alone cannot be  
771 made. The explosive nitrobenzene was detected in several samples at low concentrations below  
772 the human health screening values and ESVs. Based on the low risk for MEC and no MC  
773 hazards, a recommendation for NDAI is made for the Air to Air Gunnery Range.

### 774 **6.2 Removal Actions**

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

### 780 **6.3 Munitions Response Sites**

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

783 Based on the use and physical distribution of the AOC at COGR, one MRS is identified (Figure  
784 6-1):

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

786 This MRS consists of the entire Central Oregon Gunnery Range FUDS property. A  
787 recommendation is made that the area of the MRS in the MMRP range inventory should be  
788 corrected to 795,057 acres.

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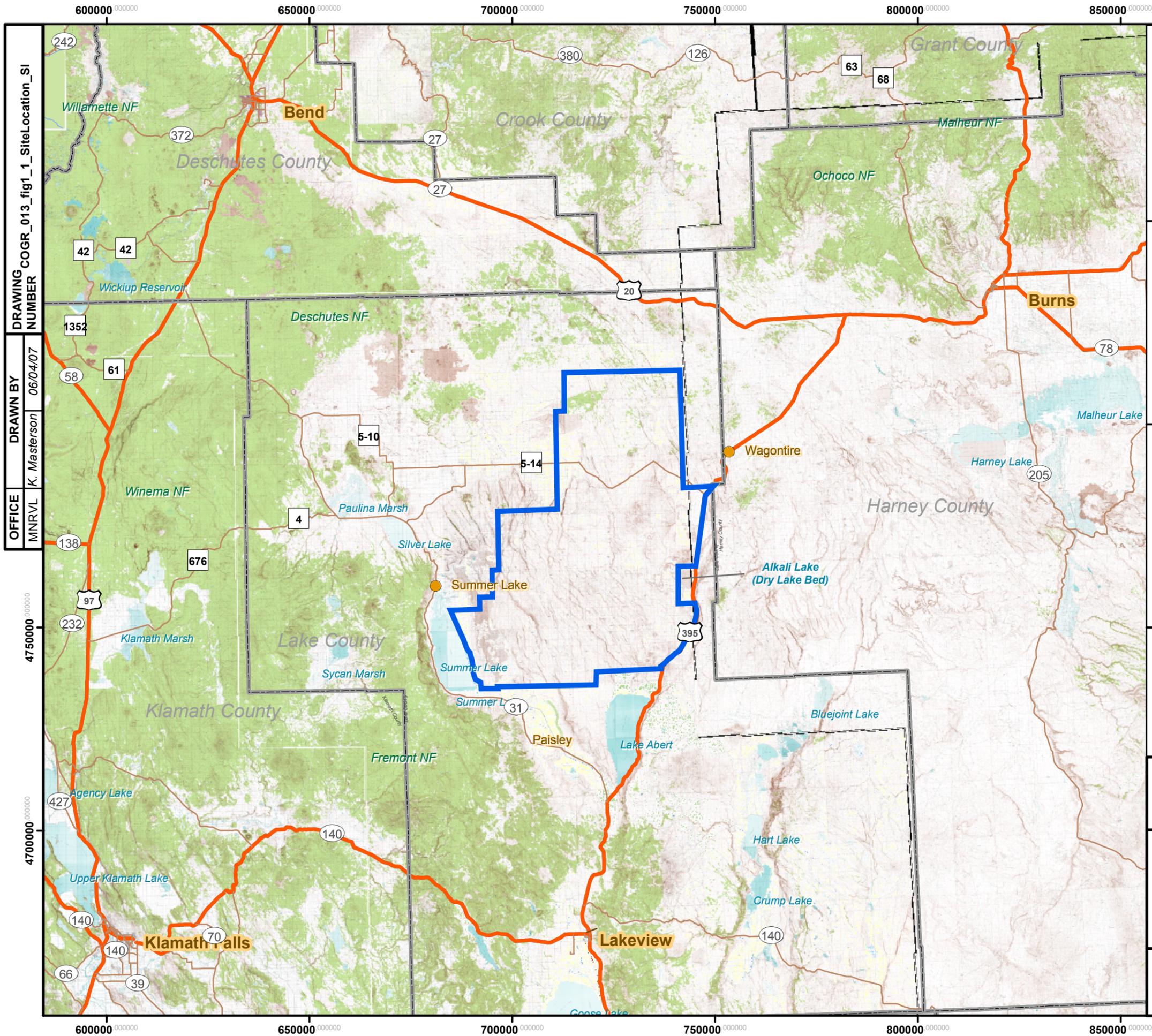
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## *Figures*



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



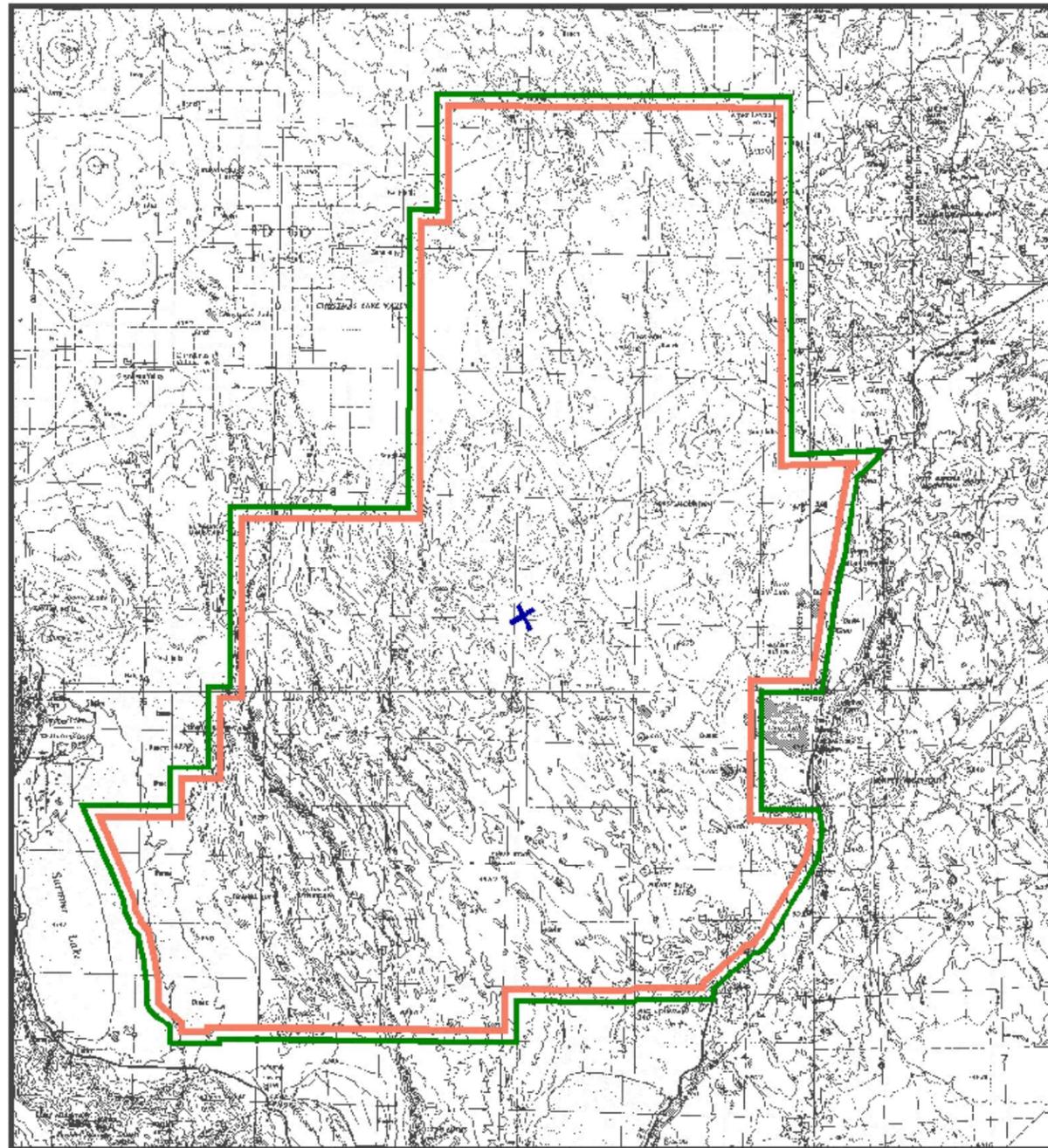
69000 72000 75000 78000 81000

DRAWING COGR\_014\_fig1\_2\_OriginalSiteLayout\_SI  
NUMBER

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

47700  
474000

471000



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.dwg

4830000

4800000

4770000

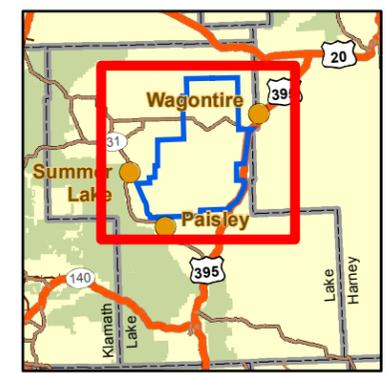
4740000

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



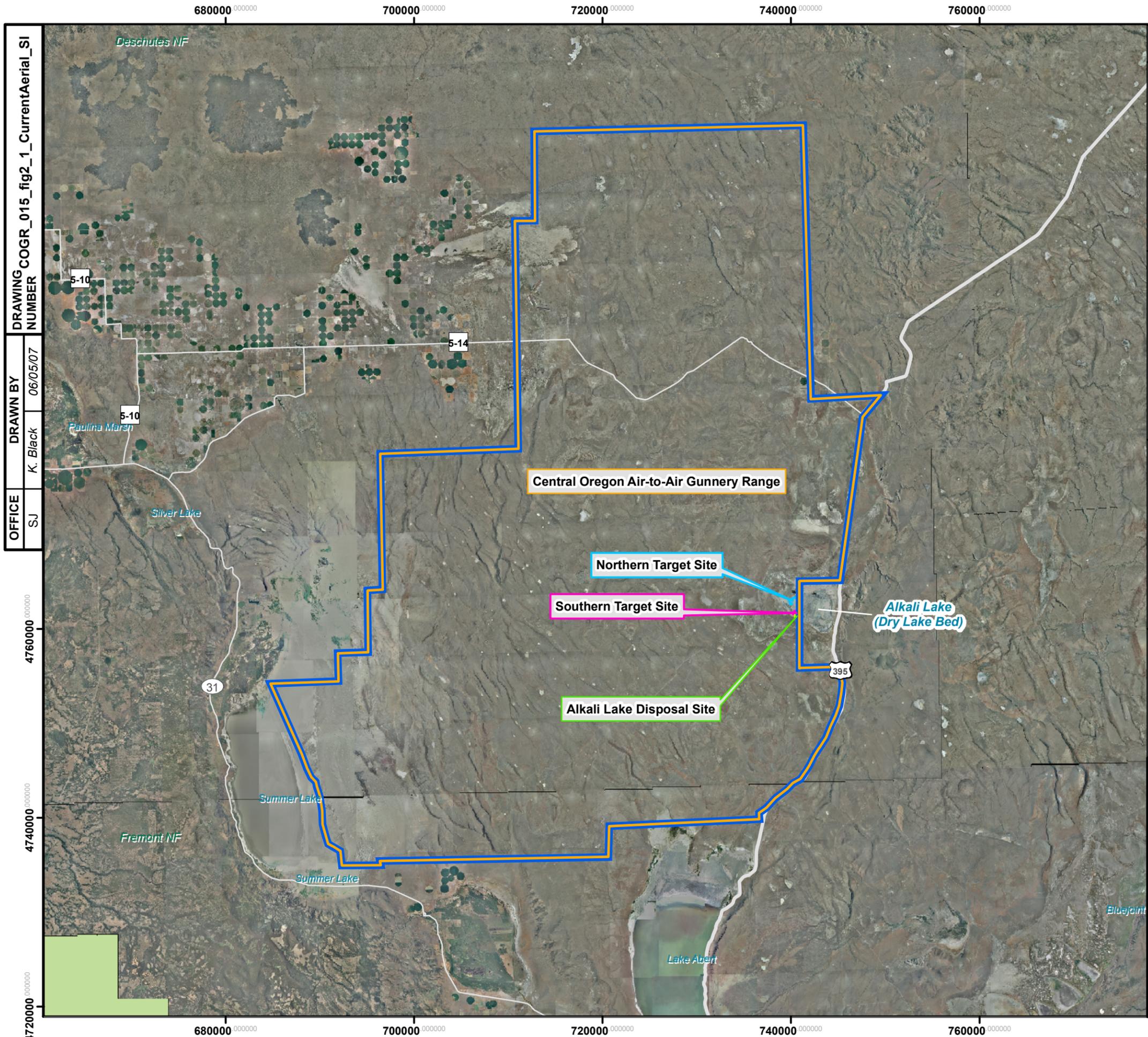
U.S. ARMY CORPS OF ENGINEERS  
OMAHA DESIGN CENTER

FIGURE 1-2  
ORIGINAL SITE LAYOUT

CENTRAL OREGON GUNNERY RANGE



69000 72000 75000 78000 81000



DRAWING COGR\_015\_fig2\_1\_CurrentAerial\_SI  
 NUMBER  
 DRAWN BY  
 K. Black 06/05/07  
 OFFICE  
 SJ

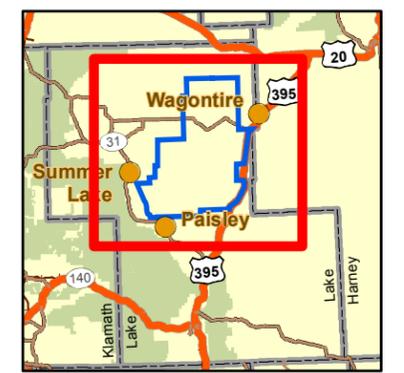
**Legend**

- 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.



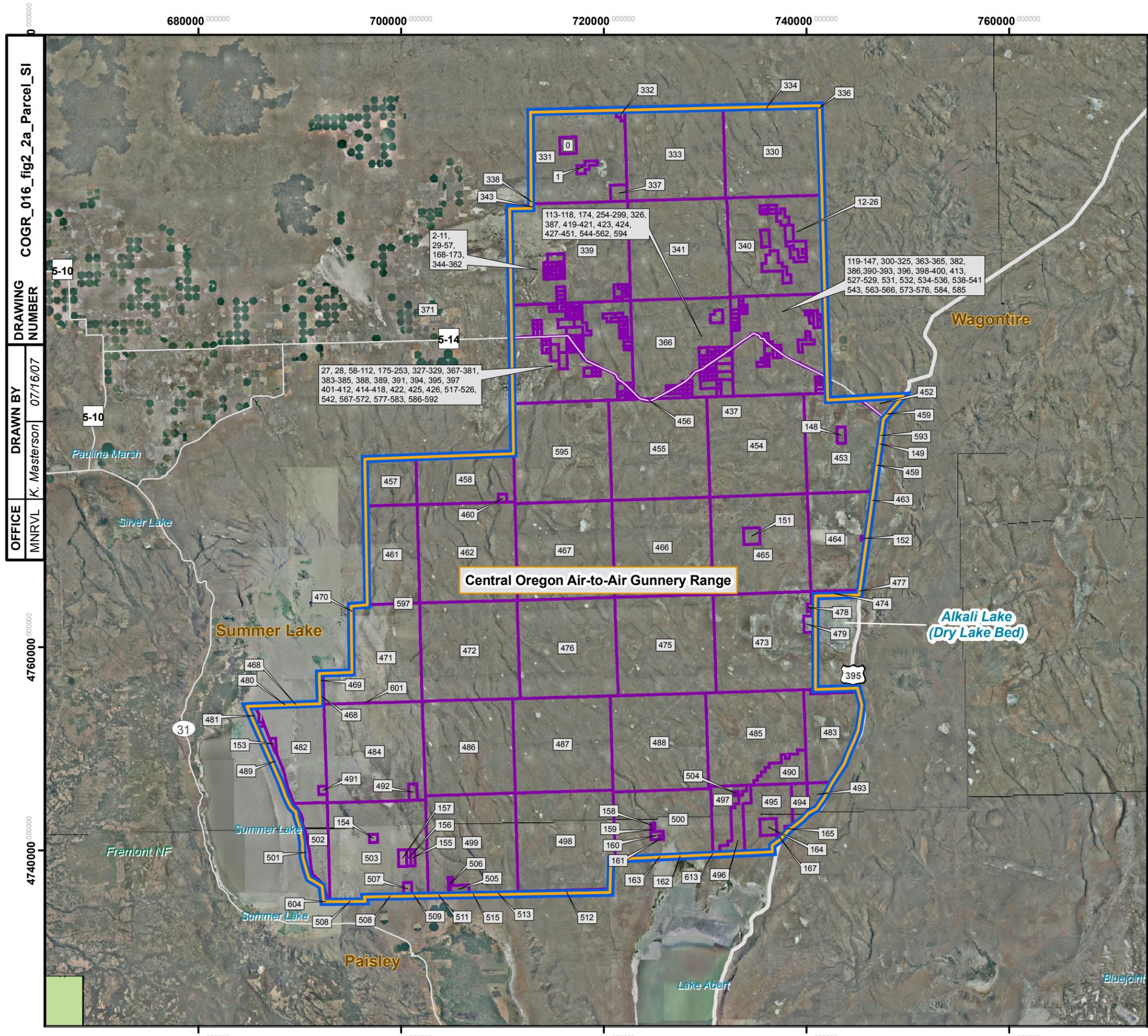
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS  
 OMAHA DESIGN CENTER

**FIGURE 2-1**  
**CURRENT AERIAL PHOTOGRAPH**  
 CENTRAL OREGON GUNNERY RANGE





COGR\_016\_fig2\_2a\_Parcel\_SI  
 DRAWING NUMBER  
 DRAWN BY  
 OFFICE  
 MNRVL  
 K. Masterson  
 07/16/07

**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.

N

0 2 4 6 12 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS  
OMAHA DESIGN CENTER

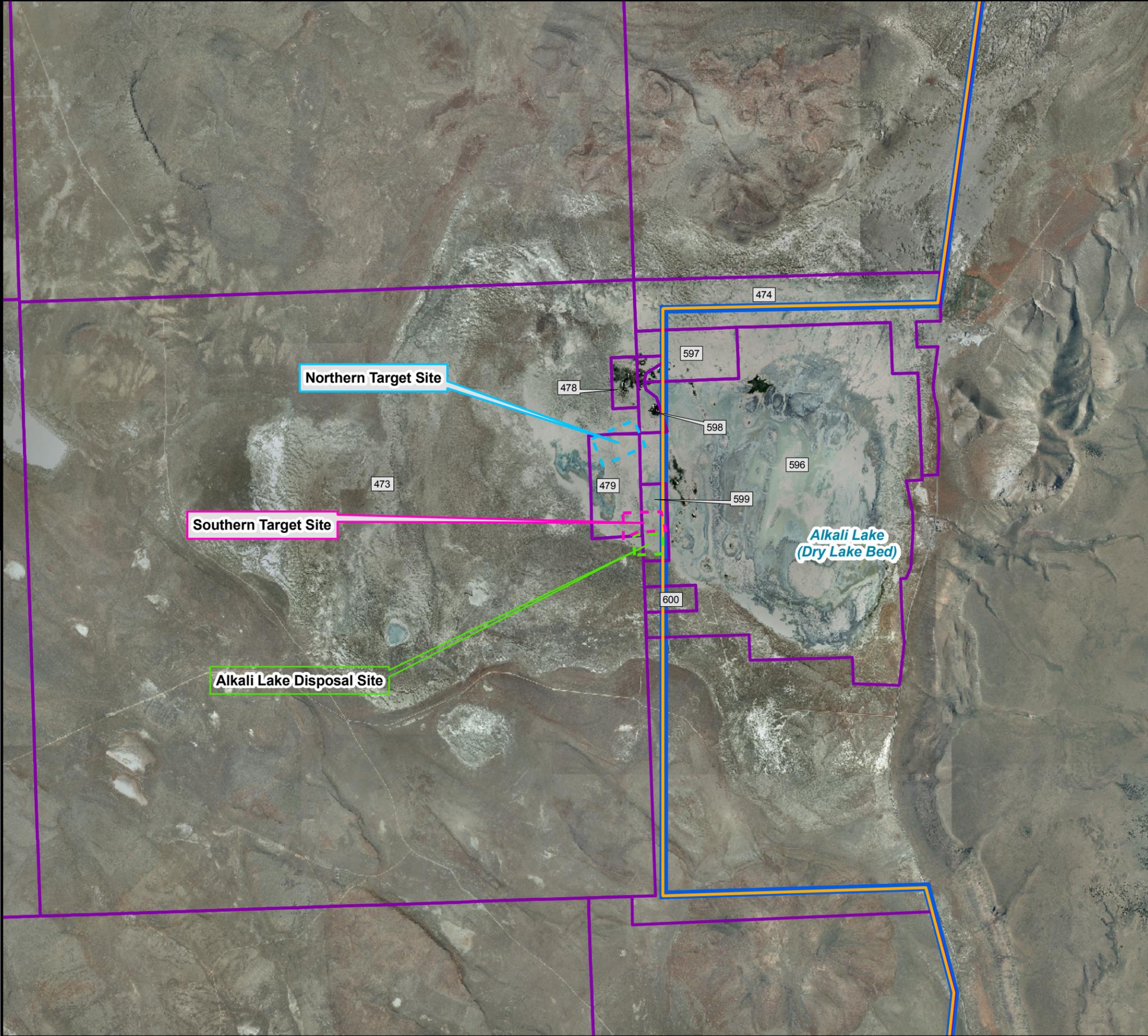
**FIGURE 2-2A**  
**PARCEL MAP**  
CENTRAL OREGON GUNNERY RANGE

Shaw Environmental, Inc.

DRAWING COGR\_017\_fig2\_2b\_Parcel\_Target\_SI  
NUMBER

DRAWN BY  
K. Masterson 07/17/07

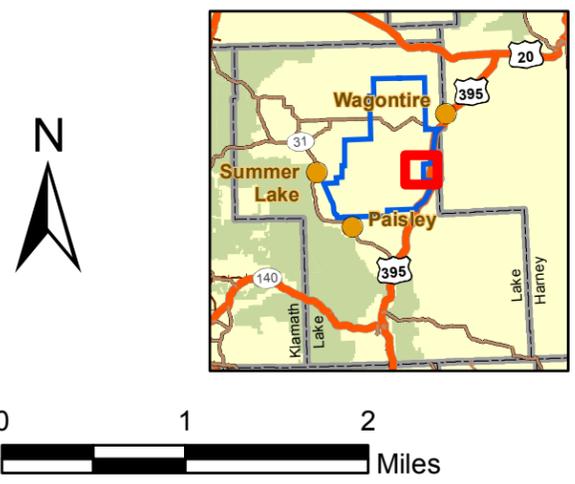
OFFICE  
MNRVL



**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)

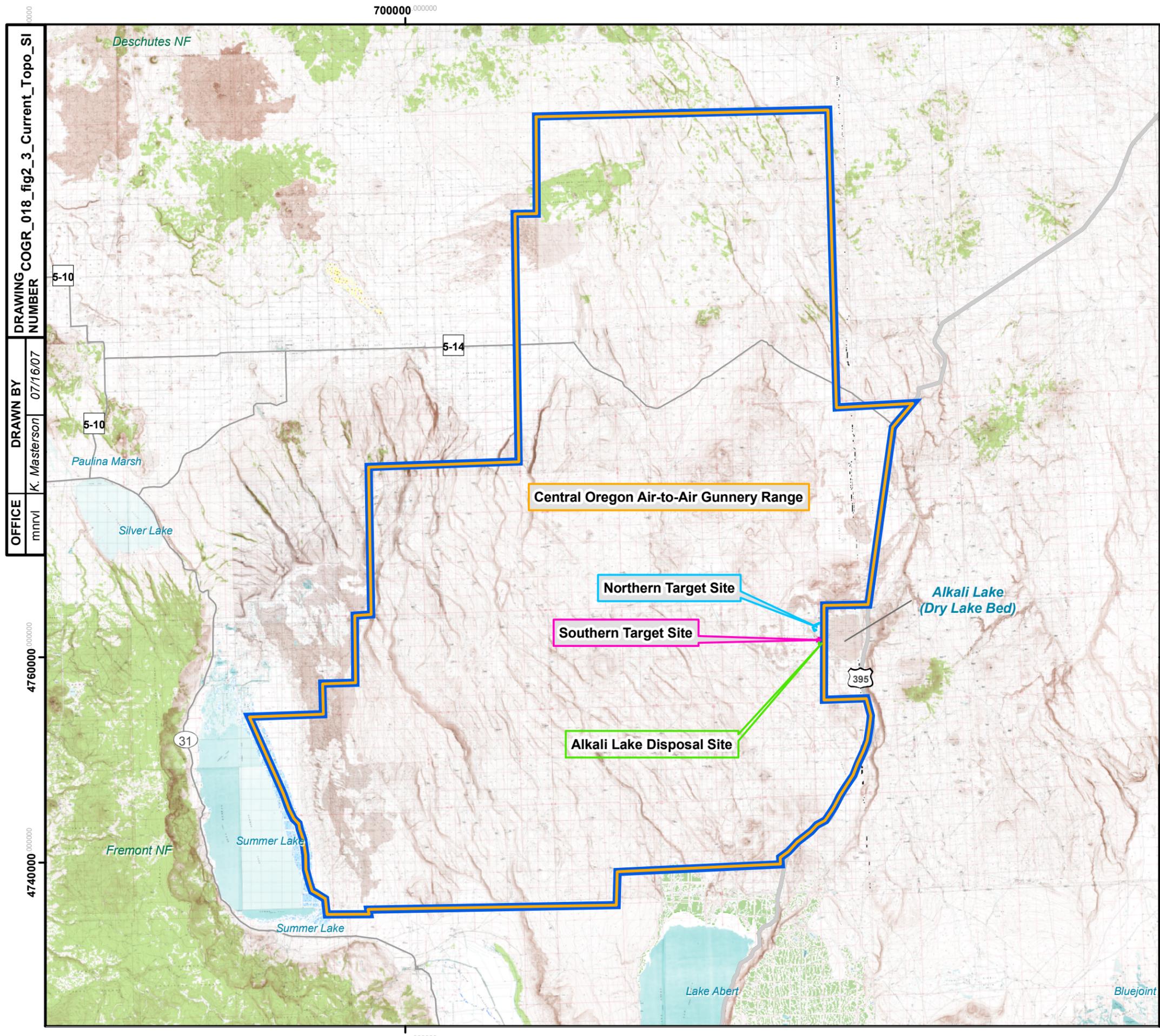
NOTES:  
1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.  
2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project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



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.

N

0 2 4 6 12 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS  
 OMAHA DESIGN CENTER

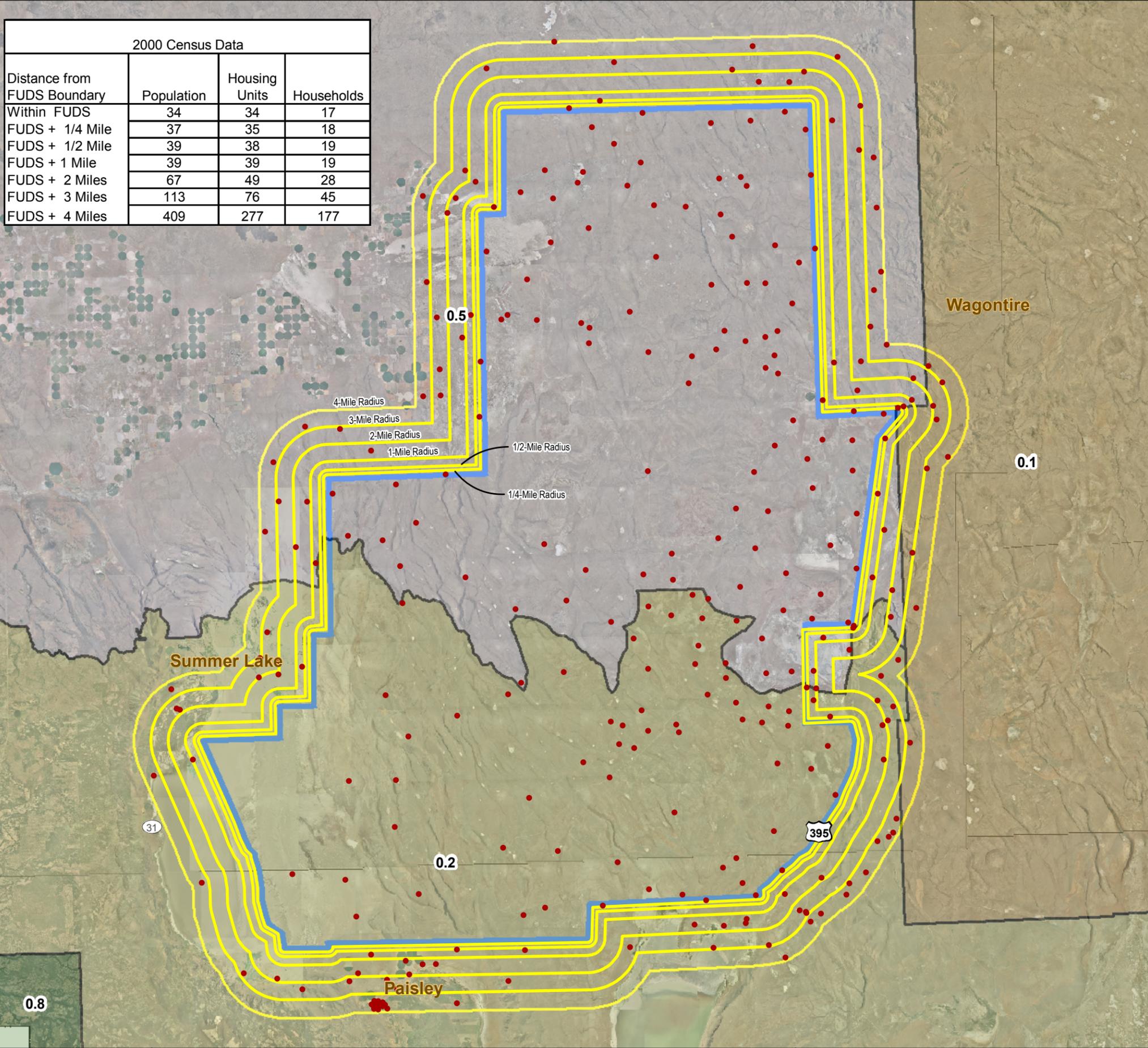
**FIGURE 2-3**  
**CURRENT SITE LAYOUT**  
**TOPOGRAPHIC MAP**  
 CENTRAL OREGON GUNNERY RANGE

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.

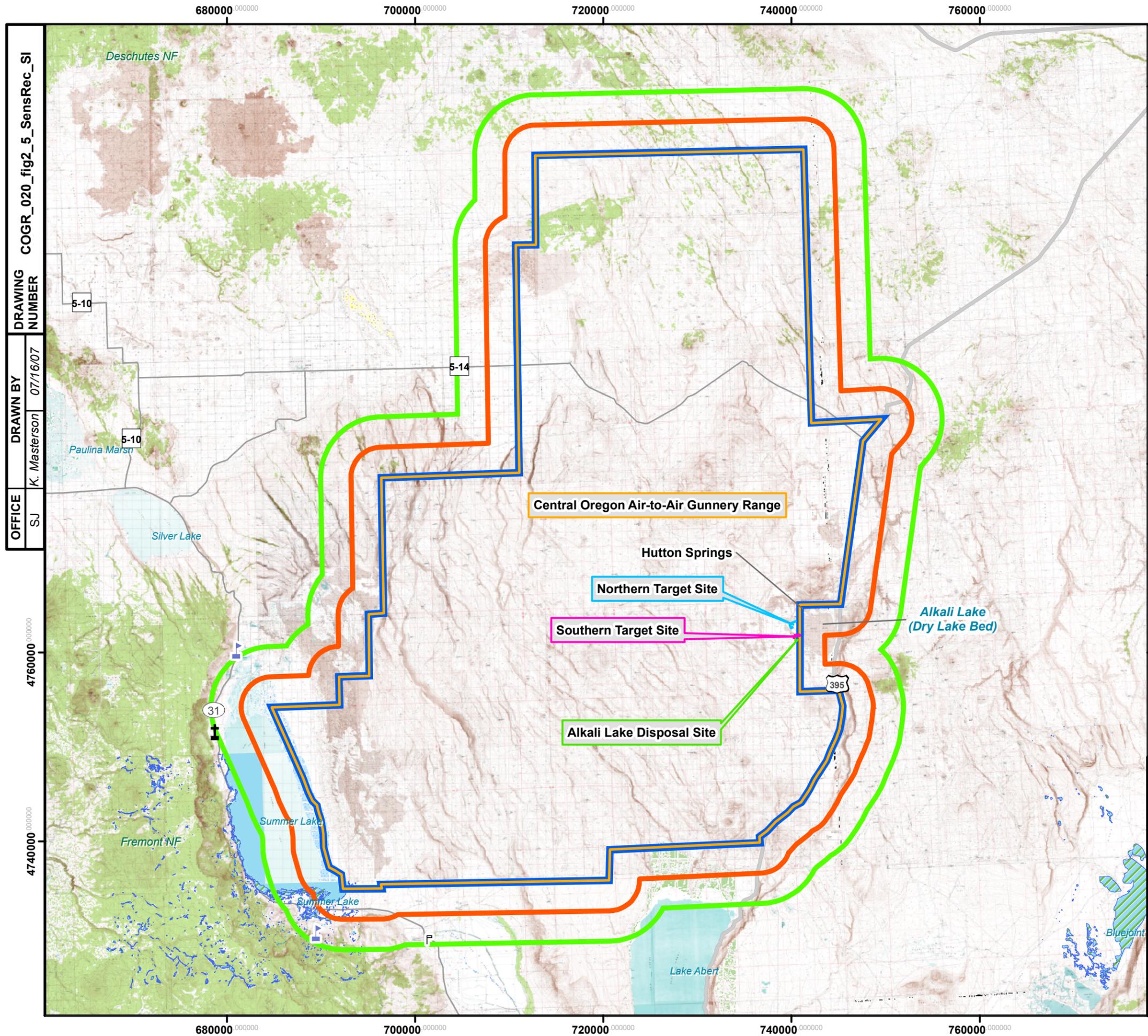
0 2.5 5 Miles

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 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



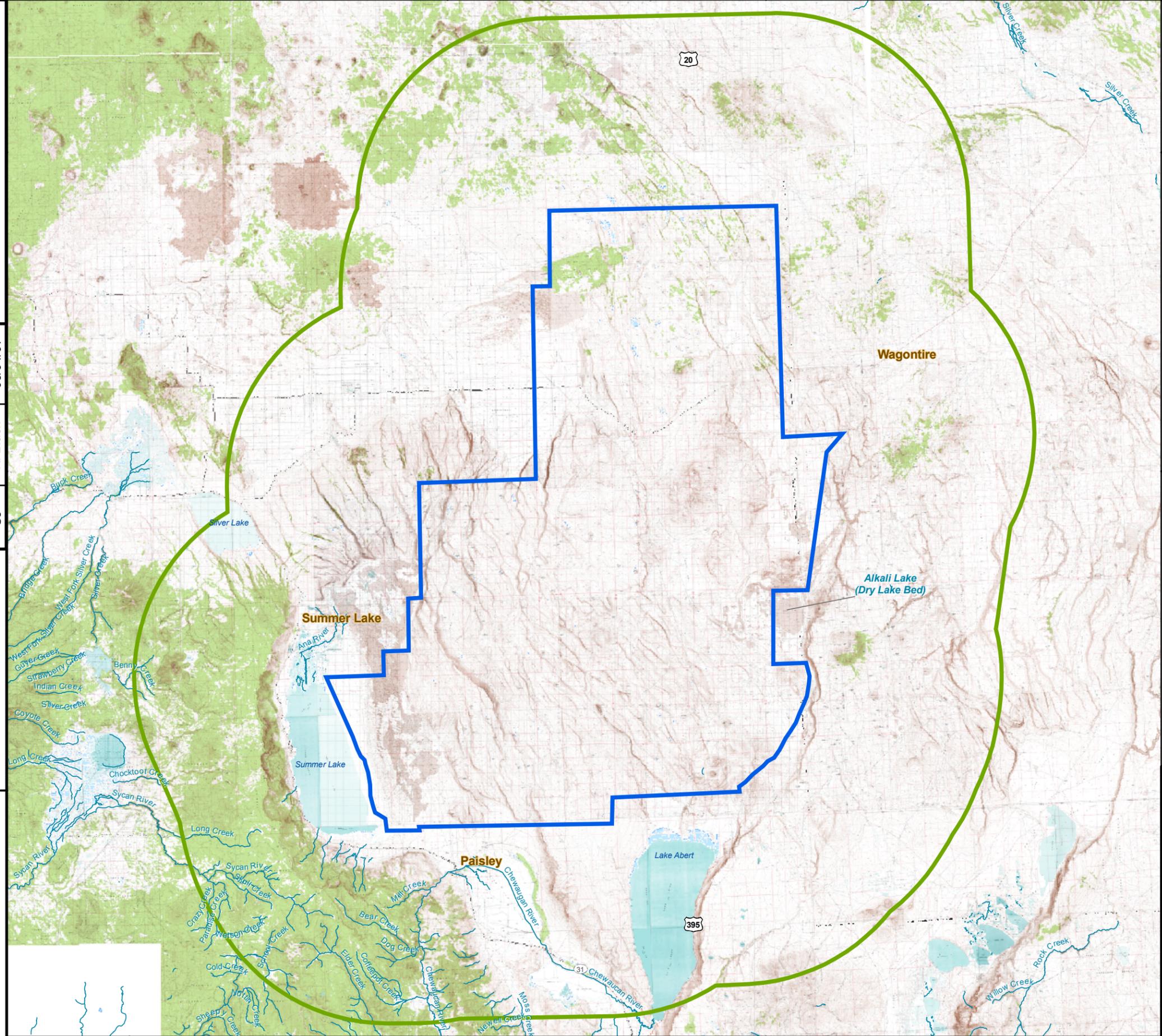
U.S. ARMY CORPS OF ENGINEERS  
 OMAHA DESIGN CENTER

**FIGURE 2-5**  
**SENSITIVE RECEPTOR LOCATIONS**

CENTRAL OREGON GUNNERY RANGE



OFFICE: SJ  
 DRAWN BY: K. Black  
 DATE: 06/04/07  
 DRAWING NUMBER: COGR\_022\_fig2\_6\_SurfaceWater\_SI

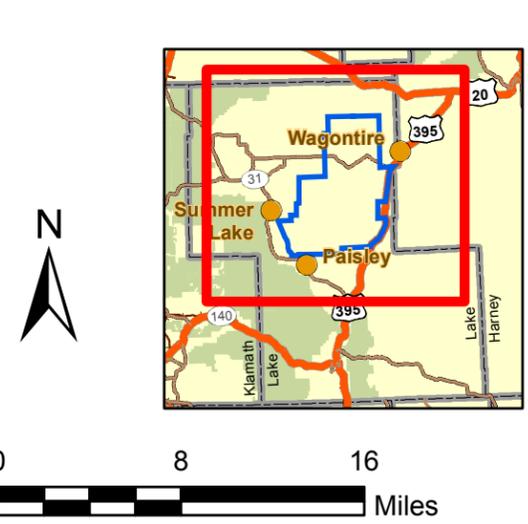


**Legend**

- 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



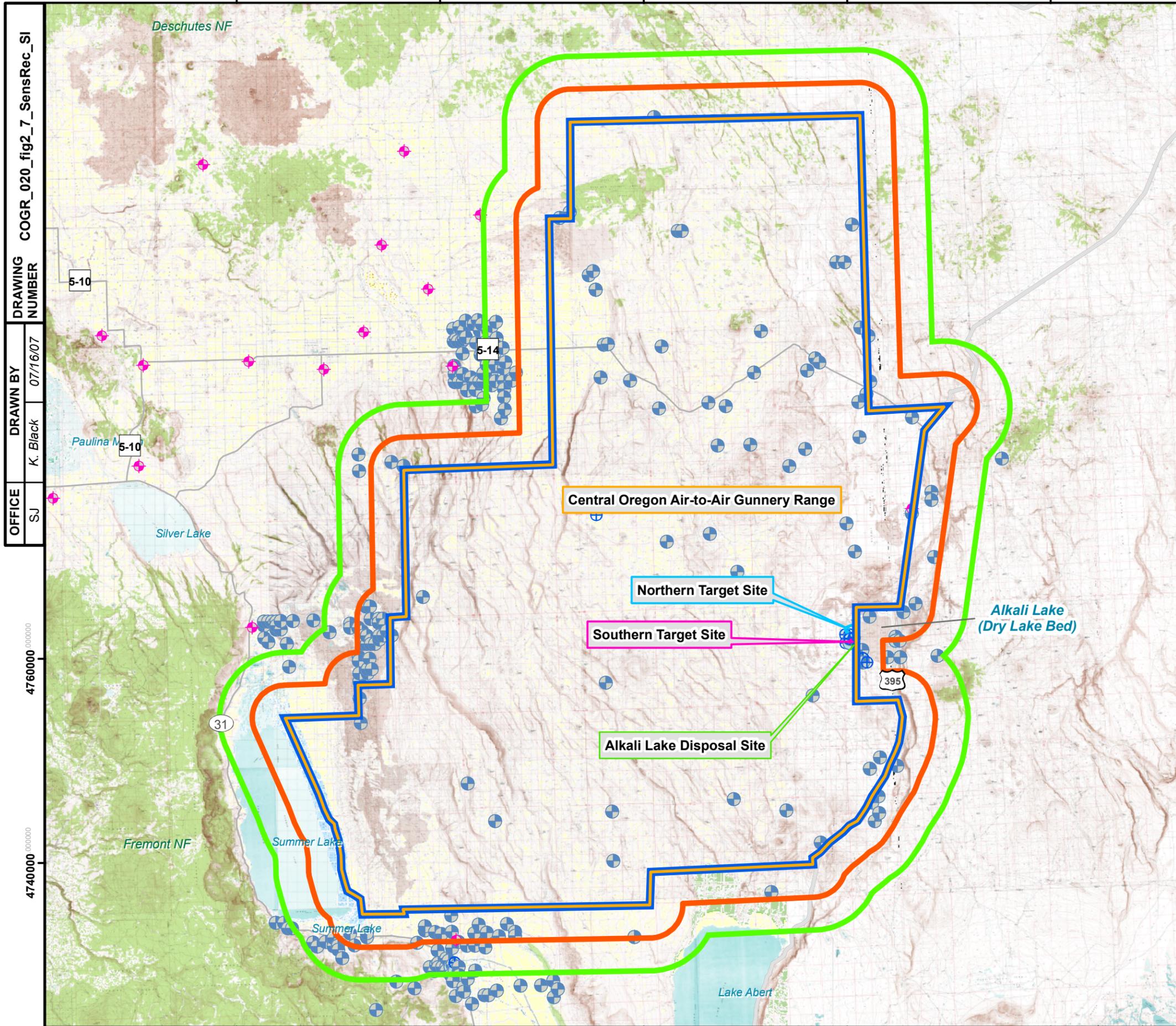
U.S. ARMY CORPS OF ENGINEERS  
 OMAHA DESIGN CENTER

**FIGURE 2-6**  
**REGIONAL SURFACE WATER DRAINAGE**

CENTRAL OREGON GUNNERY RANGE



Shaw Environmental, Inc.



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)**

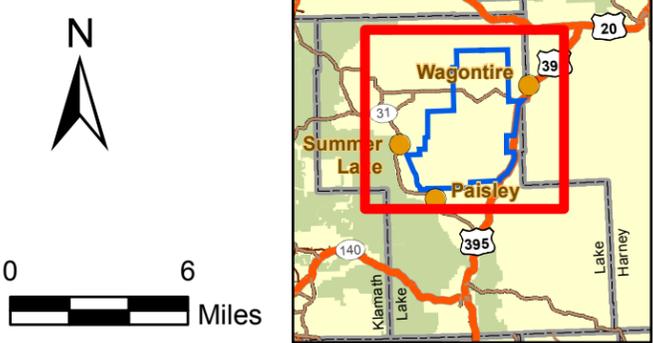
- Groundwater Well

**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.



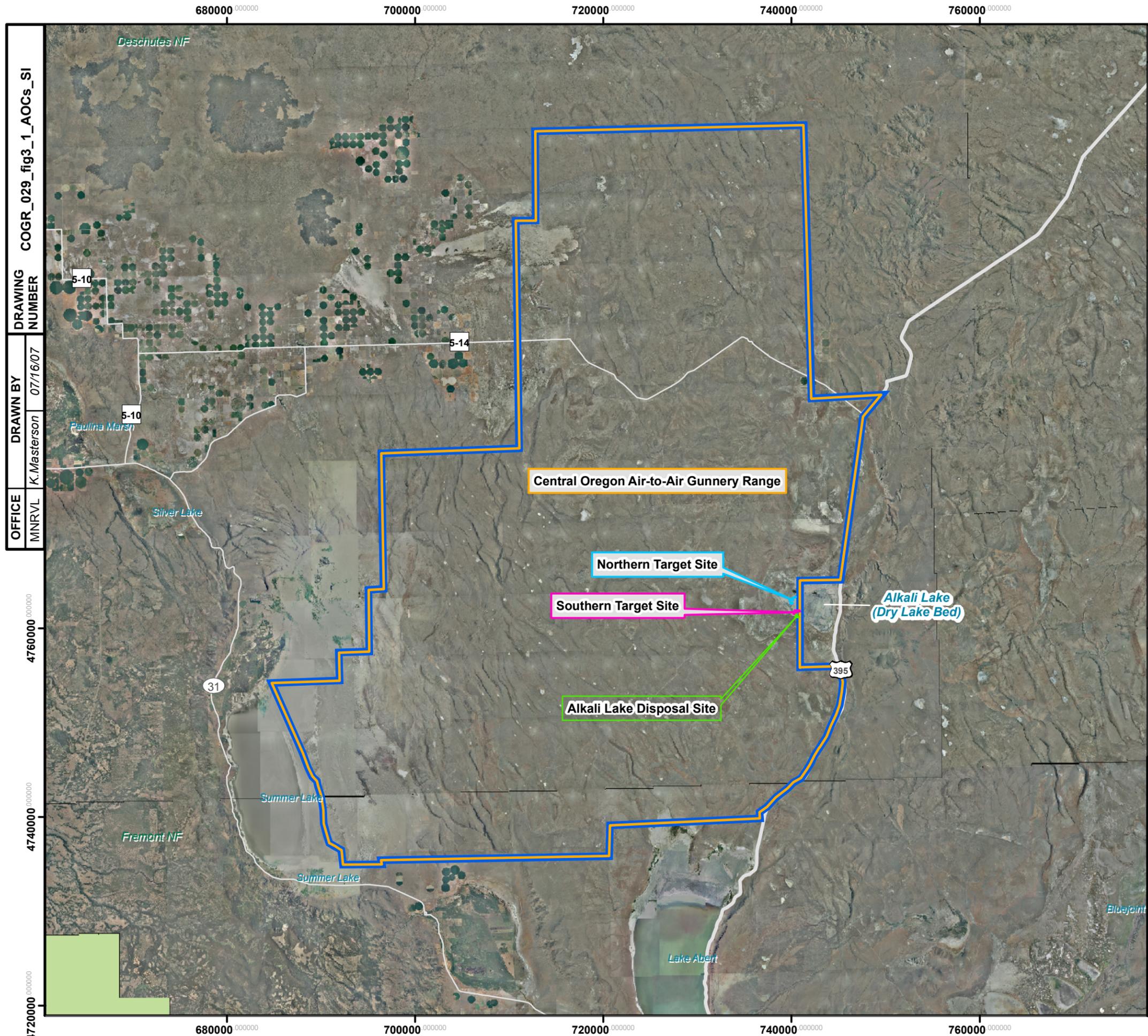
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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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

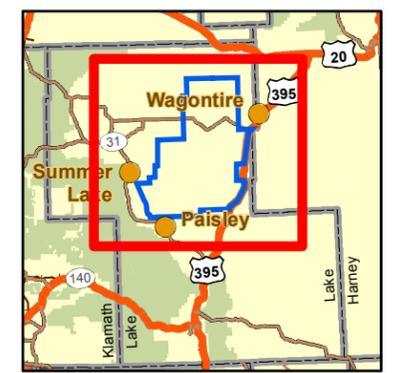
**Legend**

- 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.



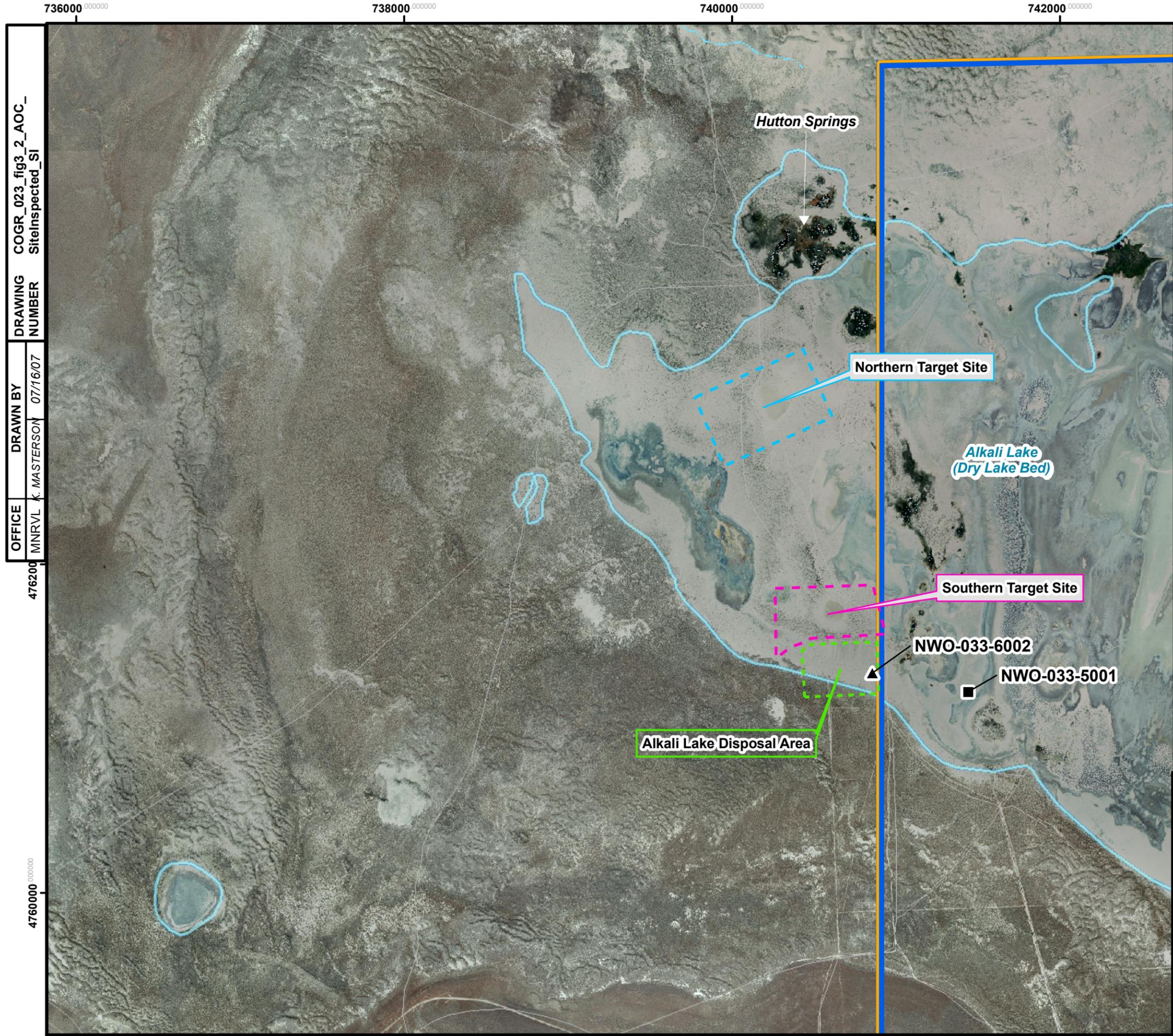
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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OMAHA DESIGN CENTER

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

Shaw Environmental, Inc.

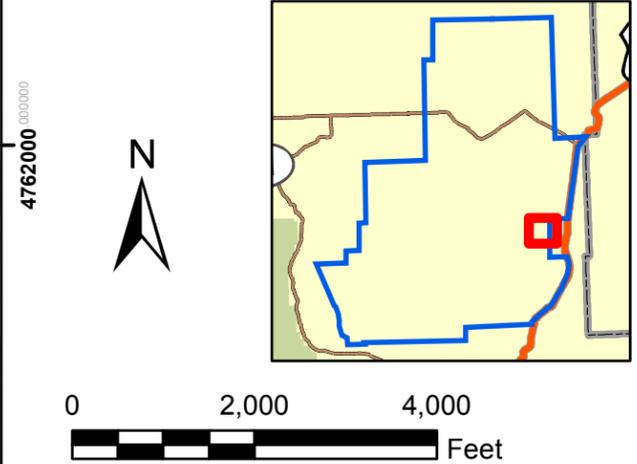


OFFICE: MNRVL K. MASTERSON  
 DRAWN BY: MNRVL K. MASTERSON  
 DRAWING NUMBER: COGR\_023\_fig3\_2\_AOC\_SiteInspected\_SI  
 DATE: 07/16/07

**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
- Background Groundwater Sample
- Background Sediment Sample

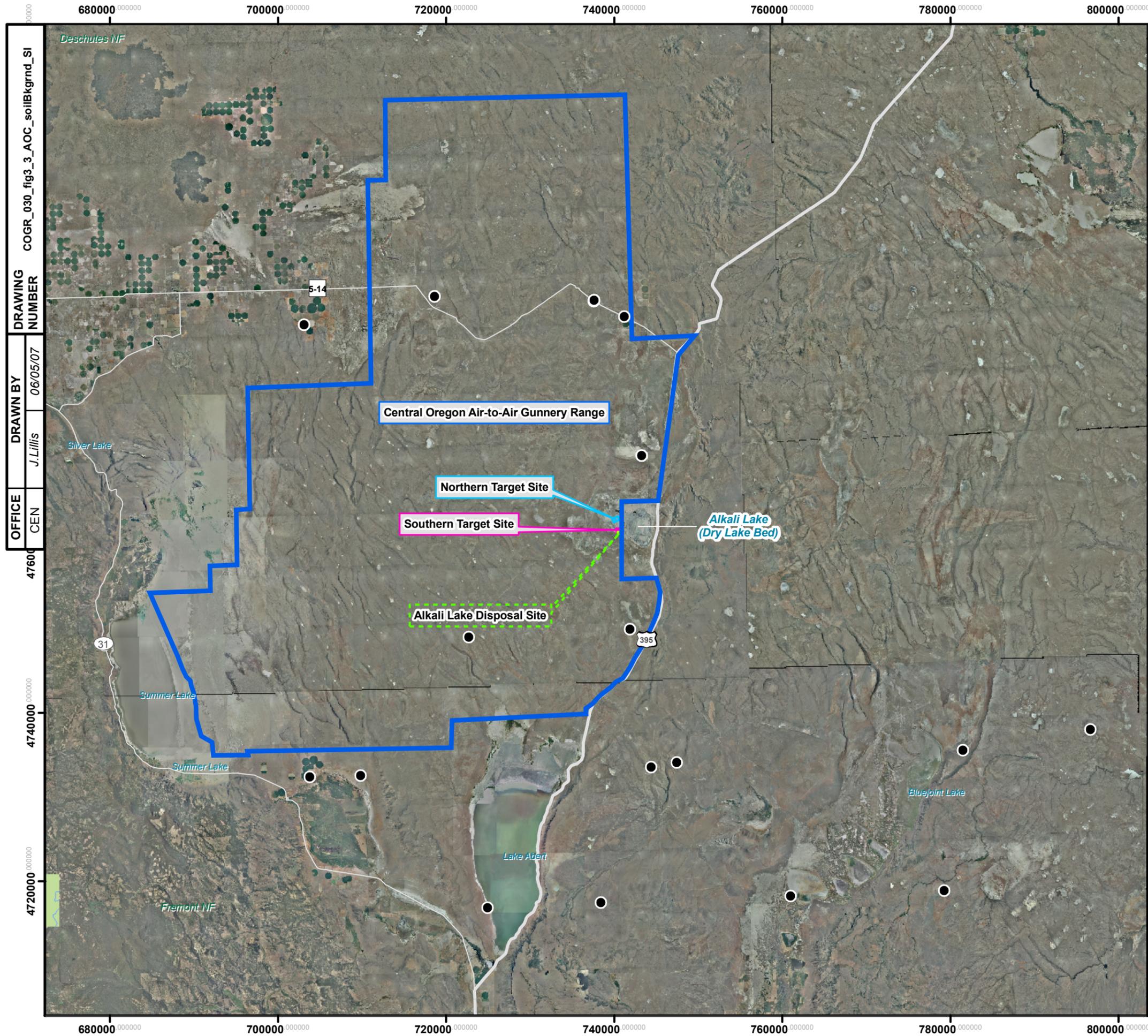
**NOTES:**  
 1) FUDS property boundary and range boundaries were derived from the Central Oregon Gunnery Range ASR and ASR Supplement.  
 2) Aerial photo (Lake County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory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



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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



COGR\_030\_fig3\_3\_AOC\_soilBkgnd\_SI  
 DRAWING NUMBER  
 DRAWN BY J.Lillis 06/05/07  
 OFFICE CEN  
 47600  
 474000  
 472000

**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.

N

0 2 4 6 12 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS  
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**FIGURE 3-3**  
**SOIL BACKGROUND**  
**SAMPLE LOCATIONS**  
 CENTRAL OREGON GUNNERY RANGE

Shaw Environmental, Inc.



OFFICE: MNRV/LK  
 DRAWN BY: MASTERSON  
 DATE: 06/05/07  
 DRAWING NUMBER: COGR\_024\_fig4\_1\_AOC\_Recon\_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
- 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.

N

0 1,000 2,000  
Feet

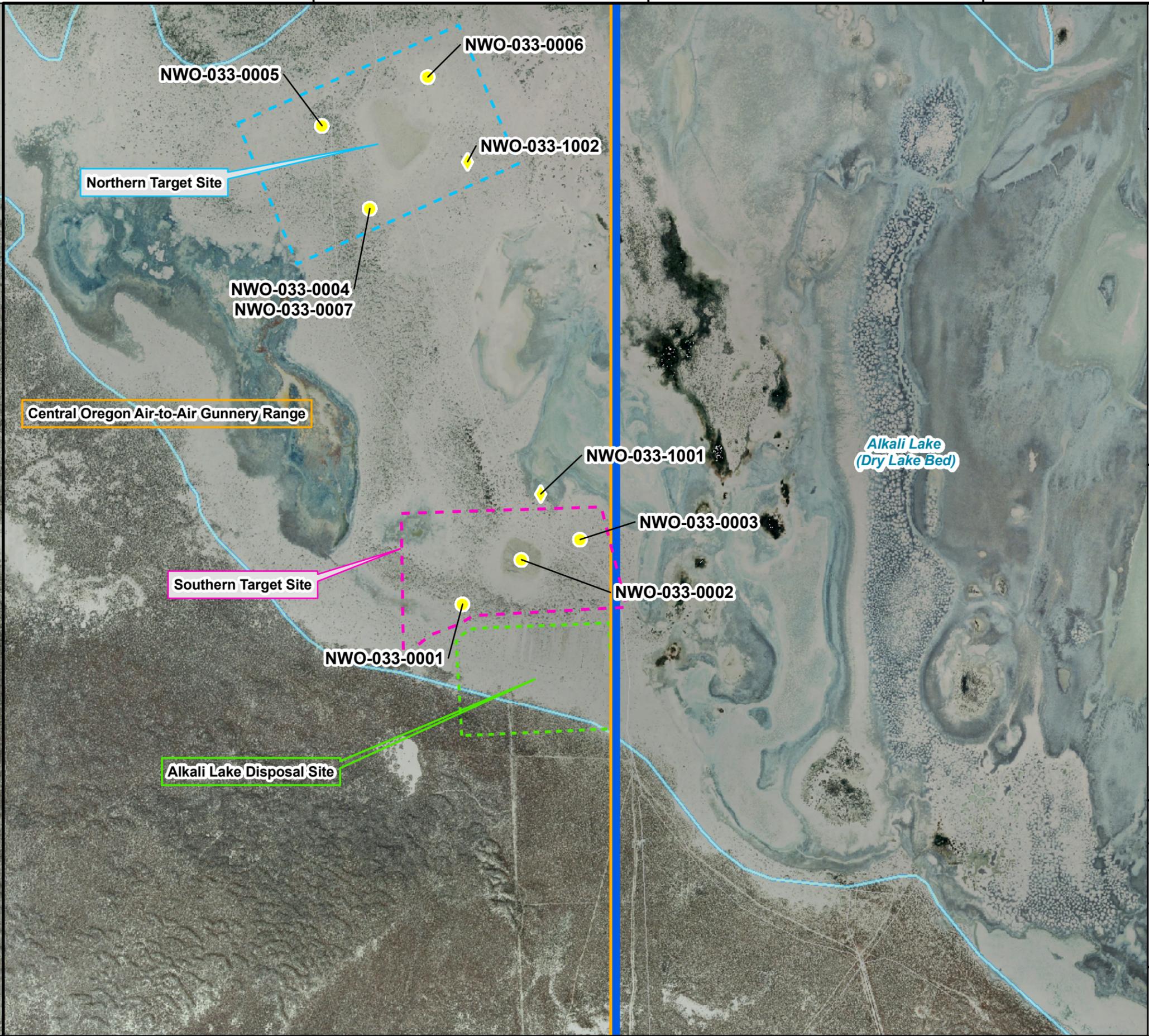
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS  
 OMAHA DESIGN CENTER

**FIGURE 4-1**  
**TARGET SITES RECONNAISSANCE**  
 CENTRAL OREGON GUNNERY RANGE

Shaw 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.

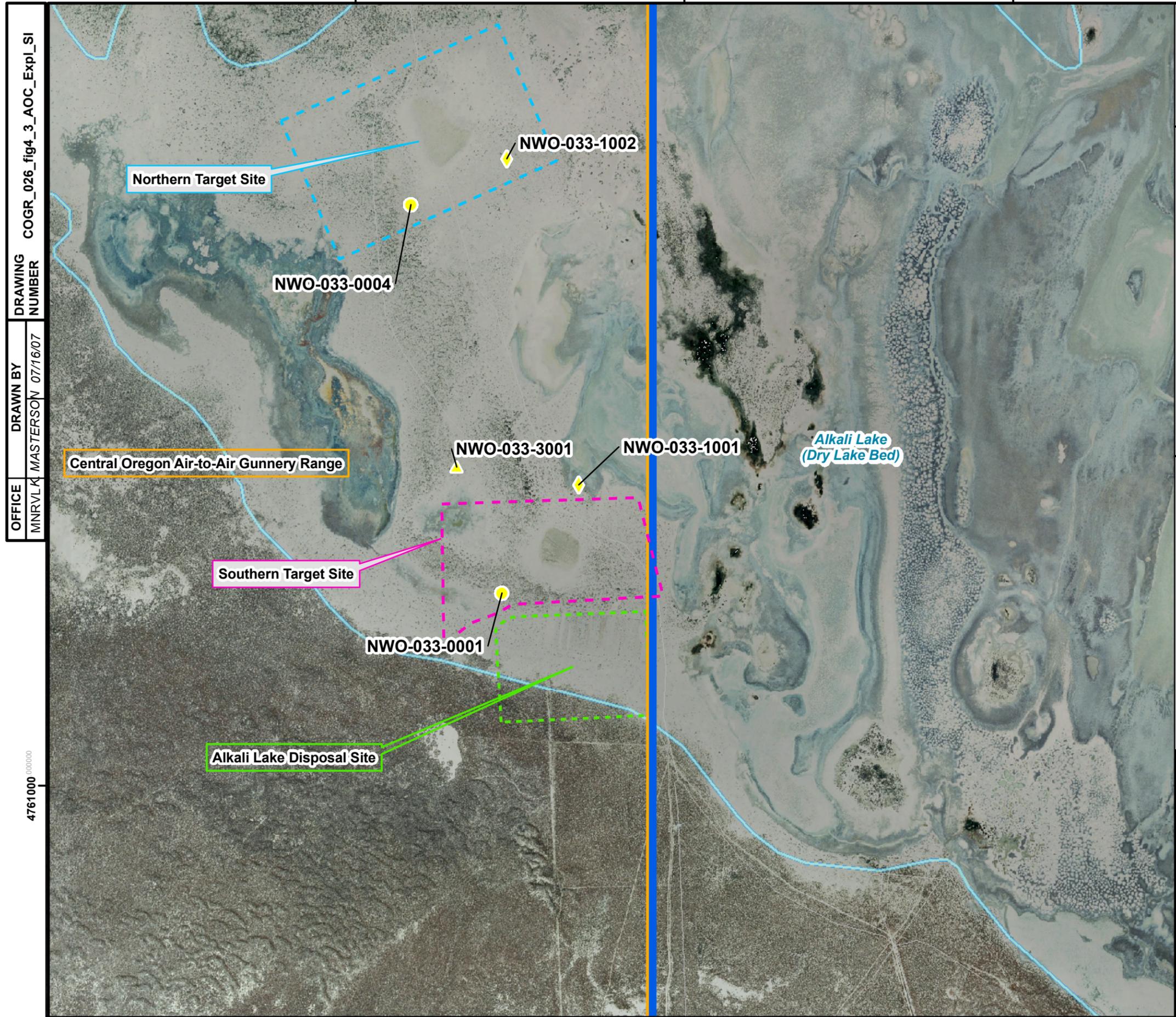
0 1,000 2,000 Feet

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.



OFFICE: MNRV/LK  
 DRAWN BY: MASTERSON  
 DRAWING NUMBER: 07/16/07  
 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.

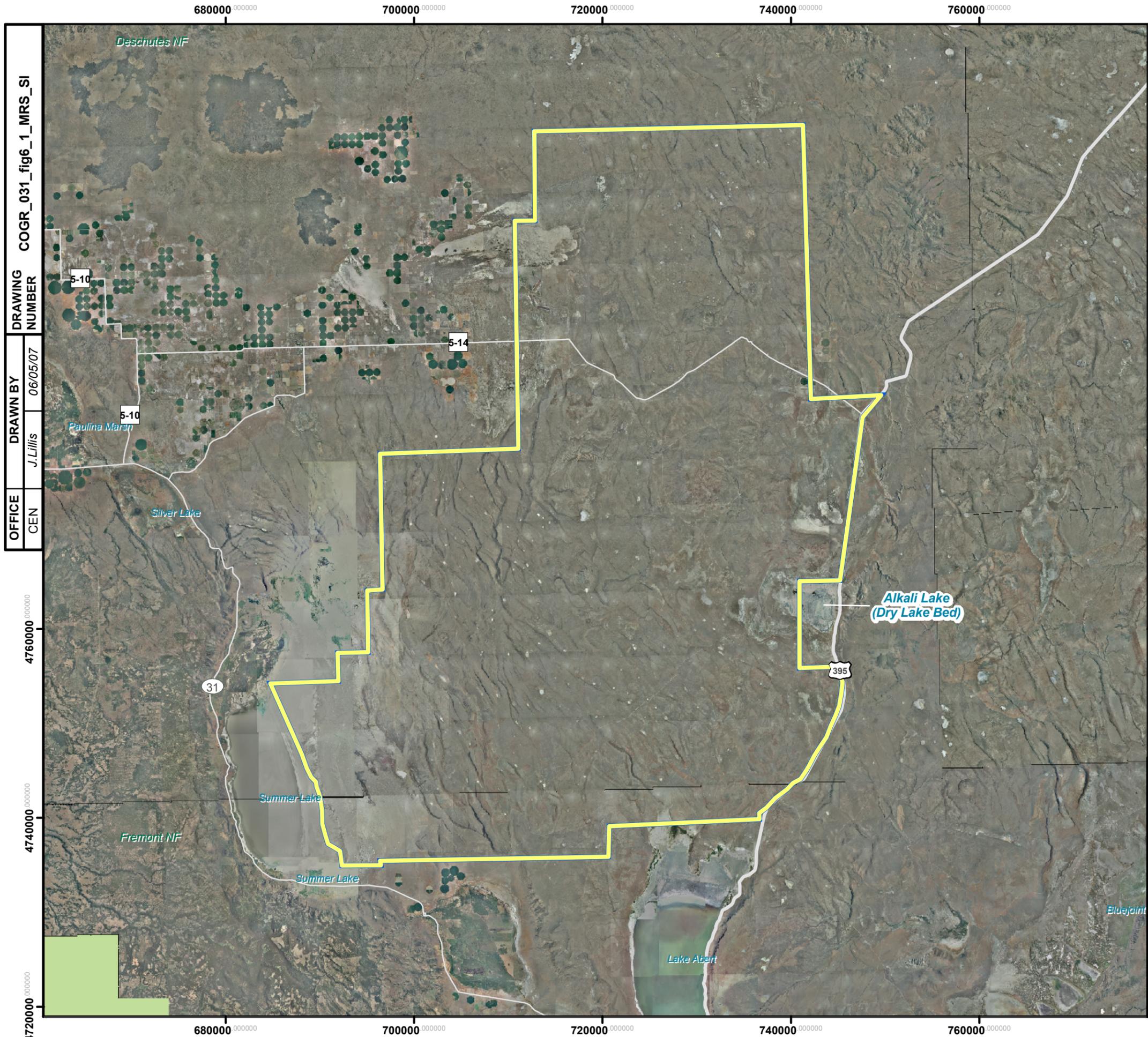
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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

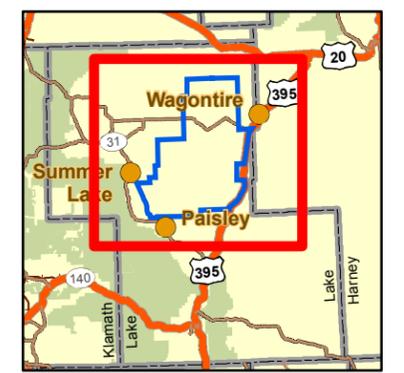
**COGR\_031\_fig6\_1\_MRS\_SI**

**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**

<b>Area of Concern</b>	<b>Munitions</b>	<b>Munitions Constituents</b>
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 <sup>a</sup>  
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 6 fish, 1 bird, 1 invertebrate and 1 plant species.
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 6 fish, 1 bird, 1 invertebrate and 1 plant species. The State threatened Hutton Tui Chub is found in Hutton Springs that is within the Site boundary.
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.

<sup>a</sup> 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 <sup>a</sup>**

<b>Analyte</b>	<b>Soil Background Concentration 95th UTL/95th Percentile <sup>b</sup> (Based on 24 Samples) (mg/kg)</b>	<b>Sediment Background Concentration (Based on 1 Sample <sup>c</sup>) (mg/kg)</b>	<b>Groundwater Background Concentration (Based on 1 Sample <sup>c</sup>) (µg/L)</b>
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

<sup>a</sup> United States Geological Survey. National Geochemical Survey Database. 2006.

<sup>b</sup> Supporting calculations for soil background values are provided in Appendix L.

<sup>c</sup> 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 <sup>a</sup>**

Analyte	Abbreviation	Soil/Sediment Human Health Screening Values (mg/kg)	Groundwater Human Health Screening Values (µg/L)
<b>Explosives</b>			
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
<b>Metals/Inorganics</b>			
Chromium <sup>b</sup>	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

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

<sup>b</sup> Total chromium values used.

**Table 3-3  
Ecological Soil and Sediment Screening Values for Central Oregon Gunnery Range <sup>a</sup>**

Analyte	Abbreviation	Soil Ecological Screening Value (mg/kg)	Sediment Ecological Screening Value (mg/kg)
<b>Metals/Inorganics</b>			
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
<b>Explosives</b>			
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

<sup>a</sup> 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	<b>149</b>		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>		23.9	
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	<b>32.4</b>		<b>29.1</b>		2.1	J	<b>20.9</b>	
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.