



U.S. Army
Corps of Engineers
Omaha District



DRAFT FINAL SITE INSPECTION REPORT
Camp Abbot Volume 1 - DATA REPORT
Deschutes County, OR
FUDS PROPERTY No. F10OR0041

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

March 30, 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.

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March 30, 2007
Submitted to:

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

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List of Acronyms

°F	degrees Fahrenheit
AOC	area of concern
ASR	Archives Search Report
bgs	below ground surface
CAIS	Chemical Agent Identification Sets
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CSM	conceptual site model
DERP	Defense Environmental Response Program
DMM	discarded military munitions
DoD	Department of Defense
DQO	data quality objective
EDR	Environmental Data Resources, Inc.
EPA	Environmental Protection Agency
ER	Engineering Regulation
ERTC	Engineer Replacement Training Center
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
MC	munitions constituents
MDL	method detection limit
MEC	munitions and explosives of concern
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
NWO	Northwest Region (Omaha District Military Munitions Design Center)
OB/OD	ordnance burial/ordnance disposal
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
PA/SI	Preliminary Assessment/Site Inspection
PETN	pentaerythritol tetranitrate
PQL	practical quantitation limit
RAC	Risk Assessment Code

List of Acronyms (Cont.)

RI/FS	remedial investigation/feasibility study
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SLERA	Screening-Level Ecological Risk Assessment
SSWP	Site-Specific Work Plan
TAL	target analyte list
TCRA	time-critical removal action
TPP	Technical Project Planning
UTL	upper tolerance limit
USACE	U.S. Army Corps of Engineers
USC	United States Code
UXO	unexploded ordnance

Glossary of Terms

Comprehensive Environmental Response, Compensation, and Liability Act of 1980

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

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

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

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

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

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

The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed (10 USC 101(e)(4)(A) through (C)).

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

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

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

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

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

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

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

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

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

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

1 *Executive Summary*

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

24 *Camp Abbot*

25 This report presents the results of an SI conducted at Camp Abbot, FUDS property number
26 F10OR0041, located approximately 15 miles south of Bend, Deschutes County, Oregon. Camp
27 Abbot was commissioned in 1943 and was used primarily for training engineer soldiers. Camp
28 Abbot was decommissioned in June 1944. In November 1947, the Army relinquished its permits
29 for use of Forest Service land.

30 *Technical Project Planning*

31 The approach for the SI was developed by Shaw in consultation with site stakeholders. A
32 Technical Project Planning (TPP) meeting conducted in April 2006 was attended by
33 representatives from the USACE Omaha Design Center; USACE Hazardous, Toxic, and
34 Radioactive Waste Center of Expertise; USACE Seattle District; Oregon Department of
35 Environmental Quality (ODEQ); Shaw; Sunriver Owners Association; and Sunriver Resort. The

36 stakeholders agreed to the approach and identified seven areas of concern (AOCs) – Range
37 Complex No. 1, Anti-Tank Range, Demolition Area, Mortar Range, Grenade Courts, Burial Pit,
38 and Chemical Training Area – for further evaluation in the SI.

39 SI Field Activities

40 SI field activities, conducted in September 2006, included a site reconnaissance to look for
41 evidence of MEC and to avoid MEC during sampling. Samples were collected from
42 groundwater, surface water, sediment, and surface soil and analyzed for metals, explosives,
43 and/or perchlorate depending on the media and AOC sampled.

44 No MEC or munitions debris was identified at Range Complex No. 1 or the Grenade Courts
45 during the visual reconnaissance. Since MEC has been previously confirmed at the Anti-Tank
46 Range, Demolition Area, and Mortar Range (Explosives Munitions Ranges), no further
47 reconnaissance was performed. A visual reconnaissance for the site of the Burial Pit did not
48 reveal its location. No visual reconnaissance was performed for the Chemical Training Area
49 based on its close location to the former cantonment area, the current development that has
50 occurred in the area, and the limited activities that occurred in the area.

51 SI Recommendations

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

54 *Range Complex No. 1 (Small Arms Ranges)*

55 Based on historical evidence and results from the SI field activities, the MEC risks are low and
56 Range Complex No. 1 is recommended for NDAI with respect to MEC.

57 Ecological screening of metals results from sediment samples and lead, mercury, and zinc results
58 from soil samples that also exceeded background concentrations indicate that adverse ecological
59 impacts may occur. There are no human health impacts indicated. As agreed to during the TPP
60 and documented in the DQOs, “If sample results do not exceed human health screening values
61 but do exceed both ecological screening values and background values, additional evaluation of
62 the data will be conducted in conjunction with the stakeholders to determine if additional
63 investigation is warranted.” Therefore, no recommendation for either NDAI or RI/FS with
64 respect to MC is made until consultation with the stakeholders is completed.

65 *Explosive Munitions Ranges (Anti-Tank Range, Demolition Area, and Mortar Range)*

66 Based on historical evidence and results of the SI field activities, there is evidence of MEC,
67 munitions debris, and use of explosives occurring within the Anti-Tank Range, the Mortar
68 Range, and the Demolition Area. Based on the historical occurrence of MEC, the Anti-Tank Range,
69 the Mortar Range, and the Demolition Area are recommended for RI/FS.

70 Iron was detected at concentrations above the background and human health screening value in
71 soil samples from the Demolition Area and the Mortar Range. Iron is a common rock forming

72 mineral and the bedrock at Camp Abbot is basaltic, which has high iron content. These elevated
73 iron concentrations may reflect natural variation in the soils. Additionally, iron is not a
74 CERCLA hazardous substance and therefore a recommendation based on iron alone cannot be
75 used to recommend RI/FS.

76 The Camp Abbot background concentration and ecological screening value was exceeded for
77 barium, chromium, and lead in soil samples. The exceedances indicate that adverse ecological
78 impacts may occur in soil. As agreed to during the TPP and documented in the DQOs, “If
79 sample results do not exceed human health screening values but do exceed both ecological
80 screening values and background values, additional evaluation of the data will be conducted in
81 conjunction with the stakeholders to determine if additional investigation is warranted.” No
82 recommendation for either NDAI or RI/FS is made relative to MC until consultation with the
83 stakeholders is completed.

84 *Grenade Courts*

85 Historically, no MEC or munitions debris, other than a grenade spoon and expended lead bullets,
86 have been found at the Grenade Courts. Based on the types of MEC that may be present and the
87 limited investigation that has been conducted, the overall MEC risk is considered to be moderate
88 and the Grenade Courts area is recommended for RI/FS.

89 All analytical results for MC were below human health screening values. The ecological
90 screening value was exceeded for nickel in a sediment sample, which may indicate adverse
91 ecological impacts in sediments. However, the detected concentration may reflect the natural
92 variation of nickel in sediment. As agreed to during the TPP and documented in the DQOs, “If
93 sample results do not exceed human health screening values but do exceed both ecological
94 screening values and background values, additional evaluation of the data will be conducted in
95 conjunction with the stakeholders to determine if additional investigation is warranted.” No
96 recommendation for either NDAI or RI/FS is made relative to MC until consultation with the
97 stakeholders is completed.

98 *Burial Pit*

99 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
100 ordnance area, and described as follows: “The potential pit was horseshoe-shaped area, bermed
101 and ringed with stone” (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
102 old landfill and provided location coordinates. An extensive search of the area was completed
103 during the SI and no evidence of the Burial Pit was found. Workers at the Nature Center, where
104 the Burial Pit was reported as being located, could not confirm the existence of the Burial Pit.
105 There have been no reports of MEC or munitions debris from this pit or in the area. Because the
106 pit could not be located, no MC samples were collected. Because of the uncertainty in the
107 location or even existence (ASR described as ‘potential’) of the Burial Pit, the Burial Pit is
108 recommended for NDAI for both MEC and MC.

109 *Chemical Training Area*

110 No MEC or munitions debris has been reported at the Chemical Training Area. The Chemical
111 Training Area is located within a housing development. The INPR (USACE, 1994) indicated
112 that a gas chamber was located in this area. A recent telephone interview (Appendix L)
113 indicated that “chemicals” may have been buried at the ‘sledding hill’ located north of the AOC.
114 No MC samples were collected from the Chemical Training Area, because the area is currently
115 residential housing and the area has been developed and utilized, and any chemical agents that
116 may have been released would be in very small quantities associated with Chemical Agent
117 Identification Sets (CAIS) sets. However, because of the newly obtained information concerning
118 a potential burial area near the AOC, the Chemical Training Area, is recommended for RI/FS.

119 *Time Critical Removal Action*

120 There is no indication from the SI that a time critical removal action is warranted at Camp
121 Abbot.

122 **1.0 Introduction**

123 This Site Inspection (SI) Report presents the results of an SI conducted at the Camp Abbot
124 Formerly Used Defense Site (FUDS) located near Bend, Oregon. Shaw Environmental, Inc.
125 (Shaw) has prepared this report for the U.S. Army Corps of Engineers (USACE) in accordance
126 with Task Order 003, issued under USACE Contract No. W912DY-04-D-0010. Shaw is
127 responsible for conducting SIs at FUDS in the northwest region managed by the Omaha District
128 Military Munitions Design Center (NWO) as directed by the Performance Work Statement
129 (Appendix A).

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

133 **1.1 Project Authorization**

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

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

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

151 **1.2 Site Name and Location**

152 Camp Abbot, property number F10OR0041, is located approximately 15 miles south of Bend,
153 Oregon, in Deschutes County (Figure 1-1). Camp Abbot is included in the MMRP Inventory in
154 the *Defense Environmental Programs Fiscal Year 2005 Annual Report to Congress* (DoD,
155 2005a) and in the *Archive Search Report (ASR) Supplement* (USACE, 2004b). The Camp Abbot

156 project number used to identify ranges is F10OR004102. Identified ranges and other areas of
 157 concern (AOCs) as follows:

Range Name	Range Identifier	Approximate Area (acres)	UTM Coordinates (meters) ¹
Burial Pit	F10OR004102M01	48	N 4860332.50; E 624695.52
Anti-Tank Range	F10OR004102R01	354	N 4859041.99; E 623348.74
Chemical Training Area	F10OR004102R02	27	N 4858969.21; E 625900.23
Demolition Area	F10OR004102R03	96	N 4863508.32; E 623628.20
Grenade Courts	F10OR004102R04	50	N 4858051.24; E 623361.36
Mortar Range	F10OR004102R05	1421	N 4861875.88; E 624050.99
Range Complex No. 1	F10OR004102R06	3527	N 4859541.80; E 621252.77
Rifle Range	F10OR004102R06-SR01	684	N 4859031.66; E 624135.93
Rifle/Machine Gun Range	F10OR004102R06-SR02	754	N 4858527.00; E 621947.53
Landscape Range	F10OR004102R06-SR03	19	N 4859354.99; E 623965.34
Transition Range	F10OR004102R06-SR04	591	N 4858698.24; E 622099.91
Anti-Aircraft Range	F10OR004102R06-SR05	1022	N 4858316.58; E 621364.30
Field Target and Submachine Gun Range	F10OR004102R06-SR06	2766	N 4859936.70; E 620986.42

158 UTM – Universal Transverse Mercator

159 ¹ UTM Zone 10, North American Datum 1983.

160 1.3 Purpose, Scope, and Objectives of the Site Inspection

161 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further
 162 response action under CERCLA or not. The SI collects the minimum amount of information
 163 necessary to make this determination, as well as it (i) determines the potential need for a removal
 164 action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System
 165 (HRS) scoring by Environmental Protection Agency (EPA); and (iii) collects data, as
 166 appropriate, to characterize the release for effective and rapid initiation of the Remedial
 167 Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to

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

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

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

- 179 • There is no indication of MEC;
- 180 and
- 181 • MC contamination does not exceed screening levels determined from Technical
182 Project Planning (TPP).

183
184 **Is an RI/FS warranted?** An RI/FS may be recommended if:

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

192
193 **Is a time-critical removal action (TCRA) warranted?** A TCRA may be needed if:

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

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

207 **1.4 *Munitions Response Site Prioritization Protocol***

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

211 *2.0 Property Description and History*

212 The setting, history, and use of Camp Abbot are described in the following sections. Unless
213 referenced otherwise, this information is taken from the ASR (USACE, 1995).

214 *2.1 Historical Military Use*

215 Camp Abbot (Figure 2-1) was used primarily as an Engineer Replacement Training Center
216 (ERTC) during World War II. Construction of the camp was completed in May 1943, and it
217 operated for approximately 14 months, until June 1944. In that time, a total of 90,000 engineer
218 soldiers were trained (up to 10,000 men at a time). Camp trainees received instruction in
219 military construction and engineering. General and specialist training programs, in periods
220 ranging from 5 to 17 weeks, included instruction in heavy equipment operation, fire-fighting,
221 carpentry, demolition, tank operation and maintenance, bridge construction, infiltration,
222 mapmaking, pipeline construction, depot storage, specialized mechanics, aerial photography,
223 water and sewage systems, camouflage, mine detection, and bomb disarmament. The 17-week
224 general training program, a modification of earlier strategies involving shorter training periods
225 and greater emphasis on specialist training, at the Army's three ERTCs went into effect in
226 August 1943. Figure 2-1 shows the layout of Camp Abbot based on an historical site map
227 contained in the Inventory Project Report (USACE, 1994). Figure 2-2 shows the current site
228 layout overlain on the most recent available aerial photograph from 2003. Section 1.2 lists the
229 Camp Abbot ranges and subranges.

230 The Camp Abbot program included three distinct phases:

- 231 • Six weeks of basic military training, including rifle marksmanship, use of hand grenades
232 and anti-tank grenades, and defense against chemical, air, and mechanized attack;
- 233 • Eight weeks of technical training in demolitions, etc., preparing trainees for duty either as
234 general engineers or as specialists;
- 235 • A 3-week, field maneuver spent under field and combat conditions, including such team
236 training tasks as mine laying, demolitions, and building of bridges, roads, and obstacles.

237 A letter dated 25 September 1946 states that Camp Abbot was “dedudded” in November 1944,
238 and that “A recent inspection of Camp Abbot was made by the Chemical Officer of the 6th U.S.
239 Army to determine whether poisonous gases were present on the area. The inspection showed
240 that the land was free of any such contamination.”

241 A War Department letter of 30 October 1946 stated that Camp Abbot “is hereby declared safe for
242 return to private use.” A letter dated 18 November 1947, relinquishing the Army's permits for
243 use of Forest Service land, states “the lands have been examined and have been cleared of all
244 explosives or explosive objects reasonably possible to detect by visual inspection.”

245 **2.2 Munitions Information**

246 Table 2-1 includes a list of munitions and the associated MC reportedly used at Camp Abbot.
247 Use of munitions at ERTCs was very limited due to short supply of munitions because of the
248 war. For example, although the .50-caliber machine gun was issued to Camp Abbot, its use was
249 limited due to short supply of ammunition and much of the machine gun training used the .30-
250 caliber weapon. Also, the use of anti-tank rockets was limited to one rocket for every 50 men
251 (Coll et al., 1958, p 264).

252 **2.3 Ownership History**

253 Camp Abbot was constructed in May 1943. In November 1947, the Army relinquished permits
254 of use of Forest Service land west of the Deschutes River. Land east of the river was used for
255 cattle grazing until approximately 1968, when a group of developers began Sunriver Resort. The
256 resort now occupies approximately 3,300 acres east of the Deschutes River. The land east of the
257 river is owned by a private corporation (Sunriver Limited Partnership) and private citizens.
258 Figures 2-3A through 2-3F show the current property ownership. The property owners are
259 identified by an index number rather than a name on the figures. The property owner name is
260 available on request from the USACE Seattle District office.

261 **2.4 Physical Setting**

262 **2.4.1 Topography and Vegetation**

263 The landscape of the former camp varies from flat areas with low grass and few shrubs in the
264 valley of the Deschutes River, to rugged hills, buttes, and cliffs with heavy shrubs and trees west
265 of the river. Figure 2-4 shows the FUDS boundary overlain on available topographic maps.

266 **2.4.2 Land Use**

267 Current and expected future land use within the area of former Camp Abbot includes residential,
268 recreational, and multiple Forest Service land uses.

269 East of the Deschutes River, much of the former Camp Abbot is now the resort and residential
270 community of Sunriver. The privately owned area includes houses, condominiums, an airport,
271 golf courses, bike paths, and a nature center. The portion of the former Camp Abbot west of the
272 Deschutes River is under the control of the Forest Service and is virtually undeveloped. Figure
273 2-2 shows the FUDS boundary overlain on aerial photographs taken in 2003. The aerial
274 photographs illustrate the diverse use of the land.

275 **2.4.3 Nearby Population**

276 The community of Sunriver has a population of approximately 534 (U.S. Census Bureau
277 estimate). The city of Bend, Oregon, 15 miles north of Camp Abbot, has a population of 62,937.
278 Deschutes County has a total population of approximately 141,382 (averaging 44.2 people per
279 square mile) (U.S. Census Bureau, 2000). Several hundred residences and numerous farms are

280 located within a 2-mile radius of the site. Three schools are located approximately 2 miles
281 southwest of the site. The estimated population (U.S. Census, 2000) within a 2-mile radius of
282 the Camp Abbot FUDS property boundary is 4,122 (Figure 2-5). The population density is 42.6
283 persons per square mile (within a 2-mile radius). The estimated numbers of housing units and
284 households within a 2-mile radius are 5,460 and 1,798, respectively.

285 *2.4.4 Climate*

286 Camp Abbot is situated east of the Cascade Range, which strongly influences the area's climate.
287 As air moves east over the Cascades, it descends and becomes drier. The annual average rainfall
288 at Bend, Oregon is less than 12 inches, with average monthly precipitation ranging from a low of
289 0.49 inch in September to a high of 1.78 inches in December. The monthly average mean
290 temperature ranges from 31.2 degrees Fahrenheit (°F) in December and January to 63.5°F in July.

291 *2.4.5 Area Water Supply*

292 The community of Sunriver uses groundwater from deep water supply wells for the community
293 water supply. Residents outside of Sunriver use private groundwater wells. The water
294 department of the City of Bend, located 15 miles downstream of Camp Abbot, uses surface water
295 (Deschutes River) as its primary water source.

296 *2.4.6 Geologic and Hydrogeologic Setting*

297 The site is located along the Deschutes River in the High Lava Plains physiographic province of
298 Oregon, a few miles east of the Cascade Range.

299 *2.4.6.1 Geology*

300 The Cascade Range is a north-south trending zone of volcanic eruptive centers, including the
301 large stratovolcanoes North, Middle, and South Sister, and Mount Jefferson, which all exceed an
302 elevation of 10,000 feet (ft) above sea level. Broad lava plateaus are interrupted by faults and
303 fault-bounded grabens.

304 The surficial geology of the site includes Pliocene, Pleistocene, and Holocene basaltic andesite
305 and basalt flows that are often fractured and highly permeable. Deposits of alluvial and/or
306 glacial outwash silt, sand, and gravel are present along the Deschutes River. Soils at the site are
307 generally very thin to absent, with surface outcrops of volcanic rocks.

308 *2.4.6.2 Hydrogeology*

309 Groundwater is present in the fractured and highly permeable Pliocene, Pleistocene, and
310 Holocene basaltic andesite and basalt flows. Precipitation readily infiltrates the permeable lava
311 flows, particularly in the Cascade Range where both precipitation and permeability are high.

312 Groundwater flow is generally toward the Deschutes Basin and Deschutes River, where fine-
313 grained sedimentary and older volcanic units tend to divert groundwater flow to the surface, as
314 evidenced by numerous springs feeding creeks and rivers. Perched water near the ground

315 surface is likely to be encountered due to low permeability silts and clays. These perched water
316 layers likely flow to the Deschutes River or small ponds within the Sunriver community.

317 Domestic water wells are typically less than 100 ft deep, and the depth to groundwater is a few
318 tens of feet, as evidenced by the domestic well used to obtain a background water sample. That
319 well had a total depth of 56 ft, with groundwater at 30 ft. Wells used by the Sunriver community
320 are deeper and may extend to as much as 600 ft below ground surface (bgs).

321 ***2.4.7 Sensitive Environments***

322 Camp Abbot contains sensitive environments. The Deschutes River is designated as a Federal
323 Wild and Scenic River and several miles of sensitive wetlands occur along the river. Portions or
324 all of Camp Abbot qualify as Important Ecological Places (IEP) or Sensitive Environments as
325 defined by USACE (2006) or EPA (1997). Table 2-2 provides the checklist used for determining
326 the IEP status. A determination has been made by Shaw for SI evaluation purposes to consider
327 the whole FUDS to qualify as IEP or Sensitive Environments because there is a stream running
328 through the middle of the site and AOCs that contains wetlands. Sensitive environments are
329 present in Range Complex No. 1, the Anti-Tank Range, Mortar Range, Grenade Court, and
330 Burial Pit AOCs. No sensitive environments are present at the Demolition Area and Chemical
331 Training Area.

332 ***2.5 Previous Investigations for MC and MEC***

333 Multiple investigations regarding MC/MEC have been performed at Camp Abbot.

334 ***2.5.1 Archives Search Report***

335 The USACE completed an ASR in 1995. The ASR confirmed past DoD ownership of Camp
336 Abbot and compiled available information with emphasis on types, quantities, and areas of
337 ordnance use and disposal. Members of the USACE performed a limited inspection of the site,
338 “focusing specifically on areas of past recoveries” (USACE, 1995). The site visit team
339 concluded that “there exists the possibility of OEW [ordnance and explosive waste]
340 contamination of the site...” and that “no indications of CWM [chemical warfare materials]
341 contamination were found” (USACE, 1995).

342 ***2.5.2 ASR Supplement***

343 The USACE completed an ASR Supplement in 2004, which identified Range Complex No. 1,
344 Mortar Range, Demolition Area, Anti-Tank Range, Grenade Courts, Burial Pit, and Chemical
345 Training Area as AOCs. A risk assessment was completed on the explosives safety hazard
346 related to munitions. The risk assessment did not address the environmental hazards associated
347 with munitions constituents. The Risk Assessment Code (RAC) score was assigned to each
348 AOC. Possible scores range from high (1) to low (5). All AOCs received a score of 1 (high risk)
349 except for Range Complex No. 1, which received a score of 5.

350 **2.5.3 Other Investigations**

351 In 2005, a *Preliminary Assessment/Site Inspection Report (PA/SI)* for Camp Abbot was
352 completed for the EPA by Weston (2005). The scope of the PA/SI largely parallels the scope of
353 the 2006 SI. Samples were collected from soil, sediment, surface water, and groundwater at
354 several AOCs. To the extent possible, this SI uses data previously collected for the PA/SI. The
355 data collected during the PA/SI is discussed in Section 5, along with the data collected during the
356 SI field activities. Note that the data collected from the landfill area was for HTRW and not MC
357 evaluation. The landfill samples were analyzed for metals, semivolatile organic compounds, and
358 pesticides/polychlorinated biphenyls. Only metals and nitrogen-based explosives are chemicals
359 of concern for the Camp Abbot MMRP SI.

360 One groundwater sample was collected during the PA/SI from municipal Well #2, as designated
361 by Sunriver Water LLC. The well is located approximately 0.75 mile east of the Machine Gun
362 Range and approximately 0.4 mile southeast of the landfill and is upgradient of all AOCs.
363 Review of the well log data shows that the well was screened between 254 ft and 266 ft bgs. The
364 PA/SI groundwater sample was analyzed for perchlorate and nitrogen-based explosives. There
365 were no detected compounds (Weston, 2005).

366 Analytical reporting limits used in the PA/SI report were generally higher than those used in this
367 Camp Abbot SI. In particular, reporting limits used in the PA/SI for soil explosive compound
368 analysis using EPA Method 8330 were approximately 10 times higher than those used in the
369 Camp Abbot SI. Analysis for metals in the PA/SI also generally had somewhat higher reporting
370 limits than those used in this Camp Abbot SI report. Section 5 evaluates the impact, if any, that
371 higher detection limits for the PA/SI data has on the Camp Abbot SI results.

372 **2.6 Other Land Uses that May Have Contributed to Contamination**

373 A large portion of Camp Abbot is within the Deschutes National Forest, which has uncontrolled
374 access. Areas within the Sunriver community include an airport and commercial buildings that
375 may have contributed to HTRW contamination in surface soil. Agricultural uses may have
376 included the use of fertilizers and pesticides containing nitrate-based compounds and heavy
377 metals, which may also occur as MC.

378 **2.7 Past Regulatory Activities**

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

380 **2.8 Previous MEC Finds**

381 Previous MEC finds at Camp Abbot include:

- 382 • At the Anti-Tank Range, a 2.36-inch anti-tank rocket was found.
- 383 • At the Mortar Range, 60 and 81 millimeter (mm) mortar duds were found.

- 384 • At an unknown site, an historical brochure published by Sunriver states that a group of
385 youths found bazooka rockets, bullets, hand grenades, and barbed wire that were used
386 in the engineers' bivouac training.
- 387 • In the area of the Grenade Court, a grenade spoon was found during the ASR site visit.
- 388 • An artillery round and a bazooka round were found west of the Sunriver Resort
389 (across the Deschutes River). In addition, spent mortar and rocket rounds have been
390 found northwest of the Sunriver airstrip.
- 391 These finds are further noted in Section 4.0.

392 3.0 Site Inspection Tasks

393 The SI tasks conducted at the FUDS involved compiling and reviewing historical reports and
394 information that were then used in the TPP process. Following the TPP meeting, the *Site-*
395 *Specific Work Plan* (SSWP) was prepared to define the SI field activities necessary to collect the
396 information needed to address the data gaps and data quality objectives (DQOs). Field work was
397 conducted at the site in September 2006.

398 3.1 Technical Project Planning

399 TPP involved compiling and reviewing historical reports and information to identify data gaps
400 and develop a path forward. The TPP Meeting for the Camp Abbot was conducted on April 4,
401 2006 at the Sunriver Resort, located at Sunriver, Oregon. This meeting included representatives
402 from USACE – Omaha Design Center, the USACE Hazardous, Toxic, and Radioactive Waste
403 Center of Expertise, and the USACE Seattle District; Shaw; Oregon Department of
404 Environmental Quality (ODEQ); Sunriver Owners Association; and Sunriver Resort.

405 In the TPP Meeting, historical information was discussed and historical aerial photographs were
406 reviewed. The stakeholders agreed that soil, surface water, and groundwater warrant inspection
407 to evaluate the potential presence of MEC and MC. The results of the TPP meeting were
408 documented in the *TPP Memorandum* (Shaw, 2006b), which was issued final on July 26, 2006
409 after incorporating comments from the stakeholders. The proposed technical approach was
410 defined in the SSWP (Shaw, 2006c), which was issued final on September 15, 2006 after
411 incorporating comments from the stakeholders.

412 The SI approach groups ranges and other areas into historical use, types of MEC, MC expected,
413 and environmental conditions. This grouping was documented in the *TPP Memorandum*. The
414 AOC groupings identified within Camp Abbot were (Figure 3-1):

- 415 • Range Complex No. 1 contains all small arms ranges;
- 416 • Explosive Munitions Ranges includes the Anti-Tank Range, the Demolition Area, and
417 the Mortar Range;
- 418 • Grenade Courts includes all grenade training areas;
- 419 • Burial Pit is a potential munitions disposal area, and
- 420 • Chemical Training Area is where chemical weapons familiarization was conducted.

421 A more complete discussion of the TPP meeting is contained in Appendix B.

422 Following the TPP meeting with institutional stakeholders on April 4, 2006, a second TPP/public
423 information meeting was held at Sunriver Resort. The meeting presented to interested public an
424 overview of the proposed work at Camp Adair. Discussed were the overall project purpose,
425 contact information, preliminary sampling areas, and rights of entry. Questions were answered

426 following the meeting. An additional public information meeting was held on July 19, 2006 to
427 brief the public on the upcoming sampling that was to be completed in September.

428 As discussed during the TPP meeting and subsequent telephone calls, the following project
429 objectives and DQOs were developed.

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

432 DQO #1 – At AOCs where MEC has not been reported in the past (Range Complex No. 1 and
433 the Live Hand Grenade Court), trained UXO personnel will conduct a visual search of the AOCs
434 aided by a handheld magnetometer or metal detector, searching for evidence of the presence of
435 MEC (e.g., craters and ground scars indicative of ordnance burial/ordnance disposal (OB/OD)
436 activities, MEC on the surface, munitions debris indicative of OB/OD activities, and soil
437 discoloration indicative of explosives). The visual search will consist of a meandering path
438 survey along trails and in accessible areas. The magnetometer will aid the UXO personnel in
439 locating MEC or munitions debris on the ground surface. The magnetometer or metal detector
440 will identify subsurface magnetic or metal anomalies. However, no attempt will be made to
441 identify any subsurface anomalies. Typically, only a handheld magnetometer is used to identify
442 MEC; however, the FUDS is underlain by basaltic rock that has high iron content. A backup
443 metal detector (White’s Eagle Metal Detector – which is based on electromagnetic geophysical
444 methods) may be used if excessive signal noise is encountered from the basaltic rocks.

445 The following decision rules will apply for AOCs where no MEC has been previously reported:

- 446 • If no evidence of MEC is found, the AOCs will be recommended for NDAI relative to
447 MEC.
- 448 • If evidence of MEC is confirmed, the AOCs will be recommended for additional
449 investigation.
- 450 • If there is indication of an imminent MEC hazard, the site may be recommended for a
451 TCRA.

452 DQO #2 – At AOCs where MEC has been reported in the past (Anti-Tank Range, Demolition
453 Area, and Mortar Range), the following decision rules will apply:

- 454 • The presence of MEC is confirmed on the basis of past finds, and these areas will be
455 recommended for additional investigation.
- 456 • If, in the course of reconnaissance for sample targets and/or UXO avoidance, there is
457 indication of an imminent MEC hazard, the site may be recommended for a TCRA.

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

460 DQO #3 – Soil, sediment, surface water, and groundwater samples will be collected and
461 analyzed. Analytical results will be compared to screening values for human health screening

462 risk assessment and a screening level ecological risk assessment, and to background values for
463 naturally occurring substances. The following decision rules will apply if there is a complete
464 human health or ecological pathway:

- 465 • If sample results are less than human health and ecological screening values, the AOC
466 will be recommended for NDAI relative to MC.
- 467 • If sample results exceed both human health screening values and background values, the
468 AOC will be recommended for additional investigation.
- 469 • If sample results do not exceed human health screening values but do exceed both
470 ecological screening values and background values, additional evaluation of the data will
471 be conducted in conjunction with the stakeholders to determine if additional investigation
472 is warranted.

473 **3.2 Additional Records Research**

474 **3.2.1 Coordination with State Historic Preservation Office**

475 The State Historic Preservation Office (SHPO) for Oregon is located within the Parks and
476 Recreation Department. After a search of the SHPO's archaeological database, a SHPO
477 representative identified several reported archaeological/cultural sites within the project AOCs.
478 Furthermore, the SHPO representative indicated that this area includes several features typically
479 associated with archaeological resources. In order to protect these sites and any previously
480 unidentified sites from damage or inadvertent intrusion, Shaw contracted with a local
481 archaeologist to accompany the field teams to ensure known sites were avoided and previously
482 unidentified sites were noted for the SHPO. The archeologist prepared and submitted a field
483 report (Appendix C). The archeologist's report noted that known sites were successfully avoided
484 during sampling activities, and one previously unknown site was identified with appropriate
485 photos and GPS locations, and forwarded to the SHPO. The known and recently identified
486 archeological sites that were avoided were located west of the Deschutes River in Range
487 Complex No. 1, Anti-Tank Range, and Mortar Range AOCs.

488 **3.2.2 Coordination Regarding Natural Resources**

489 The Oregon Department of Fish and Wildlife (ODFW) was contacted to identify any potentially
490 impacted threatened or endangered species in the area. The ODFW indicated there was no
491 impact to threatened or endangered wildlife species in the area (ODFW, 2006). The U.S. Fish
492 and Wildlife Service website was reviewed for threatened or endangered species. Species are
493 identified in the *Final TPP Memorandum* (Shaw, 2006b). The Oregon Department of
494 Agriculture coordinates inquiries into threatened or endangered plant species for the State of
495 Oregon. The Department indicated it has no jurisdictional authority for the Forest Service
496 property within the FUDS and did not provide any information pertinent to endangered plants for
497 the Camp Abbot area. The U.S. Forest Service has responsibility over its lands. The Forest
498 Service communicated verbally that they did not have any concerns over impacts to their lands.
499 Species lists are included in Appendix C.

500 **3.2.3 Historical Aerial Photographs**

501 The historical aerial photographs of Camp Abbot were reviewed and interpreted prior to field
502 mobilization to aid in site reconnaissance and to refine proposed sampling point locations. Four
503 aerial photographs dating from 1957 were obtained from the U. S. Geological Survey and reviewed.
504 There were no significant observations made from these photographs.

505 **3.2.4 Environmental Database Search**

506 A search of available environmental records was conducted by Environmental Data Resources,
507 Inc. (EDR, 2005a and b). The government records search met the requirements of ASTM
508 Standard Practice for Environmental Site Assessments. The search results indicated that Camp
509 Abbot does appear on mapped sites in known federal, state, or local databases (Appendix L).
510 Within a 1-mile radius of the Camp Abbot site the following were identified:

- 511 • Facility Index System – 8 sites,
- 512 • Environmental Cleanup Site Information System – 5 sites,
- 513 • Oregon Underground Injection Control System Database – 2 sites,
- 514 • Leaky Underground Storage Tank List – 1 site,
- 515 • Underground Storage Tanks – 2 sites,
- 516 • Above Ground Storage Tanks – 12 sites,
- 517 • Oregon HAZMAT Spill database – 2 sites, and
- 518 • Oregon Hazardous Substance Information Survey – 22 sites.

519 Additional information on the databases searched and the results for surrounding properties is
520 included in the EDR reports found in Appendix L.

521 **3.2.5 Rights of Entry**

522 Prior to mobilizing to the site, the Project Manager for the USACE Seattle District office
523 obtained the Right of Entry from the property owners where the SI field activities were
524 performed.

525 **3.3 Field Work**

526 SI field activities, conducted between September 22 and September 28, 2006, included site
527 reconnaissance and collection of surface soil, sediment, surface water, and groundwater samples.
528 The following conditions were recorded in the field log book (Appendix D) and/or by digital
529 photographs (Appendix E):

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

535 **3.4 Lab Analysis and Data Quality Review**

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

538 One-hundred percent of the analytical data have been reviewed based on EPA Contract
539 Laboratory Program (CLP) *National Functional Guidelines for Organic Data Review*, October
540 1999 and EPA CLP *National Functional Guidelines for Inorganic Data Review*, October 2004.
541 Automated Data Review software (version 8.1) was used to assist in the data validation process
542 for all areas with the exception of initial calibration blanks, continuing calibration blanks,
543 interference check standards, serial dilutions, internal standards, instrument tuning standards, and
544 second-column confirmation. Data were evaluated against specific criteria to verify the
545 achievement of all precision, accuracy, representativeness, completeness, comparability, and
546 sensitivity goals established to meet the project DQOs.

547 The overall quality of the data collected is discussed in the Analytical Data QA/QC Report
548 (Appendix G). Results of the analyses, as discussed in this evaluation, suggest that
549 representative samples were collected and analyzed, and the results are indicative of the media
550 analyzed, with the exception of the few anomalies noted in the report.

551 No data was “R” qualified as unusable. Overall, these data reflect expected site conditions and
552 they are fully usable for their intended purpose.

553 **3.5 Variances from the SSWP**

554 A surface water sample was scheduled to be collected from the Mortar Range (Location
555 013A013, sample number NWO-013-2001). The location was the same as where a sediment
556 sample was collected by Weston during the PA/SI (Weston, 2005). However, the site was dry
557 and surface water was not available for sampling.

558 Samples NWO-013-0005 (surface soil) and NWO-013-1002 (sediment) were scheduled to be
559 analyzed for lead only. However, during the visual reconnaissance, a depression possibly caused
560 by explosives was identified. This soil sample was collected from within the depression and the
561 sediment sample was collected from a drainage approximately 0.2 mile downslope of the
562 depression. The analytical suite for these two samples was expanded to metals and explosives
563 including nitroglycerin and pentaerythritol tetranitrate (PETN).

564 **3.6 Third TPP Meeting**

565 A third TPP meeting is planned to present the SI findings to stakeholders and reach consensus
566 regarding conclusions.

567 *4.0 Munitions and Explosives of Concern*

568 A reconnaissance for potential MEC was completed at specific AOCs. A visual observation of
569 site conditions was performed prior to collection of samples, and a hand-held all-metal detector
570 was used to aid in discovering unseen items obscured by shallow soil or vegetative cover.

571 *4.1 Field Observations*

572 The reconnaissance team located each planned sampling location and documented conditions
573 with respect to vegetative cover, soil conditions, unexpected debris or material, presence or
574 absence of water, and any other conditions that could potentially impact the collection of
575 samples. Particular attention was paid to munitions debris, potential indications of
576 contamination such as vegetative stress, and other features of interest (e.g., building foundations,
577 floor slabs, drain tiles, etc.). Additionally, the reconnaissance team recorded the path walked
578 within the AOC using a hand-held Global Positioning System (GPS) unit. Digital photographs
579 were taken to document significant features. Representative photographs of reconnaissance
580 activities and observations are included as Appendix E. A table of GPS coordinates is included
581 in Appendix H.

582 The approach used for MEC evaluations/investigations at Camp Abbot was that if MEC or
583 munitions debris had been previously reported at an AOC, no visual reconnaissance would be
584 completed. MEC has been previously identified at the Explosive Munitions Ranges, but not at
585 Range Complex No. 1 or the Live Grenade Court.

586 During the SI field activities a visual search was completed to locate the reported Burial Pit
587 (USACE, 1995). The route walked was also recorded using a GPS unit.

588 The field activities included a visual reconnaissance along four routes in Range Complex No. 1
589 (Routes 1 through 4) and in the vicinity of the reported Live Grenade Court located north of the
590 Grenade Court AOC (Figure 4-1) to evaluate the presence or absence of MEC. The visual
591 reconnaissance was supplemented with a Fisher 1266-X electromagnetic all-metal detector. The
592 electromagnetic all-metal detector was used to avoid high iron-content rock interference that
593 occurs with the ferrous metal magnetometer. The SSWP identified a White's Eagle Metal
594 Detector as a possible instrument, but the unit was not available from the vendor. The
595 instrument used (Fisher 1266-X metal locator) provided equivalent metallic object detection
596 capability as the White's instrument. The path walked during the visual reconnaissance was
597 recorded using a hand-held GPS unit.

598 *4.1.1 Range Complex No. 1*

599 The field activities conducted at the Range Complex No. 1 included a visual reconnaissance to
600 evaluate the presence or absence of MEC, and collection of surface soil, sediment, and
601 groundwater samples. Four visual reconnaissance routes of Range Complex No. 1 were

602 completed to identify whether there was evidence of military activity inconsistent both with use
603 as a small arms range and with the CSM. The reconnaissance routes are shown on Figure 4-1
604 and are identified as Routes 1, 2, 3, and 4. The route locations were selected to provide a
605 representative evaluation of the terrain and environment of the subranges within Range Complex
606 No. 1 and to look in areas that may have a higher likelihood of having other than small arms
607 munitions used (e.g. reconnaissance Route No. 2 completed the Field Target and Submachine
608 Gun Subrange). All routes were approximately 4,200 ft in length and covered a swath
609 approximately 3 ft wide (swing of the all-metal detector).

610 The CSM for Range Complex No. 1 is for small arms ranges, with all munitions used being of
611 .50-caliber or less. Numerous spent bullets and casings were identified along reconnaissance
612 Route 2, which appeared to indicate that maneuvers occurred in the area. Bullet holes were
613 noted in tree stumps, and multiple finds of concentrations of bullets and casings were found. No
614 MEC or munitions debris was identified. Along Route 2, two large depressions were identified.
615 One appeared to be a crater (possibly caused by explosives), with multiple small subsurface
616 anomalies. The crater was located on a slope and generally circular, approximately 10 ft in
617 diameter, and 2 ft deep. Photographs 1 and 2 (Appendix E) show the crater. A second smaller
618 depression, approximately 6 ft in diameter, was identified approximately 0.2 miles west and
619 upslope or the larger depression. The second depression was supported by rocks on the
620 downslope side and may have been a constructed observation post.

621 *4.1.2 Explosive Munitions Ranges (Anti-Tank Range, Demolition Area, and Mortar Range)*

622 The field activities at the Explosive Munitions Ranges included a visual observation aided by an
623 all-metal detector for MEC avoidance during sampling. No reconnaissance was completed to
624 evaluate the presence or absence of MEC, because MEC has been confirmed previously at this
625 AOC. However, MEC avoidance was conducted using an electromagnetic all-metal detector
626 when walking from the vehicle to the sampling location. These MEC avoidance paths are shown
627 on Figure 4-1.

628 *4.1.3 Grenade Courts*

629 The ASR Supplement identified the Grenade Court AOC as a small area (50 acres) located
630 between the Spring and Deschutes Rivers. A map included in the ASR (Appendix D-1)
631 indicated a practice grenade court at the same location indicated in the ASR Supplement, and a
632 live grenade court located further north near the confluence of the Spring and Deschutes Rivers.
633 A visual reconnaissance of the suspected live grenade court was completed, aided by a hand-held
634 all-metal detector. The objective of the reconnaissance was to identify the location of the
635 suspected live grenade court and to determine whether any MEC or munitions debris was present
636 in the live grenade court area. The reconnaissance route paths are shown on Figure 4-1 (Route
637 5). The route location was based on the location suggested by historical maps provided in the
638 ASR (see also Figure 2-1). Because of the amount of vegetation in the area, a meandering path

639 was followed to cover the area of the suspected live grenade court. The location of the suspected
640 live grenade court was not found and no MEC or munitions debris, other than bullets, was
641 identified in the live grenade court area. The field team did identify a small camp site (shredded
642 tent, sleeping bags, aluminum bowl with brush, cassette tape), suspected to have been used by
643 recreationists. A small area with several subsurface anomalies was identified with the hand-held
644 all-metal detector that appeared to be associated with recreational use.

645 **4.1.4 Burial Pit**

646 A visual reconnaissance (Figure 4-1, Route 6) was conducted in the suspected vicinity of the
647 Burial Pit, with the objective of finding the pit for sampling. The ASR and ASR Supplement had
648 identified the Burial Pit as “horseshoe in shape, bermed, and ringed with stone.” The ASR
649 placed the pit as east of the ordnance area and the ASR Supplement placed it at the former
650 landfill. The two documents provided conflicting location coordinates for the pit. The ASR
651 placed the pit near the northern FUDS boundary along the Deschutes River. One coordinate set
652 provided in the ASR Supplement placed the location nearly 70 miles south of Camp Abbot. The
653 second coordinate set provided in the ASR Supplement placed the Burial Pit location very near
654 the landfill in a lake.

655 The visual reconnaissance failed to find the location of the Burial Pit. Personnel at the Nature
656 Center did not know of the reported pit or any feature that is “horseshoe in shape, bermed, and
657 ringed with stone.”

658 **4.1.5 Chemical Training Area**

659 No visual reconnaissance was completed in the vicinity of the Chemical Training Area. At the
660 TPP, the stakeholders agreed that additional investigation was not warranted based on the
661 location of the Chemical Training Area relative to the cantonment area, the development that has
662 occurred at the area, and the type of activities that may have occurred there. It is understood that
663 these activities were limited to training using Chemical Agent Identification Sets (CAIS) in a
664 building or tent. Neither conventional explosive MEC nor chemical agents were expected to be
665 present at this site. Additional information on this AOC is provided in Section 5.7.

666 **4.2 MEC Risk Assessment**

667 The following sections present a qualitative assessment of the risk associated with MEC at each
668 inspected AOC. This assessment is based on historical documentation and limited visual
669 inspection conducted during the SI. This is provided to convey relative risk on a scale from low
670 to high and is not intended to be a thorough risk assessment as required by CERCLA.

671 **4.2.1 Range Complex No. 1**

672 Four magnetometer assisted visual reconnaissance were completed within Range Complex No.
673 1. No MEC or munitions debris (other than expended small arms munitions) was identified.
674 One suspected explosion crater was identified and a second smaller depression was identified

675 that may have been an observation post along Route 2. Photographs of the suspected crater are
676 provided in Appendix E (photographs 1 and 2). Historically, no MEC (other than expended
677 small arms munitions) has been reported within Range Complex No. 1. The first crater may
678 have been an explosive detonation site used to simulate field conditions. The only known
679 potential use of explosives at the small arms ranges would have been explosive detonations used
680 to simulate field conditions during practice.

681 The current land use is primarily open field east of the river and forested areas west of the river.
682 However, there are residences along the southeastern boundary of Range Complex No. 1. Based
683 on the reported use of this range for small arms training only and no evidence of other uses, other
684 than the two craters, the MEC risk at Range Complex No. 1 is considered to be low.

685 *4.2.2 Explosive Munitions Ranges*

686 Types of explosive munitions used within the Explosive Munitions Ranges included: 2.36-inch
687 anti-tank high explosive and practice rockets, rifle grenades, explosives, dynamite, detonators,
688 and 60 mm and 81 mm high explosive and practice mortar rounds. Based on reports (Coll et al.,
689 1958) the availability of munitions for training by the ETRCs was limited, and the density of
690 MEC or munitions debris would be expected to be low. Shaw completed limited all-metal
691 detector assisted reconnaissance at soil and sediment sampling locations within the Explosive
692 Munitions Ranges. No MEC or munitions debris was located. Historically, MEC and munitions
693 debris have been found associated with the Anti-Tank Range and Mortar Range (60 mm and 81
694 mm mortar rounds) (USACE, 1995). No MEC or munitions debris were reported during the
695 PA/SI (Weston, 2005) at the Demolition Area. However, MEC is considered potentially present
696 because of the adjacent Mortar Range.

697 Current land use for the Explosive Munitions Ranges is primarily National Forest land.
698 However, the reported firing positions for the Mortar Range and Anti-tank Range are within the
699 Sunriver development and numerous residences are present east of the Deschutes River. Public
700 access to the Explosive Munitions Ranges is unrestricted. The types of MEC that may be present
701 are potentially dangerous because of sensitive fuzes or high explosive content. Potential
702 receptors include forest workers and recreational users. Based on the current use of the
703 Explosive Munitions Ranges and the historical occurrence of MEC and munitions debris, the
704 overall MEC risk is considered to be moderate for the Anti-Tank and Mortar Ranges and the
705 Demolition Area.

706 *4.2.3 Grenade Courts*

707 Munitions used at the grenade courts included the Mk II hand grenade, fragmentation; the M21
708 practice grenade; AN-M8 smoke grenade; AN-M14, incendiary grenade; and the M15 smoke
709 grenade. Shaw completed a visual reconnaissance of the live grenade court area. The location of
710 the live grenade court was not confirmed, and no MEC or munitions debris associated with a
711 grenade court were identified. Historically, no MEC or munitions debris have been found at the

712 live grenade court area. However, the ASR reported that a grenade spoon had been found in the
713 vicinity of the practice grenade court during the ASR site visit (USACE, 1995).

714 The grenade court is a natural area that is between Spring River on the west and the Deschutes
715 River on the east. The land is vegetated with tall grass and pine trees. Access to the land is
716 unrestricted and open to the public. The types of MEC that may be present are potentially
717 dangerous because of sensitive fuzes or high explosive content. Potential receptors include
718 forest workers and recreational users. Based on the limited investigation that has been
719 conducted, the overall MEC risk is considered to be moderate.

720 *4.2.4 Burial Pit*

721 Munitions that may have been disposed to the Burial Pit included small arms, anti-tank rockets,
722 mortar rounds, practice and live grenades, explosives, and chemical identification kits. Shaw
723 conducted a visual reconnaissance of the area and could not locate the Burial Pit. No evidence of
724 MEC or munitions debris was found during the SI, and there have been no historical reports of
725 MEC or munitions debris.

726 The Burial Pit was reported as located within a natural area with tall grasses, marsh areas, and
727 pine and alder trees (USACE, 1995). This area is controlled by the local Nature Center. There
728 are no noticeable remnants of the Burial Pit, and Nature Center staff are unaware of its existence.
729 Access to the land is unrestricted and open to the public, however the public are required to stay
730 on trails. Based on the current use of the area, absence of MEC or munitions debris, uncertainty
731 of the location, and even whether the site was actually used as a munitions burial pit, the overall
732 MEC risk is considered to be low.

733 *4.2.5 Chemical Training Area*

734 Shaw did not conduct any field work at the Chemical Training Area, as the area is located
735 entirely within a housing development and all remnants of the AOC or evidence of prior use by
736 Camp Abbot personnel is gone. No MEC or munitions debris has been reported at this area. The
737 likely munitions used at this AOC included CAIS.

738 Access to the land is unrestricted and open to the public. Based on the current use of this AOC
739 and no occurrence of MEC or munitions debris, the overall MEC risk is considered to be low.

740 **5.0 Munitions Constituents Sampling and Analysis**

741 The results from sampling and analysis for MC are described in this section. Data collected from
742 both this SI and the PA/SI (Weston, 2005) are used in the evaluation of MC impacts to media.
743 As appropriate, results are compared to site-specific background values to determine if there is a
744 release. If a release is confirmed, analytical results are compared to screening values for human
745 health risk assessment and, if appropriate, for ecological risk assessment. Results are considered
746 in terms of groundwater, surface water, terrestrial, and air pathways for each AOC. Tables 5-1
747 and 5-2 provide a summary of samples and analyses completed during the SI and the PA/SI,
748 respectively.

749 **5.1 General Setting**

750 The general setting for Camp Abbot was provided in Section 2.0.

751 Figure 5-1 shows groundwater wells in the vicinity of Camp Abbot in relation to distance from
752 the AOCs. Available well records indicate that water wells are numerous in the community of
753 Three Rivers directly south and mostly upgradient of the site. There are also water wells within
754 the FUDS boundary in developed areas within and near Sunriver. Figure 5-2 shows regional
755 surface water features in the vicinity of Camp Abbot in relation to distance from the AOCs.
756 Figure 5-3 shows the location of sensitive receptors such as schools in the vicinity of Camp
757 Abbot in relation to distance from the AOCs.

758 **5.2 Screening Values**

759 The following subsections present details regarding the development of screening values for this
760 SI. Project specific screening values are presented on Tables 5-3 through 5-11.

761 **5.2.1 Determination of Background Concentrations**

762 Ten background soil samples were collected from the Camp Abbot area and analyzed for metals.
763 Background sample locations are shown on Figure 5-4. The selection of the soil background
764 locations was aided by Visual Sampling Plan (VSP) (PNNL, 2005). VSP is a computer software
765 program that allows for an independent sampling location selection across a designated area.
766 The area provided to the VSP software was all areas within the FUDS boundary not included in a
767 known AOC. After VSP identified potential sampling locations, the locations were adjusted by
768 hand to place the background sample location on a property for which the USACE has a signed
769 ROE. Background surface water and sediment sampling locations were collected from a location
770 at the upstream Camp Abbot FUDS boundary. The background groundwater sampling location
771 was from an existing well interpreted to be upgradient or cross gradient of the FUDS where no
772 Camp Abbot activities were conducted. Note that groundwater flow is assumed to be towards
773 the Deschutes River. The well log for the background well is provided in Appendix L.

774 The background soil sample analytical results were used to calculate background metal soil
775 concentrations using published EPA Guidance (1989, 1992, 1994, 1995, and 2006). The
776 background concentrations are either a 95th upper tolerance limit (UTL) for normally and
777 lognormally distributed analytes or the 95th percentile for nonparametric distributed analytes.
778 The background soil sample analytical results are provided in Appendix G. Table 5-A lists the
779 soil, groundwater, surface water, and sediment background concentrations used in this report. A
780 summary of the soil background calculations is presented in Appendix L.

781 One sediment, one surface water, and one groundwater background samples were collected from
782 the Camp Abbot vicinity (Figure 5-4). The analytical results are presented in Appendix G.

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

- 791 1. If the sample measurement is less than or equal to the sample quantitation limit, no
792 observed release is established.
- 793 2. If the sample measurement is greater than or equal to the sample quantitation limit,
794 then an observed release is established as follows:
 - 795 • If the background concentration is not detected (or is less than the detection limit),
796 an observed release is established when the sample measurement equals or exceeds
797 the sample quantitation limit.
 - 798 • If the background concentration equals or exceeds the detection limit, an observed
799 release is established when the sample measurement is three times or more above
800 the background concentration.

801 In the discussions below, these criteria are used to determine whether a release of MC has
802 occurred in sediment and groundwater, regardless of whether the analyte is considered a
803 hazardous substance. However, these criteria are not applied for soils because a statistically
804 based determination of background has been established, and an exceedance of the 95th UTL or
805 95th percentile, depending on the individual analyte, is used to establish a release of MC.

806 *5.2.2 Human Health*

807 Human health screening values for groundwater, surface water, sediment, and soil analytical
808 results were established using the following reference sources:

- 809 • EPA Region 9 Preliminary Remediation Goals for Tap Water, Residential Soil.
- 810 • Federal Drinking Water Criteria Maximum Contaminant Levels (groundwater and
811 surface water).

812 In cases where screening values were listed from both sources, the lower value is used for
813 screening, except where the screening value is a Secondary Maximum Contaminant Level.
814 Secondary Maximum Contaminant Levels are based on aesthetic criteria (taste, odor, color) and
815 not on health based criteria and are not enforceable.

816 Analytical detection limits for explosive compounds analyzed for in the PA/SI were higher than
817 the detection limits used in this site inspection. However, all PA/SI detection limits were below
818 the human health screening values.

819 **5.2.3 Ecological Screening**

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

826 Some analytical detection limits (0.2 mg/kg) for explosive compounds in the PA/SI sediment
827 samples were above the ecological screening values. The screening values exceeded were for
828 RDX (0.13 mg/kg), HMX (0.047 mg/kg), 1,3,5-TNB (0.024 mg/kg), and 1,3-DNB (0.067
829 mg/kg).

830 **5.3 Range Complex No. 1**

831 **5.3.1 General History and Field Findings**

832 The ranges within Range Complex No. 1 were used by the Army between 1943 and 1944.
833 Weapons used at these ranges were limited to general small arms. At some ranges, firing would
834 have taken place from fixed positions or within a restricted area up to a fixed limit of advance.
835 Small arms fire may have been directed toward targets in front of man-made backstop berms.

836 At the Anti-Aircraft Range and the Field Target and Sub-Machine Gun Range, small arms fire
837 would tend to be dispersed over a wider area as a result of the variety of target positions and/or
838 firing positions.

839 General small arms (up to .50-caliber) may have been used at these ranges. However, although
840 ERTCs were issued the .50-caliber machine gun, the use of this weapon was limited due to a
841 limited supply of ammunition, and much machine gun training used the .30-caliber weapon (Coll
842 et al., 1958, p. 264). Based on the potential use of .50-caliber ammunition, tracer rounds
843 containing perchlorate may have been used. Additionally, Range Complex No. 1 may have been
844 potentially used for field maneuvers using explosive rounds although no evidence of this has
845 been found.

846 The current land use is primarily open field east of the river and forested areas west of the river.
847 However, there are residences along the southeastern boundary of Range Complex No. 1. Range

848 Complex No.1 contains ecologically sensitive areas, including wetland areas and the Deschutes
849 River. Range Complex No.1 also contains culturally sensitive areas that were avoided during
850 sampling.

851 *5.3.2 Sampling and Analysis*

852 Sample details are provided in Tables 5-1 and 5-2, and analytical detections are listed in Tables
853 5-3, 5-4, and 5-5. Field records are provided in Appendix D and representative photographs of
854 sampling activities are included as Appendix E. Figure 5-5 shows the SI and PA/SI sampling
855 locations and indicates if an exceedance of background concentrations and human health and/or
856 ecological screening values has occurred. Complete analytical data are presented in Appendix F
857 and the Analytical Data QA/QC Report is included as Appendix G.

858 *5.3.3 Groundwater Pathway*

859 One groundwater sample was collected from Range Complex No. 1. Results were compared to
860 the results from the background groundwater sample. The background groundwater sample
861 results are provided on Table 5-A and in Appendix G. The location of the groundwater sample is
862 shown on Figure 5-5. During the TPP process groundwater sampling was proposed from a well
863 located within the Anti-Tank Range. The well was part of the Sunriver Water LLC which
864 supplies water to the Sunriver community. The USACE was unable to obtain an ROE to sample
865 this well. During the finalization of the SSWP (Shaw, 2006c), Shaw was unable to locate any
866 wells that would sample the groundwater in this area. An alternate well was selected within
867 Range Complex No. 1 that samples groundwater from the Anti-Aircraft, Transition, and Field
868 Target and Sub-Machine Gun Subranges within Range Complex No. 1. Groundwater flow
869 direction is assumed to be towards the Deschutes River valley.

870 The sample was collected using the pump installed in the well. The well is a domestic water
871 source for the homeowner. The well log shows that the well depth is 56 ft and the static water
872 level at time of installation was 30 ft bgs (Appendix L). Neither the well depth nor the water
873 level could be measured at the time of sampling because of the installed sanitary well seal. The
874 sample was collected from a hose bib at the house. Samples were analyzed for metals,
875 explosives, and perchlorate. This analyte list was selected based on use of Range Complex No. 1
876 for small arms firing, including the use of potential perchlorate-containing tracer rounds, and the
877 potential use of Range Complex No. 1 for field maneuvers using explosive rounds. Analytical
878 result detections, background concentrations, and human health screening values are shown on
879 Table 5-3. The potential receptor is the homeowner.

880 *5.3.3.1 Comparison to Background Data*

881 Lead, magnesium, and molybdenum were detected at concentrations above the background
882 values. Lead was not detected in the background sample, but it was detected in the well sample
883 at an estimated concentration of 0.44 micrograms per liter ($\mu\text{g/L}$), which is between the method
884 detection limit (MDL) ($0.18 \mu\text{g/L}$) and the practical quantitation limit (PQL) ($2 \mu\text{g/L}$). The

885 magnesium detection (3,140 µg/L) was 1.5 times the background value (2,100 µg/L) and is not
886 considered a significant exceedance (greater than 3 times background). Molybdenum was not
887 detected in the background sample, but it was detected in the well sample at an estimated
888 concentration of 0.72 µg/L, which is between the MDL (0.12 µg/L) and the PQL (5 µg/L).
889 Explosive compounds and perchlorate were not detected in the groundwater sample.

890 The magnesium detection was 1.5 times the background value and is not considered a significant
891 (greater than three time background) exceedance. Because lead and molybdenum were not
892 detected in the background sample but were in the source area sample the detections are
893 considered significant.

894 *5.3.3.2 Comparison to Human Health Screening Values*

895 The groundwater sample analytical result was compared to the human health screening values if
896 the concentrations significantly exceeded (greater than three times background) the background
897 concentration. Lead, magnesium, and molybdenum concentrations were below the human health
898 screening values.

899 *5.3.4 Surface Water/Sediment Pathway*

900 No surface water samples were collected at Range Complex No. 1. The surface water conditions
901 for Camp Abbot are evaluated by a sample collected downstream from the Mortar Range and the
902 results are discussed under the explosives munitions ranges. In accordance with the SSWP, two
903 sediment samples were collected at Range Complex No. 1 (samples NWO-013-1001 and NWO-
904 013-1002). The samples were collected from the bottom of intermittent stream drainages. The
905 locations are shown on Figure 5-5. Sediment sample NWO-013-1001 was analyzed for lead
906 only. Sediment sample NWO-013-1002 was analyzed for select metals and explosives,
907 including nitroglycerin and PETN. This sample was originally scheduled for analysis for lead
908 only; however, during visual reconnaissance, an explosion crater was identified upslope from
909 this sample location, and it was decided that the additional analyses were warranted to evaluate
910 site conditions. The sediment samples were collected as dry samples. The analytical results,
911 background concentrations, and human health and ecological screening values are shown on
912 Table 5-4.

913 The select metals list was developed from metals related to either munitions firing (e.g., mercury
914 in fuzes, magnesium in incendiary devices, barium in explosives) or components of bullets,
915 projectiles, or metal casings (i.e., chromium, copper, iron, lead, magnesium, molybdenum,
916 nickel, and zinc). In addition, the metals aluminum and cadmium were also included as they
917 may be used in evaluation of site soil concentrations to background.

918 Three sediment samples collected during the PA/SI (Weston, 2005) within Range Complex No.
919 1 are also included in the evaluation and are discussed below. Note that the samples collected
920 during the PA/SI were analyzed for the 21 metal target analyte list (TAL). Analytical detections,

921 background soil concentrations, and human health and ecological screening values are shown on
922 Table 5-4.

923 Potential receptors are forest workers, recreational users, and wildlife. For the screening risk
924 assessment, it was conservatively assumed that exposures to sediments would be similar to those
925 of soil.

926 *5.3.4.1 Comparison to Background*

927 Sediment sample results were compared to the detected concentration from the single
928 background sediment sample. The background sediment sample results are provided in
929 Appendix G. In sample NWO-103-1001 lead was detected at a concentration equal to the single
930 sample background concentration of 3.7 mg/kg. The following samples had background
931 concentration exceedances.

- 932 • In sample NWO-013-1002 background concentrations were exceeded for barium (162
933 mg/kg vs. 111 mg/kg), iron (20,300 mg/kg vs. 14,100), lead (3.9 mg/kg vs. 3.7
934 mg/kg), magnesium (2,680 mg/kg vs. 1,850 mg/kg), manganese (463 mg/kg vs. 175
935 mg/kg), mercury (0.016 mg/kg vs. not detected at 0.0082 mg/kg), molybdenum (0.44
936 mg/kg vs. not detected at 0.28 mg/kg), and zinc (36.8 mg/kg vs. 29.3).

937 All exceedances were less than three times the background concentration and thus do not
938 represent a release.

939 Three sediment samples were collected from Range Complex No. 1 during the PA/SI. The
940 following summarizes the detections that were above background.

- 941 • In sample SD-MR001 from the Machine Gun Range in Range Complex No. 1
942 background concentrations were exceeded for iron (17,900 mg/kg vs. 14,100 mg/kg),
943 lead (352 mg/kg vs. 3.7 mg/kg), magnesium (2,900 mg/kg vs. 1,850 mg/kg),
944 manganese (213 mg/kg vs. 175 mg/kg), and mercury (0.07 mg/kg vs. not detected).
- 945 • In sample SD-RR001 from the Rifle Range in Range Complex No. 1 background
946 concentrations were exceeded for copper (27.4 mg/kg vs. 25.8 mg/kg), iron (18,100
947 mg/kg vs. 14,100 mg/kg), magnesium (6,900 mg/kg vs. 1,850 mg/kg), manganese
948 (197 mg/kg vs. 175 mg/kg), mercury (non-detect at 0.21 mg/kg vs. non-detect at
949 0.0082 mg/kg), and zinc (52.2 mg/kg vs. 29.3 mg/kg).
- 950 • In sample SD-RR02 from the Transition Range in Range Complex No. 1 background
951 concentrations were exceeded for magnesium (1,890 mg/kg vs. 1,850 mg/kg), mercury
952 (non-detect at 0.14 mg/kg vs. non-detect at 0.0082 mg/kg), and zinc (36.5 mg/kg vs.
953 29.3 mg/kg).

954 The lead result (352 mg/kg) for PA/SI sample SD-MR001 exceeded the lead background
955 concentration of 3.7 mg/kg by nearly a factor of 100. This is considered a significant
956 exceedance. Magnesium exceeded the site background concentration by a factor of 3.6.
957 Mercury in PA/SI samples was not detected; however, the detections limits for two samples were
958 greater than three times the background concentration. This is considered a significant

959 exceedance. All other exceedances were less than three times the background value and are not
960 considered significant.

961 *5.3.4.2 Comparison to Human Health Screening Values*

962 The analytical results were compared to the human health screening values if they exceeded
963 background concentrations. All detected concentrations that were greater than three times the
964 background values (lead at 352 mg/kg) were below the human health screening value of 400
965 mg/kg. Magnesium also significantly exceeded the background concentration. However, there
966 is no human health screening value for magnesium. Non-detect results (detection limit) for
967 mercury from the PA/SI that were greater than three times the respective background value were
968 below the human health screening value of 23 mg/kg. No human health impacts were noted in
969 sediments at Range Complex No. 1.

970 *5.3.4.3 Comparison to Ecological Screening Values*

971 The analytical results were compared to the ecological screening value if they significantly
972 exceeded the site background concentration (three times the background value). Lead,
973 magnesium, and mercury significantly exceeded the background concentration. However,
974 magnesium does not have an ecological screening value. Based on the ecological screening
975 values lead (352 mg/kg in sample SD-MR001) significantly exceeded the background
976 concentration (3.7 mg/kg) and ecological screening value (35 mg/kg) and adverse ecological
977 impacts may occur.

978 One non-detect result (detection limit) for mercury from the PA/SI (SD-RR001, 0.21 mg/kg)
979 greater than three times the background value was equal to the ecological screening value (0.2
980 mg/kg). Therefore, only lead is considered as exceeding the ecological screening criteria.

981 *5.3.5 Terrestrial Pathway*

982 The potential routes of human exposure to the surface soil include incidental ingestion, dermal
983 contact, or inhalation of soil particulates during intrusive work. Current exposure scenarios
984 would primarily involve forest workers, residents, and recreational users. Workers and residents
985 would be potentially exposed to surface and subsurface soil during intrusive activities such as
986 digging. Future land use is expected to remain as discussed in Section 5.3.1 above. Therefore,
987 potential future exposures to soil would be similar to current exposures.

988 Soil sampling at Range Complex No. 1 was completed as planned in accordance with the SSWP
989 with the collection of four surface soil samples (plus one field duplicate) from Range Complex
990 No. 1. All samples were composite samples, collected at or near the locations and coordinates
991 specified in the Final SSWP. All samples were analyzed for lead only, except sample NWO-
992 013-0005, which was analyzed for select metals and explosives, including nitroglycerin and
993 PETN. This sample was originally scheduled for analysis for lead only; however, during visual
994 reconnaissance, a detonation crater was identified. It was decided that the additional analyses
995 were warranted to evaluate site conditions.

996 The select metals list was developed from metals related to either munitions firing (i.e., mercury
997 in fuzes, magnesium in incendiary devices, barium in explosives) or components of bullets,
998 projectiles, or metal casings (i.e., chromium, cobalt, copper, iron, lead, manganese, molybdenum,
999 nickel, and zinc). In addition, the metals aluminum and cadmium were also included as they
1000 may be used in evaluation of site soil concentrations to background.

1001 Each composite surface soil sample was collected from between 0 to 6 inches in depth and
1002 consisted of seven surface samples collected in a wheel pattern (2-ft diameter). Samples were
1003 sieved by the laboratory prior to analysis for lead.

1004 Nine soil samples collected during the PA/SI (Weston, 2005) are also included in the evaluation
1005 and are discussed below. Note that the samples collected during the PA/SI were analyzed for the
1006 TAL metals. Analytical detections, background soil concentrations, and human health and
1007 ecological screening values are shown on Table 5-5.

1008 *5.3.5.1 Comparison to Background Data*

1009 Analytical results were compared to the background concentrations. Lead results in all four SI
1010 soil samples (NWO-13-0001, 4.3 mg/kg; NWO-013-0003, 4.6 mg/kg; NWO-013-0004, 4.6
1011 mg/kg; and NWO-013-0005, 7.7 mg/kg) plus the field duplicate (NWO-013-0002, 4.3 mg/kg)
1012 exceeded the background concentration for lead (4.2 mg/kg).

1013 Sample NWO-013-0005, collected from a detonation crater was analyzed for a larger list of
1014 metals and explosives. All metals results from sample NWO-013-0005 were less than the Camp
1015 Abbot background concentrations except, as noted above, lead exceeded the background
1016 concentration. There were no detections of explosive compounds.

1017 Nine soil samples were collected from Range Complex No. 1 during the PA/SI. Seven of the
1018 nine samples had exceedances of site background concentrations as follows:

- 1019 • In sample SS-RR001 background concentrations were exceeded for copper (26.8 vs.
1020 23.7), mercury (0.07 mg/kg vs. 0.022 mg/kg), and zinc (54.9 mg/kg vs. 43.5 mg/kg);
- 1021 • In samples SS-RR002, SS-RR004 and SS-005 the background concentration for mercury
1022 (0.022 mg/kg) was exceeded at concentrations of 0.1 mg/kg, 0.07 mg/kg, and 0.11
1023 mg/kg);
- 1024 • In sample SS-RR006 background concentrations were exceeded for copper (24 mg/kg vs.
1025 23.7 mg/kg), mercury (0.1 mg/kg vs. 0.022 mg/kg), and zinc (45.8 mg/kg vs. 43.5
1026 mg/kg);
- 1027 • In sample SS-MR001 background concentrations were exceeded for lead (4.8 mg/kg vs.
1028 4.2 mg/kg) and mercury (0.96 mg/kg vs. 0.022 mg/kg);
- 1029 • In sample SS-MR002 background concentrations were exceeded for lead (6.3 mg/kg vs.
1030 4.2 mg/kg), mercury (0.06 mg/kg vs. 0.022 mg/kg), and zinc (72.8 mg/kg vs. 43.5
1031 mg/kg); and
- 1032 • In sample SS-MR003 background concentrations were exceeded for copper (27.2 mg/kg
1033 vs. 23.7 mg/kg), lead (24 mg/kg vs. 4.2 mg/kg), and zinc (65.7 mg/kg vs. 43.5 mg/kg).

1034 All background exceedances were near their background concentration (Table 5-5). Exceptions
1035 to this are for lead in PA/SI sample SS-MR003 and mercury in sample SS-MR0001. Sample SS-
1036 MR003 was collected from the near the firing point of the Machine Gun Range; the lead
1037 concentration was 24 mg/kg, exceeding the background concentration of 4.2 mg/kg. Mercury
1038 was detected in PA/SI sample SS-MR001 at a concentration of 0.96 mg/kg.

1039 Mercury was not detected in two PA/SI samples. The detection limit for mercury in the PA/SI
1040 samples SS-RR003 and SS-MR003 were 0.15 mg/kg and 0.13 mg/kg, which are above the
1041 background concentration of 0.022 mg/kg. Mercury in these two samples is considered to be
1042 above the background concentrations.

1043 Metals that exceeded background values were copper, lead, mercury, and zinc.

1044 *5.3.5.2 Comparison to Human Health Screening Values*

1045 The analytical results from Range Complex No. 1 were compared to the human health screening
1046 values for soil if they exceeded the background concentration. All background exceedances
1047 were well below the human health screening criteria.

1048 *5.3.5.3 Comparison to Ecological Screening Values*

1049 Analytical results were compared to the ecological screening values if they also exceeded
1050 background concentrations. Lead in one sample from the Machine Gun Range exceeded the
1051 background concentration (4.2 mg/kg) and the ecological screening value of 16 mg/kg. Mercury
1052 in samples SS-RR005 and SS-MR001 exceeded the background concentration of 0.022 mg/kg
1053 and the ecological screening value of 0.1 mg/kg. The zinc concentration in PA/SI samples SS-
1054 RR001, SS-MR002, and SS-MR003 exceeded the background (43.5 mg/kg) and ecological
1055 screening value (50 mg/kg). These concentrations for lead, mercury, and zinc indicate that
1056 adverse ecological impacts may occur. In addition, the presence of lead bullets in soil indicates
1057 potential terrestrial bird toxicity as certain bird species intentionally ingest grit to aid their
1058 digestion.

1059 The detection limit in PA/SI samples SS-RR003 (0.15 mg/kg) and SS-MR003 (0.13 mg/kg) were
1060 also above the ecological screening level (0.1 mg/kg) for mercury.

1061 *5.3.6 Air Pathway*

1062 By agreement at the TPP meeting, air is not considered to be a significant pathway as inhalation
1063 of MC in vapor form is not a pathway of concern for non-volatile MC under normal
1064 environmental conditions. The potential inhalation of soil particles is included in the
1065 development of health-based screening values for soil.

1066 **5.4 Explosive Munitions Ranges (Anti-Tank Range, Demolition Area, Mortar**
1067 **Range)**

1068 **5.4.1 General History and Field Findings**

1069 The Explosive Munitions Ranges were used by the Army between 1943 and 1944. However, the
1070 period of use for the Demolition Area may have been more limited. Three-week team training
1071 exercises were not begun at Camp Abbot until December 1943 (Coll et al., 1958, pp. 265-266).
1072 A Camp Abbot newspaper article dated 12 February 1944 refers to a “new assault and
1073 demolitions course.” The article states that the new course “incorporates many problems of
1074 actual warfare, including barbed wire entanglements and machine gun fire.” Steps in the course
1075 included:

- 1076 • Use of a tank, directing simulated fire (using set charges to give the appearance of shells
1077 fired from the tank’s guns) at enemy machine gun nests and pill boxes,
- 1078 • A demolitions squad using Bangalore torpedoes to clear barbed wire entanglements,
- 1079 • A flame-thrower crew “running the distance and taking full advantage of cover and shell
1080 holes, to burn what remains of the ‘enemy’ from its positions,” and
- 1081 • The demolitions squad “setting charges which complete destruction of the fortifications.”

1082 The ASR Supplement provided an estimated boundary of the Mortar Range, based on reported
1083 finds of 60 mm and 81 mm mortars, assuming firing directed to the west from a position east of
1084 the river shown as a “tactical area” on historic maps.

1085 The location of the Demolition Area shown on maps in the ASR Supplement and the location of
1086 the reported pill box reported in the same report and in the ASR do not agree. The reported
1087 location of the pill box is approximately 0.4 miles east southeast of the Demolition Area
1088 location. The pill box, along with demolition craters, was also reported in the PA/SI (Weston,
1089 2005) but was shown as being located approximately 0.2 miles southwest of the Demolition Area
1090 as shown in the ASR Supplement. Based on this, the location of the Demolition Area shown in
1091 the ASR Supplement is suspect and the demolition area is likely located overlapping the
1092 northwest corner of the Mortar Range.

1093 The current land use is open field and residences east of the river and forested areas west of the
1094 river. The Anti-Tank Range and Mortar Range contain ecologically sensitive areas, including
1095 wetland areas and the Deschutes River. The Anti-Tank Range and Mortar Range also contain
1096 culturally sensitive areas that were avoided during sampling.

1097 **5.4.2 Sampling and Analysis**

1098 Sample details are provided in Tables 5-1 and 5-2, and analytical detections are listed in Tables
1099 5-6, 5-7, 5-8, and 5-9. Field records are provided in Appendix D and representative photographs
1100 of sampling activities are included as Appendix E. Figures 5-6 and 5-7 show the SI and PA/SI
1101 sampling locations and indicate if an exceedance of background concentrations and human

1102 health and/or ecological screening values has occurred. Complete analytical data are presented
1103 in Appendix F and the Analytical Data QA/QC Report is included as Appendix G.

1104 *5.4.3 Groundwater Pathway*

1105 No groundwater samples were proposed or collected within the Explosive Munitions Ranges. A
1106 sample from a spring was scheduled to be collected from the Mortar Range to assess
1107 groundwater conditions at the point of discharge. However, the spring was dry at the time of
1108 field work in September 2006.

1109 *5.4.4 Surface Water/Sediment Pathway*

1110 Two surface water samples were scheduled to be collected from the Explosive Munitions
1111 Ranges. One surface water sample (NWO-013-2001) was to be collected from the same location
1112 as a sediment sample (SD-DP001) collected during the PA/SI (Weston, 2005). The sample was
1113 to be analyzed for total and dissolved metals. However, at the time of sampling there was no
1114 water at the site; therefore, the sample was not collected.

1115 One surface water sample (NWO-013-2003) was collected from a point along the Deschutes
1116 River downstream of the Mortar Range. The objective of this sample was to evaluate the
1117 impacts of the Mortar Range and other upstream AOCs on the overall water quality of the
1118 Deschutes River. The sample was analyzed for total and dissolved metals, explosives, and
1119 perchlorate.

1120 A sediment sample (NWO-013-1003 and field duplicate NWO-013-1005) was collected from the
1121 same location as the surface water sample (NWO-013-2003). The sample was analyzed for
1122 metals and explosives, including nitroglycerin and PETN. No sediment sample was collected
1123 from the Anti-Tank Range.

1124 One PA/SI sediment sample was collected from a location downslope from the Demolition Area
1125 and within the Mortar Range. The sample was analyzed for TAL metals and nitrogen-based
1126 explosive compounds.

1127 Analytical results, background concentrations, and human health and ecological screening values
1128 are shown on Tables 5-6, 5-7, and 5-8. Potential receptors are recreational users and wildlife.
1129 The city of Bend, located approximately 15 miles downstream, obtains its drinking water supply
1130 from the Deschutes River. For the screening risk assessment, it was conservatively assumed that
1131 exposures to sediments would be similar to those of soil.

1132 *5.4.4.1 Comparison to Background*

1133 Both filtered (dissolved) and unfiltered (total) metals were analyzed in the surface water samples.
1134 Each was compared to respective background sample concentrations collected at a location
1135 upstream of Camp Abbot. For the dissolved sample (NWO-013-2003) the single sample
1136 background concentrations were exceeded for iron (95.5 µg/L vs. 71.9 µg/L), magnesium (2,180

1137 $\mu\text{g/L}$ vs. 2,020 $\mu\text{g/L}$, and manganese (7.3 $\mu\text{g/L}$ vs. 4.3 $\mu\text{g/L}$). All were less than a factor of 2
1138 above the background concentrations.

1139 The total metal sample (NWO-013-2003) detections exceeded the single sample background
1140 concentrations for iron (56.7 $\mu\text{g/L}$ vs. not detected at 5.5 $\mu\text{g/L}$), manganese (6.5 $\mu\text{g/L}$ vs. 1.1
1141 $\mu\text{g/L}$), molybdenum (0.5 $\mu\text{g/L}$ vs. 0.47 $\mu\text{g/L}$), and nickel (0.38 $\mu\text{g/L}$ vs. 0.37 $\mu\text{g/L}$). Iron and
1142 manganese significantly exceeded (greater than three times background) their respective
1143 background concentrations, although at relatively low levels. Iron was not detected in the
1144 unfiltered background sample, but was detected in the filtered background sample at a
1145 concentration of 71.9 $\mu\text{g/L}$, which is above the concentration detected in the unfiltered sample
1146 NWO-013-2003. Similarly, manganese was detected at a higher concentration in the filtered
1147 background sample than in the unfiltered one. This is likely a result of normal variability in
1148 surface water concentrations for pristine streams. The other background exceedances were very
1149 near the unfiltered background concentrations.

1150 The SI sediment sample collected from the Deschutes River (sample NWO-013-1003 and field
1151 duplicate sample NWO-013-1005) exceeded the single sample background concentration for
1152 iron, magnesium, and zinc. The detected concentration for sample NWO-013-1003 and
1153 respective background concentrations were: iron (16,500 mg/kg vs. 14,100 mg/kg), magnesium
1154 (2,860 mg/kg vs. 1,850 mg/kg), and zinc (39.8 mg/kg vs. 29.3 mg/kg). These results exceeded
1155 the background concentration by a factor of less than 1.5. The lead concentration in sample
1156 NWO-013-1003 (Figure 5-7) was equal to the background concentration.

1157 The mercury concentration in the sediment sample collected during the PA/SI (sample SD-
1158 DP001) significantly exceeded the background concentration (0.11 mg/kg vs. not detected at
1159 0.0082 mg/kg).

1160 Based on the above discussion, iron and manganese in the surface water sample and mercury in
1161 sediment represent a potential release. However, only one sample is used for comparison.

1162 No explosives were detected in either the SI surface water or sediment sample or the PA/SI
1163 sediment sample.

1164 *5.4.4.2 Comparison to Human Health Screening Values*

1165 The analytical results were compared to the human health screening values if their
1166 concentrations exceeded background. All results were below the human health screening value.

1167 *5.4.4.3 Comparison to Ecological Screening Values*

1168 There were no exceedances of ecological screening values for surface water.

1169 For sediment the analytical results were compared to the ecological screening values if analytical
1170 results significantly (greater than three times) exceeded the background value. Only mercury
1171 meets this criterion. The detected mercury concentration of 0.11 mg/kg is below the ecological
1172 screening value of 0.2 mg/kg. Therefore, no ecological impacts are indicated.

1173 **5.4.5 Terrestrial Pathway**

1174 The potential routes of human exposure to the surface soil include incidental ingestion, dermal
1175 contact, or inhalation of soil particulates during intrusive work. Current exposure scenarios
1176 would primarily involve forest workers, residents, and recreational users. Workers and residents
1177 would be potentially exposed to surface and subsurface soil during intrusive activities such as
1178 digging. Future land use is expected to remain as discussed in Section 5.4.1 above. Therefore,
1179 potential future exposures to soil would be similar to current exposures.

1180 Soil sampling for the SI at the Explosive Munitions Ranges was completed as planned in
1181 accordance with the SSWP with the collection of four surface soil samples. One sample (NWO-
1182 013-0006) was collected east of the Deschutes River in the Anti-Tank Range, two samples
1183 (NWO-013-008 and NWO-013-0009) were collected from the Mortar Range, and one sample
1184 (NWO-013-0007) was collected from the Demolition Area. All samples were composite
1185 samples, collected at or near the locations and coordinates specified in the Final SSWP. All
1186 samples were analyzed for metals and explosives, including nitroglycerin and PETN, except
1187 sample NWO-013-0007 collected from the Demolition Area, which was analyzed only for
1188 nitroglycerin and PETN. Each composite surface soil sample was collected from between 0 to 6
1189 inches in depth and consisted of seven surface samples collected in a wheel pattern (2-ft
1190 diameter). Metals and nitrogen-based explosives were previously analyzed in a PA/SI sample
1191 from this location. Each composite surface soil sample was collected from between 0 to 6 inches
1192 in depth and consisted of seven surface samples collected in a wheel pattern (2-ft diameter).

1193 Three soil samples were collected at the Demolition Area during the PA/SI. Samples were
1194 analyzed for metals and nitrogen-based explosives. The PA/SI analyzed for the TAL metals.

1195 Analytical detections, background soil concentrations and human health and ecological screening
1196 values are shown on Table 5-9.

1197 **5.4.5.1 Comparison to Background Data**

1198 Analytical results were compared to background concentrations. The following summarizes
1199 background exceedances for SI and PA/SI sample results.

- 1200 • In sample NWO-013-0006 the background concentration was exceeded for lead (27.8
1201 mg/kg vs. 4.2 mg/kg) and mercury (0.027 mg/kg vs. 0.022 mg/kg);
- 1202 • In sample NWO-013-0008 the background concentration was exceeded for iron
1203 (23,500 mg/kg vs. 21,300 mg/kg);
- 1204 • In sample NWO-013-0009 the background concentration was exceeded for barium
1205 (198 mg/kg vs. 176 mg/kg), chromium (22.3 mg/kg vs. 19.2 mg/kg), iron (28,800
1206 mg/kg vs. 21,300 mg/kg), lead (4.3 mg/kg vs. 4.2 mg/kg), and mercury (0.027 mg/kg
1207 vs. 0.022 mg/kg). In PA/SI sample SS-DP001 the background concentration was
1208 exceeded for barium (191 mg/kg vs. 176 mg/kg), and iron (23,400 mg/kg vs. 21,300
1209 mg/kg);

- 1210 • In sample SS-DP003 the background concentration was exceeded for barium (262
1211 mg/kg vs. 176 mg/kg), cobalt (13.9 mg/kg vs. 13 mg/kg), and zinc (48.1 mg/kg vs.
1212 43.5 mg/kg).

1213 Metals exceeding background concentrations were barium, chromium, iron, lead, mercury, and
1214 zinc. There were no explosives detections in any sample.

1215 *5.4.5.2 Comparison to Human Health Screening Values*

1216 The analytical results from the Explosive Munitions Ranges were compared to the human health
1217 screening values for soil if they exceeded the background concentration. Only iron in SI samples
1218 NWO-013-0008 and NWO-013-0009 and in PA/SI sample SS-DP001 exceeded both the
1219 background soil concentration and the human health screening value.

1220 *5.4.5.3 Comparison to Ecological Screening Values*

1221 Analytical results were compared to the ecological screening values if they also exceeded
1222 background concentrations. The following summarizes the analytical results that exceeded both
1223 site background values and the ecological screening values.

- 1224 • In sample NWO-013-0006 lead (27.8 mg/kg) exceeded the ecological screening value
1225 of 16 mg/kg;
- 1226 • In sample NWO-013-0008 iron (23,500 mg/kg) exceeded the ecological screening
1227 value of 200 mg/kg;
- 1228 • In sample NWO-013-0009 the ecological screening values were exceeded for barium
1229 (198 mg/kg vs. 85 mg/kg), chromium (22.3 mg/kg vs. 0.4 mg/kg), and iron (28,800
1230 mg/kg vs. 200 mg/kg);
- 1231 • In PA/SI sample SS-DP001 the ecological screening values were exceeded for barium
1232 (191 mg/kg vs. 85 mg/kg) and iron (23,400 mg/kg vs. 200 mg/kg); and
- 1233 • In PA/SI sample SS-DP003 barium (262 mg/kg) exceeded the ecological screening
1234 value of 85 mg/kg).

1235 A SLERA was completed (Appendix L) that evaluated the exceedances.

1236 Iron and manganese are only a concern for adverse effects on soil microbial processes.

1237 Typically, protection of soil microbes is not selected as an assessment endpoint in ecological risk
1238 assessments, therefore, iron and manganese are not considered to be a concern at the site.

1239 The SLERA concludes that only lead in sample NWO-013-0006, barium and chromium in
1240 sample NWO-013-0009, and barium in PA/SI samples SS-DP001 and SS-DP003 were above
1241 ecological screening values that may result in adverse ecological effects.

1242 *5.4.6 Air Pathway*

1243 By agreement at the TPP meeting, air is not considered to be a significant pathway as inhalation
1244 of MC in vapor form is not a pathway of concern for non-volatile MC under normal
1245 environmental conditions. The potential inhalation of soil particles is included in the
1246 development of health-based screening values for soil.

1247 **5.5 Grenade Courts**

1248 **5.5.1 General History and Field Findings**

1249 The Grenade Courts were used by the Army between 1943 and 1944 and were used for training
1250 in the use of live (explosive) and/or training hand grenades. Grenades were thrown from
1251 individual throwing bays constructed from sandbags or concrete, or from a trench and were
1252 thrown toward targets in an impact area approximately 25 yards from the throwing line. A safety
1253 zone of approximately 600 ft would have been established around the court.

1254 The location of the grenade courts is within a natural area located between the Spring and
1255 Deschutes Rivers. There are no residences within the area. The Grenade Courts AOC contains
1256 ecologically sensitive areas, including wetland areas and the Deschutes River.

1257 **5.5.2 Sampling and Analysis**

1258 The TPP Memo and SSWP identified that one sediment and two soil samples would be collected
1259 from the live grenade court if the visual reconnaissance found evidence of the live grenade court.
1260 No evidence was found (see Section 4.1.3 above) and therefore no samples were collected during
1261 the SI. No groundwater or surface water sampling within the Grenade Court AOC were
1262 proposed in the TPP Memo and SSWP.

1263 One sediment sample and three soil samples were collected from the practice grenade court
1264 during the PA/SI. Sample details are provided in Table 5-2, and analytical detections are listed
1265 in Tables 5-10 and 5-11. Field records are provided in Appendix D and representative
1266 photographs of sampling activities are included as Appendix E. Figure 5-8 shows the PA/SI
1267 sampling locations and indicates if an exceedance of background concentrations and human
1268 health and/or ecological screening values has occurred.

1269 **5.5.3 Groundwater Pathway**

1270 No groundwater samples were proposed or collected within the Grenade Court.

1271 **5.5.4 Surface Water/Sediment Pathway**

1272 No surface water samples were collected during the PA/SI at the Grenade Court.

1273 One sediment sample (SD-GC001) was collected during the PA/SI from the grenade court
1274 probable point of entry to the river. The sample was analyzed for TAL metals and nitrogen-
1275 based explosives.

1276 Detected analytical results, background concentrations, and human health and ecological
1277 screening values are shown on Tables 5-10. Potential receptors are recreational users and
1278 wildlife. The city of Bend, located approximately 15 miles downstream, obtains its drinking
1279 water supply from the Deschutes River. For the screening risk assessment, it was conservatively
1280 assumed that exposures to sediments would be similar to those of soil.

1281 *5.5.4.1 Comparison to Background*

1282 The PA/SI sediment sample (SD-GC001) exceeded the single sample background concentrations
1283 for copper (27.5 mg/kg vs. 25.8 mg/kg), iron (15,500 mg/kg vs. 14,100 mg/kg), magnesium
1284 (1,900 mg/kg vs. 1,850 mg/kg), and nickel (34.4 mg/kg vs. 31.4 mg/kg). These results exceeded
1285 the background concentration by a factor of less than 1.1. Based on these results, a significant
1286 release to the sediment has not occurred.

1287 As indicated in Section 2.5.3, reporting limits used in the PA/SI were generally higher than those
1288 used in this Camp Abbot SI. Evaluation of the PA/SI reporting limits for non-detect metals of
1289 concern indicates that all PA/SI detection limits were below the background concentration for
1290 sediments except mercury. The PA/SI detection limit and SI background concentration for
1291 mercury was 0.19 mg/kg vs. non-detect at 0.0082 mg/kg). This detection limit was above the
1292 respective background concentration at greater than three times the background value, and will
1293 be carried forward in the evaluation of human health and ecological risk.

1294 *5.5.4.2 Comparison to Human Health Screening Values*

1295 No detected sediment analytical results significantly exceeded the single background sample
1296 concentrations. Non-detect result (detection limit) for mercury from the PA/SI was greater than
1297 three times the respective background value but was below the human health screening value of
1298 23 mg/kg. No human health impacts were noted in sediments at the Grenade Courts.

1299 *5.5.4.3 Comparison to Ecological Screening Values*

1300 No detected sediment analytical results significantly exceeded the single background sample
1301 concentrations. Therefore, there are no exceedances of the ecological screening criteria.
1302 Non-detect results (detection limit) for mercury (0.19 mg/kg) were below the ecological
1303 screening value in sediment (0.2 mg/kg). Therefore, no ecological impacts are indicated for the
1304 Grenade Court.

1305 *5.5.5 Terrestrial Pathway*

1306 The potential routes of human exposure to the surface soil include incidental ingestion, dermal
1307 contact, or inhalation of soil particulates during intrusive work. Current exposure scenarios
1308 would primarily involve forest workers and recreational users. Workers would be potentially
1309 exposed to surface and subsurface soil during intrusive activities such as digging. Future land
1310 use is expected to remain as discussed in Section 5.5.1 above. Therefore, potential future
1311 exposures to soil would be similar to current exposures.

1312 No soil sampling was conducted at the Grenade Court during the SI. However, three soil
1313 samples (SS-GC001, SS-GC002, and SS-GC003) were collected during the PA/SI. The samples
1314 were analyzed for TAL metals and nitrogen-based explosives. Analytical detections,
1315 background soil concentrations and human health and ecological screening values are shown on
1316 Table 5-11.

1317 **5.5.5.1 Comparison to Background Data**

1318 Analytical results were compared to background concentrations. For the PA/SI sample results,
1319 no detected concentrations exceeded soil background concentrations.

1320 As indicated in Section 2.5.3, reporting limits used in the PA/SI were generally higher than those
1321 used in this Camp Abbot SI. Evaluation of the PA/SI reporting limits for non-detect metals of
1322 concern indicates that all PA/SI detection limits were below the background concentration for
1323 sediments except mercury. The PA/SI detection limits for the three samples were SS-GC001
1324 (0.11 mg/kg), SS-GC-002 (0.10 mg/kg), and SS-GC-003 (0.11 mg/kg) and SI background
1325 concentration for mercury was 0.022 mg/kg. These detection limits were above the respective
1326 background concentration and will be carried forward in the evaluation of human health and
1327 ecological risk.

1328 **5.5.5.2 Comparison to Human Health Screening Values**

1329 The analytical results from the grenade courts were compared to the human health screening
1330 values for soil if they exceeded the background concentration. The detection limits for the three
1331 PA/SI grenade court samples for mercury, SS-GC001 (0.11 mg/kg), SS-GC-002 (0.10 mg/kg),
1332 and SS-GC-003 (0.11 mg/kg), were below the human health screening value of 23 mg/kg. Based
1333 on that criterion, there were no exceedances of human health screening values.

1334 **5.5.5.3 Comparison to Ecological Screening Values**

1335 Analytical results were compared to the ecological screening values if they also exceeded
1336 background concentrations. The detection limits for the three PA/SI grenade court samples for
1337 mercury, SS-GC001 (0.11 mg/kg), SS-GC-002 (0.10 mg/kg), and SS-GC-003 (0.11 mg/kg),
1338 were equal to the ecological screening value of 0.1 mg/kg. Based on that criterion, there were no
1339 exceedances of ecological screening values.

1340 **5.6 Burial Pit**

1341 **5.6.1 General History and Field Findings**

1342 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
1343 ordnance area, and described as follows: “The potential pit was horseshoe-shaped area, bermed
1344 and ringed with stone” (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
1345 old landfill and provided location coordinates. An air photo review conducted for the ASR
1346 (USACE, 1995) found evidence that the landfill had expanded eastward between 1951 and 1968,
1347 indicating continued use of the landfill by others following closure of Camp Abbot. An
1348 extensive search of the landfill area was completed during the SI and no evidence of the Burial
1349 Pit was found. Workers at the Nature Center, where the Burial Pit was reported as being located,
1350 could not confirm the existence of the Burial Pit. There have been no reports of MEC or
1351 munitions debris from this pit or in the area. Because the pit could not be located, no MC
1352 samples were collected.

1353 The area of the suspected burial pit is within a grassy area with some timber and is located within
1354 the Sunriver Nature Area. The area of the burial pit AOC contains ecologically sensitive areas
1355 including wetland areas.

1356 *5.6.2 Sampling and Analysis*

1357 The SSWP identified that one sediment, one surface soil and one subsurface soil samples would
1358 be collected from the Burial Pit if the pit could be located. A visual reconnaissance completed
1359 during the SI did not identify the location of the Burial Pit (see Section 4.1.4 above), and
1360 therefore no samples were collected during the SI.

1361 No samples were collected from the Burial Pit itself during the PA/SI. However, soil samples
1362 were collected from the location of the former landfill. The PA/SI landfill samples were
1363 analyzed for metals, semivolatile organic compounds, and pesticides/polychlorinated biphenyls.
1364 The PA/SI analytical results indicated that there were no detections of semivolatile organic
1365 compounds or pesticides/polychlorinated biphenyls. The PA/SI concluded that there were no
1366 metal detections that were at significant concentrations (greater than three times background).

1367 *5.7 Chemical Training Area*

1368 *5.7.1 General History and Field Findings*

1369 The area was used by the Army between 1943 and 1944. The INPR (USACE, 1994) indicated
1370 that a gas chamber was located in this area. Soldiers were trained in the proper use of gas masks.
1371 Training likely included exposure to tear gas. There is evidence that chemical agents other than
1372 tear gas were used on a limited basis at Camp Abbot, but not necessarily at the gas chamber.

1373 A camp newspaper article (USACE, 1995, Appendix G-3) refers to a 34-hour specialist course
1374 taught for 30 officers and noncommissioned officers. The program was intended to train “unit
1375 gas defense personnel...in order to fit them for instructors’ posts as well as combat jobs.” The
1376 training program included “repair of gas masks, protective measures against all types of chemical
1377 warfare agents, offensive use of gas, first aid measures, knowledge and identity of gasses,
1378 fighting incendiaries, handling violent mobs with gas, and night reconnaissance of gassed areas.”
1379 The program consisted of largely practical field work. The article went on to say that the
1380 “program will include actual use of mustard and other vesicant gases.” There is no indication
1381 that chemical training of this type was part of the general program for enlisted personnel.

1382 Because of the location of this area, which was adjacent to the cantonment area and in close
1383 proximity to the post hospital, it is unlikely that any conventional weapons or chemical agents
1384 were used here, with the possible exception of CAIS (K941/K942 and K955), which contained
1385 several 4-ounce glass bottles variously containing 50 cubic centimeters of charcoal saturated
1386 with agent gas or small quantities of solid agents, and intended for indoor use. The use of
1387 conventional weapons and chemical agents was likely carried out in another area of Camp Abbot
1388 away from the cantonment area.

1389 The Chemical Training Area AOC has been developed for residential housing. There are no
1390 remnants of the former training area. This AOC does not contain any ecological sensitive areas.

1391 *5.7.2 Sampling*

1392 No sampling was planned at the Chemical Training Area because any chemical agents that may
1393 have been released would be in very small quantities associated with CAIS, and if released the
1394 agents would not be expected to persist in the environment.

1395 **6.0 Summary and Conclusions**

1396 The conclusions of the SI are presented in this section. Recommendations for further action are
 1397 presented in Section 7.0 and Appendix K.

1398 Camp Abbot is included in the MMRP Inventory in the *Defense Environmental Programs Fiscal*
 1399 *Year 2005 Annual Report to Congress* (DoD, 2005a) and in the *ASR Supplement* (USACE,
 1400 2004b), with seven identified ranges and other AOCs as follows:

Range Name	Range ID	Approximate area (acres)	UTM Coordinates (meters)
Burial Pit	F10OR004102M01	48	N 4860332.50; E 624695.52
Anti-Tank Range	F10OR004102R01	354	N 4859041.99; E 623348.74
Chemical Training Area	F10OR004102R02	27	N 4858969.21; E 625900.23
Demolition Area	F10OR004102R03	96	N 4863508.32; E 623628.20
Grenade Courts	F10OR004102R04	50	N 4858051.24; E 623361.36
Mortar Range	F10OR004102R05	1421	N 4861875.88; E 624050.99
Range Complex No. 1	F10OR004102R06	3527	N 4859541.80; E 621252.77
Rifle Range	F10OR004102R06-SR01	684	N 4859031.66; E 624135.93
Rifle/Machine Gun Range	F10OR004102R06-SR02	754	N 4858527.00; E 621947.53
Landscape Range	F10OR004102R06-SR03	19	N 4859354.99; E 623965.34
Transition Range	F10OR004102R06-SR04	591	N 4858698.24; E 622099.91
Anti-Aircraft Range	F10OR004102R06-SR05	1022	N 4858316.58; E 621364.30
Field Target and Submachine Gun Range	F10OR004102R06-SR05	2766	N 4859936.70; E 620986.42

1401 **6.1 Range Complex No. 1**

1402 No MEC or munitions debris, other than expended bullets and casings were encountered or have
 1403 been reported at Range Complex No. 1. Based on the reported use of this range for small arms
 1404 training only and no evidence of other uses, the MEC risk at Range Complex No. 1 is considered
 1405 to be low.

1406 During the SI and PA/SI (Weston, 2005) field work, 1 groundwater, 5 sediment, and 13 soil
1407 samples were collected from Range Complex No. 1. Analyses completed are summarized on
1408 Tables 5-1 and 5-2. Analytical results were compared to site background concentrations. If the
1409 analytical results exceeded the background concentration, the results were then compared to EPA
1410 Region 9 PRGs for human health risk screening and ecological risk screening values developed
1411 during the TPP process. The exceedances and subsequent evaluation are summarized below.

1412 **6.1.1 Groundwater Pathway**

1413 There were no significant exceedances of Camp Abbot groundwater background concentrations
1414 and human health risk screening values for metals. There were no detections of explosive
1415 compounds. There does not appear to be an impact to groundwater at Range Complex No. 1.

1416 **6.1.2 Surface Water/Sediment Pathway**

1417 No surface water samples were collected during the SI field work. There were no analytical
1418 results that significantly exceeded background concentrations and also exceeded human health
1419 screening values. Analytical results from the sediment samples indicate lead in one PA/SI
1420 sediment sample significantly exceeded the Camp Abbot sediment background concentration and
1421 also the ecological screening values. This result indicates that adverse ecological impacts may
1422 occur in sediments.

1423 **6.1.3 Terrestrial Pathway**

1424 All analytical results were below the human health screening value. Analytical results from soil
1425 samples collected during the SI and PA/SI (Weston, 2005) indicate that lead, mercury, and zinc
1426 concentrations exceeded both the respective Camp Abbot background concentrations and the
1427 ecological screening values. This result indicates that adverse ecological impacts may occur. In
1428 addition, the presence of lead bullets in soil indicates potential terrestrial bird toxicity from
1429 ingestion of grit for digestive purposes.

1430 **6.2 Explosive Munitions Ranges**

1431 No MEC or munitions debris was located during SI field work. Historically MEC and munitions
1432 debris have been found associated with the Anti-Tank Range and Mortar Range (60 mm and 81
1433 mm mortar rounds). No MEC or munitions debris were reported during the PA/SI (Weston,
1434 2005) at the Demolition Area. However MEC is considered potentially present because of the
1435 adjacent and overlapping Mortar Range. Note that the sampling locations from the Demolition
1436 Area discussed in this SI report are just outside the AOC boundary shown in the ASR
1437 Supplement. Based on the current use of the Explosive Munitions Ranges and the historical
1438 occurrence of MEC and munitions debris, the overall MEC risk is considered to be moderate.

1439 During the SI and PA/SI (Weston, 2005) field work, one surface water, two sediment, and seven
1440 soil samples were collected from the Explosive Munitions Ranges. No groundwater samples
1441 were collected. Analyses completed are summarized on Tables 5-1 and 5-2. Analytical results

1442 were compared to site background concentrations. If the analytical results exceeded the
1443 background concentration, the results were then compared to EPA Region 9 PRGs for human
1444 health risk screening values and ecological risk screening values developed during the TPP
1445 process. The exceedances and subsequent evaluation are summarized below.

1446 *6.2.1 Groundwater Pathway*

1447 No groundwater samples were proposed or collected within the Explosive Munitions Ranges. A
1448 spring sample was scheduled to be collected from the Mortar Range to assess groundwater
1449 conditions at the point of discharge. However, the spring was dry at the time of field work in
1450 September 2006.

1451 *6.2.2 Surface Water/Sediment Pathway*

1452 One surface water sample was collected during the SI along the Deschutes River downstream of
1453 the Mortar Range. All analytical results for the surface water sample were below the background
1454 value and ecological and human health screening values.

1455 Two sediment samples were collected. One sediment sample was collocated with the surface
1456 water sample and one sample was collected during the PA/SI within the Mortar Range. All
1457 analytical results for the sediment samples were below the background values and ecological and
1458 human health screening values. There were no explosive compounds detected.

1459 *6.2.3 Terrestrial Pathway*

1460 The analytical results from the Explosive Munitions Ranges indicate that iron in SI and PA/SI
1461 samples exceeded both the background soil concentration and the human health screening value.
1462 However, iron is a common rock forming mineral and not a hazardous substance. The bedrock
1463 at Camp Abbot is basaltic, which has high iron content. These elevated iron concentrations may
1464 reflect natural variation in the soils. There were no explosive compounds detected.

1465 Analytical results from soil samples collected during the SI and PA/SI indicate that barium,
1466 chromium and lead exceeded both the Camp Abbot background concentrations and the
1467 ecological screening values. These exceedances indicate that adverse ecological impacts may
1468 occur. In addition, the presence of lead bullets in soil indicates potential terrestrial bird toxicity
1469 from ingestion of grit for digestive purposes.

1470 *6.3 Grenade Courts*

1471 No MEC or munitions debris was located during SI field work. Historically no MEC or
1472 munitions debris have been found at the live grenade court area. However, the ASR reported
1473 that a grenade spoon had been found in the vicinity of the practice grenade court during the ASR
1474 site visit (USACE, 1995). Based on the types of MEC that may be present and the limited
1475 investigation that has been conducted, the overall MEC risk is considered to be moderate.

1476 One sediment sample and three soil samples were collected during the PA/SI (Weston, 2005).
1477 Analytical results were compared to site background concentrations. If the analytical results

1478 exceeded the background concentration, the results were then compared to EPA Region 9 PRGs
1479 for human health risk screening values and ecological risk screening values developed during the
1480 TPP process. The exceedances and subsequent evaluation are summarized below.

1481 **6.3.1 Groundwater Pathway**

1482 No groundwater samples were proposed or collected within the Grenade Courts area. The
1483 Grenade Courts are located in a peninsula between the Spring and Deschutes Rivers. There is no
1484 groundwater use in the grenade court area. All near-surface groundwater is in direct connection
1485 with the surface water in the rivers.

1486 **6.3.2 Surface Water/Sediment Pathway**

1487 No surface water samples were collected from the Grenade Court area. One sediment sample
1488 was collected during the PA/SI (Weston, 2005). There were no detected concentrations of
1489 metals in sediment that significantly exceeded the background concentrations. Therefore, no
1490 human health or ecological screening was completed on detected concentrations.

1491 **6.3.3 Terrestrial Pathway**

1492 Analytical results from soil samples collected during the PA/SI were all below ecological and
1493 human health screening values and no adverse impacts are indicated.

1494 **6.4 Burial Pit**

1495 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
1496 ordnance area, and described as follows: “The potential pit was horseshoe-shaped area, bermed
1497 and ringed with stone” (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
1498 old landfill and provided location coordinates. An extensive search of the landfill area was
1499 completed during the SI and no evidence of the Burial Pit was found. Workers at the Nature
1500 Center, where the Burial Pit was reported as being located, could not confirm the existence of the
1501 Burial Pit. There have been no reports of MEC or munitions debris from this pit or in the area.
1502 Because the pit could not be located, no MC samples were collected. No evidence of MEC or
1503 munitions debris was found and there have been no historical reports. Based on the current use
1504 of the area, absence of MEC or munitions debris, uncertainty of the location, and even whether
1505 the site was actually used as a munitions burial pit, the overall MEC risk is considered to be low.

1506 No sampling was completed at the Burial Pit during the SI because the location could not be
1507 verified or found. Sampling of the landfill in the vicinity of where the Burial Pit is reported as
1508 being located was completed during the PA/SI (Weston, 2005). The PA/SI analytical results
1509 indicated that there were no detections of semivolatile organic compounds or
1510 pesticides/polychlorinated biphenyls. The PA/SI concluded that there were no metal detections
1511 that were at significant concentrations (greater than three times background).

1512 No MC assessments of the groundwater, surface water/sediment, or terrestrial pathways were
1513 completed.

1514 **6.5 Chemical Training Area**

1515 No field work was completed during the SI or PA/SI (Weston, 2005) at the Chemical Training
1516 Area. All evidence of area is gone. No MEC or munitions debris have been reported at this area.
1517 Information obtained, following completion of field work, during a telephone interview with a
1518 Sunriver resident indicates that a hill located north of the Chemical Training Area may contain
1519 buried items. The person interviewed (Appendix L) indicated that a former longtime Sunriver
1520 resident (now deceased) relayed that the 'sledding hill' located in Sunriver was "there for a
1521 reason" and "all kinds of stuff was buried there."

1522 The likely munitions used at these AOCs included riot control (tear gas) and CAIS including
1523 K955, K941/K942. The Chemical Training Area is located within a housing development.
1524 Based on the current use of this AOC and no occurrence of MEC or munitions debris, the overall
1525 MEC risk is considered to be low.

1526 No sampling was planned at the Chemical Training Area because any chemical agents that may
1527 have been released would be in very small quantities associated with CAIS. However, based on
1528 the telephone interview MC associated with the Chemical Training Area may be present in the
1529 subsurface at the 'sledding hill'.

1530 **7.0 Recommendations**

1531 Results of the SI provide the basis for conclusions and/or recommendations for further actions at
1532 each of the AOCs.

1533 **7.1 Range Complex No. 1**

1534 Based on historical evidence and results from the SI field activities, the MEC risks are low and
1535 Range Complex No. 1 is recommended for NDAI with respect to MEC.

1536 Ecological screening of metals results from sediment samples and lead, mercury, and zinc results
1537 from soil samples that also exceeded background concentrations indicate that adverse ecological
1538 impacts may occur. There are no human health impacts indicated. As agreed to during the TPP
1539 and documented in the DQOs, “If sample results do not exceed human health screening values
1540 but do exceed both ecological screening values and background values, additional evaluation of
1541 the data will be conducted in conjunction with the stakeholders to determine if additional
1542 investigation is warranted.” Therefore, no recommendation for either NDAI or RI/FS with
1543 respect to MC is made until consultation with the stakeholders is completed.

1544 **7.2 Explosive Munitions Range**

1545 Based on historical evidence and results of the SI field activities, there is evidence of MEC,
1546 munitions debris, and use of explosives occurring within the Anti-Tank Range, the Mortar
1547 Range, and the Demolition Area. Based the historical occurrence of MEC, the Anti-Tank Range,
1548 the Mortar Range, and the Demolition Area are recommended for RI/FS.

1549 Iron was detected at concentrations above the background and human health screening value in
1550 soil samples from the Demolition Area and the Mortar Range. Iron is a common rock forming
1551 mineral and the bedrock at Camp Abbot is basaltic, which has high iron content. These elevated
1552 iron concentrations may reflect natural variation in the soils. Additionally, iron is not a
1553 CERCLA hazardous substance and therefore a recommendation based on iron alone cannot be
1554 used to recommend RI/FS.

1555 The Camp Abbot background concentration and ecological screening value was exceeded for
1556 barium, chromium, and lead in soil samples. The exceedances indicate that adverse ecological
1557 impacts may occur in soil. As agreed to during the TPP and documented in the DQOs, “If
1558 sample results do not exceed human health screening values but do exceed both ecological
1559 screening values and background values, additional evaluation of the data will be conducted in
1560 conjunction with the stakeholders to determine if additional investigation is warranted.” No
1561 recommendation for either NDAI or RI/FS is made relative to MC until consultation with the
1562 stakeholders is completed.

1563

1564 **7.3 Grenade Courts**

1565 Historically, no MEC or munitions debris, other than a grenade spoon and expended lead bullets,
1566 have been found at the Grenade Courts. Based on the types of MEC that may be present and the
1567 limited investigation that has been conducted, the overall MEC risk is considered to be moderate
1568 and the Grenade Courts area is recommended for RI/FS.

1569 All analytical results for MC were below human health screening values. The ecological
1570 screening value was exceeded for nickel in a sediment sample, which may indicate adverse
1571 ecological impacts in sediments. However, the detected concentration may reflect the natural
1572 variation of nickel in sediment. As agreed to during the TPP and documented in the DQOs, “If
1573 sample results do not exceed human health screening values but do exceed both ecological
1574 screening values and background values, additional evaluation of the data will be conducted in
1575 conjunction with the stakeholders to determine if additional investigation is warranted.” No
1576 recommendation for either NDAI or RI/FS is made relative to MC until consultation with the
1577 stakeholders is completed.

1578 **7.4 Burial Pit**

1579 The Burial Pit was identified in the ASR as occurring east of the Deschutes River and east of the
1580 ordnance area, and described as follows: “The potential pit was horseshoe-shaped area, bermed
1581 and ringed with stone” (USACE, 1995). The ASR Supplement placed the Burial Pit as near the
1582 old landfill and provided location coordinates. An extensive search of the area was completed
1583 during the SI and no evidence of the Burial Pit was found. Workers at the Nature Center, where
1584 the Burial Pit was reported as being located, could not confirm the existence of the Burial Pit.
1585 There have been no reports of MEC or munitions debris from this pit or in the area. Because the
1586 pit could not be located, no MC samples were collected. Because of the uncertainty in the
1587 location or even existence (ASR described as ‘potential’) of the Burial Pit, the Burial Pit is
1588 recommended for NDAI for both MEC and MC.

1589 **7.5 Chemical Training Area**

1590 No MEC or munitions debris has been reported at the Chemical Training Area. The Chemical
1591 Training Area is located within a housing development. The INPR (USACE, 1994) indicated
1592 that a gas chamber was located in this area. A recent telephone interview (Appendix L)
1593 indicated that “chemicals” may have been buried at the ‘sledding hill’ located north of the AOC.
1594 No MC samples were collected from the Chemical Training Area, because the area is currently
1595 residential housing and the area has been developed and utilized, and any chemical agents that
1596 may have been released would be in very small quantities associated with CAIS sets. However,
1597 because of the newly obtained information concerning a potential burial area near the AOC, the
1598 Chemical Training Area, is recommended for RI/FS.

1599 **7.6 Removal Actions**

1600 Section 1.3 identified as one of the decision rules evaluation of whether a TCRA is warranted. A
1601 TCRA would be warranted if a high MEC hazard or an elevated MC risk were identified. There
1602 is no indication that a high MEC risk is present at Camp Abbot. No MEC was identified during
1603 the SI or ASR field activities and no reports of MEC have been made since 1988 (USACE,
1604 1993).

1605 Based on SI sampling results, no elevated MC risk has been identified. Only limited
1606 exceedances of human health or ecological screening criteria were noted. Based on the above
1607 discussion, a TCRA at Camp Adair is not warranted.

1608 **7.7 Munitions Response Sites**

1609 Results of the SI field activities provide the basis for identifying munitions response areas
1610 (MRAs) and/or munitions response sites (MRSs) and for scoring each MRS using the MRSPP.
1611 An MRA is any area on a defense site that is known or suspected to contain MEC or MC. The
1612 MRA may contain one or more MRS.

1613 Based on the use and physical distribution of the ranges at Camp Abbot, seven separate MRSs
1614 are identified (Figure 7-1):

- 1615 • MRS No. 1: Includes Range Complex No. 1
- 1616 • MRS No. 2: Consists of the Anti Tank Range.
- 1617 • MRS No. 3: Consists of the Grenade Court.
- 1618 • MRS No. 4: Consists of the Mortar Range
- 1619 • MRS No. 5: Consists of the Demolition Area,
- 1620 • MRS No. 6: Consists of the Burial Pit,
- 1621 • MRS No. 7: Consists of the Chemical Training Area.

1622 These MRSs correspond to the ranges shown in the MMRP Inventory. There is no evidence of
1623 MEC or MC in areas outside these MRS boundaries.

1624 The live grenade court, identified from on a historical map (Figure 2-1) is within MRS No. 2
1625 Anti-Tank Range.

1626 The draft MRSPP scoring packages for the MRSs are included in Appendix K.

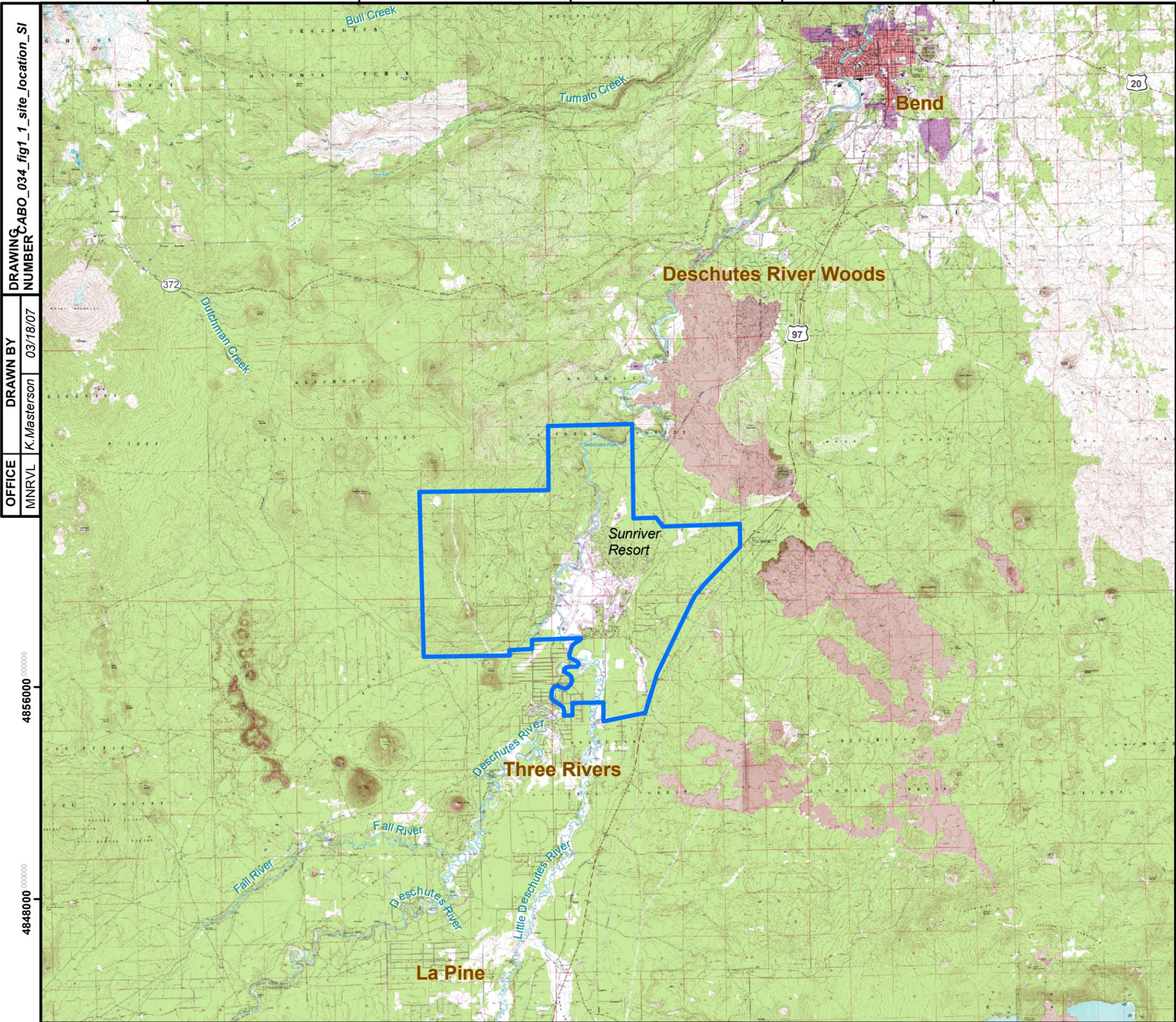
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Figures

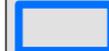


DRAWING NUMBER CABO_034_fig1_1_site_location_SI

DRAWN BY K.Masterson 03/18/07

OFFICE MNRVL

Legend

 Camp Abbot FUDS Boundary

- NOTES:
- 1) FUDS property boundary was derived from the Camp Abbot ASR Supplement.
 - 2) Topographic map was obtained from the USDA/NRCS - National Cartography & Geospatial Center.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

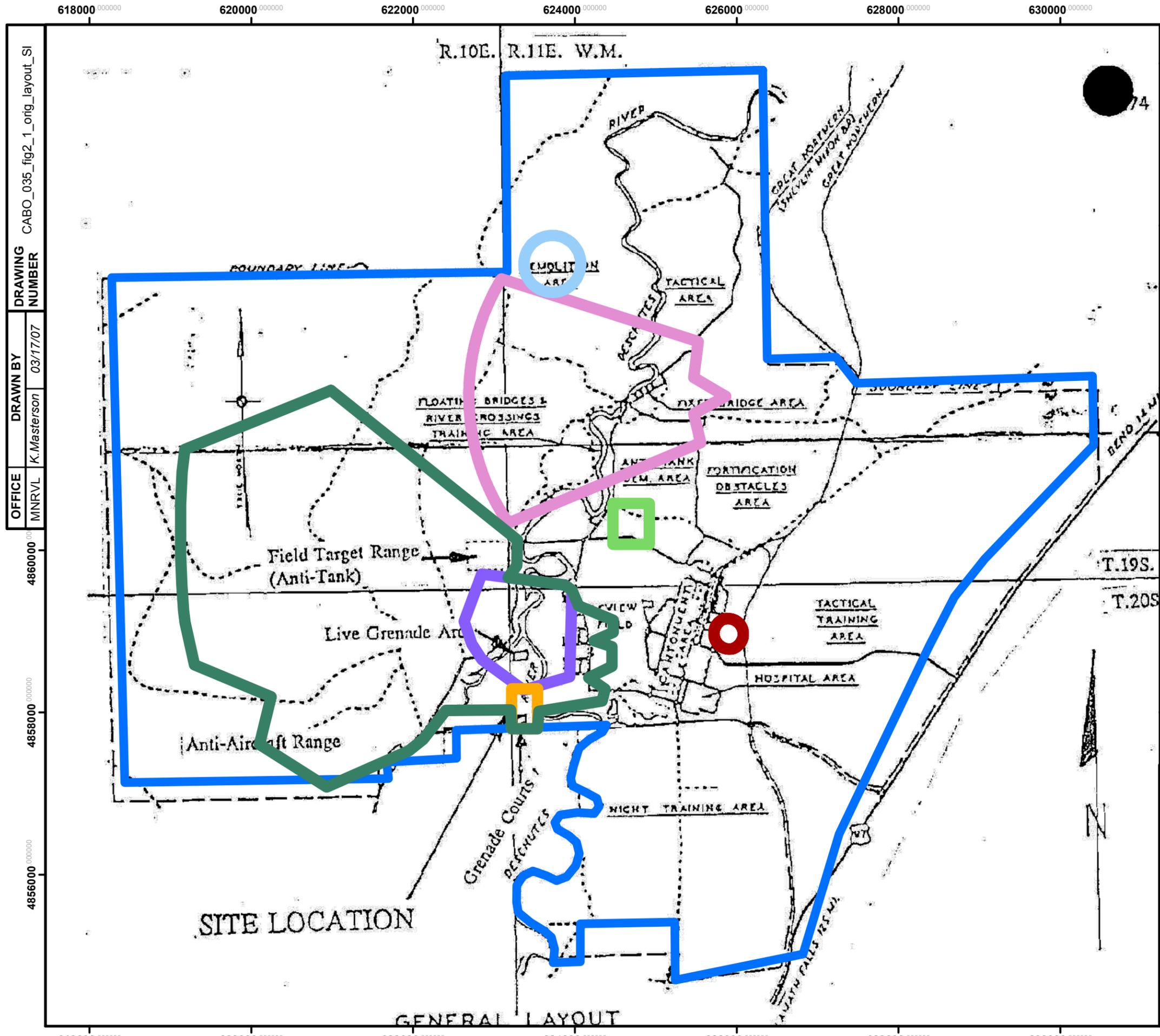


U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 1-1
SITE LOCATION

CAMP ABBOT

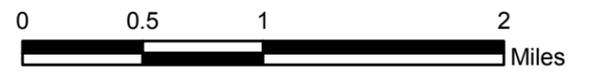




Legend

-  Camp Abbot FUDS Boundary
-  Anti-Tank Range AOC Boundary
-  Burial Pit AOC Boundary
-  Chemical Training Area AOC Boundary
-  Demolition Area AOC Boundary
-  Grenade Courts AOC Boundary
-  Mortar Range AOC Boundary
-  Range Complex No. 1 AOC Boundary

NOTES:
 1) The site layout drawing was obtained from the Inventory Project Report (INPR) for Camp Abbot, Oregon, 13 October 1993, Revised 6 April 1994.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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 OMAHA DESIGN CENTER

FIGURE 2-1
ORIGINAL SITE LAYOUT
 CAMP ABBOT

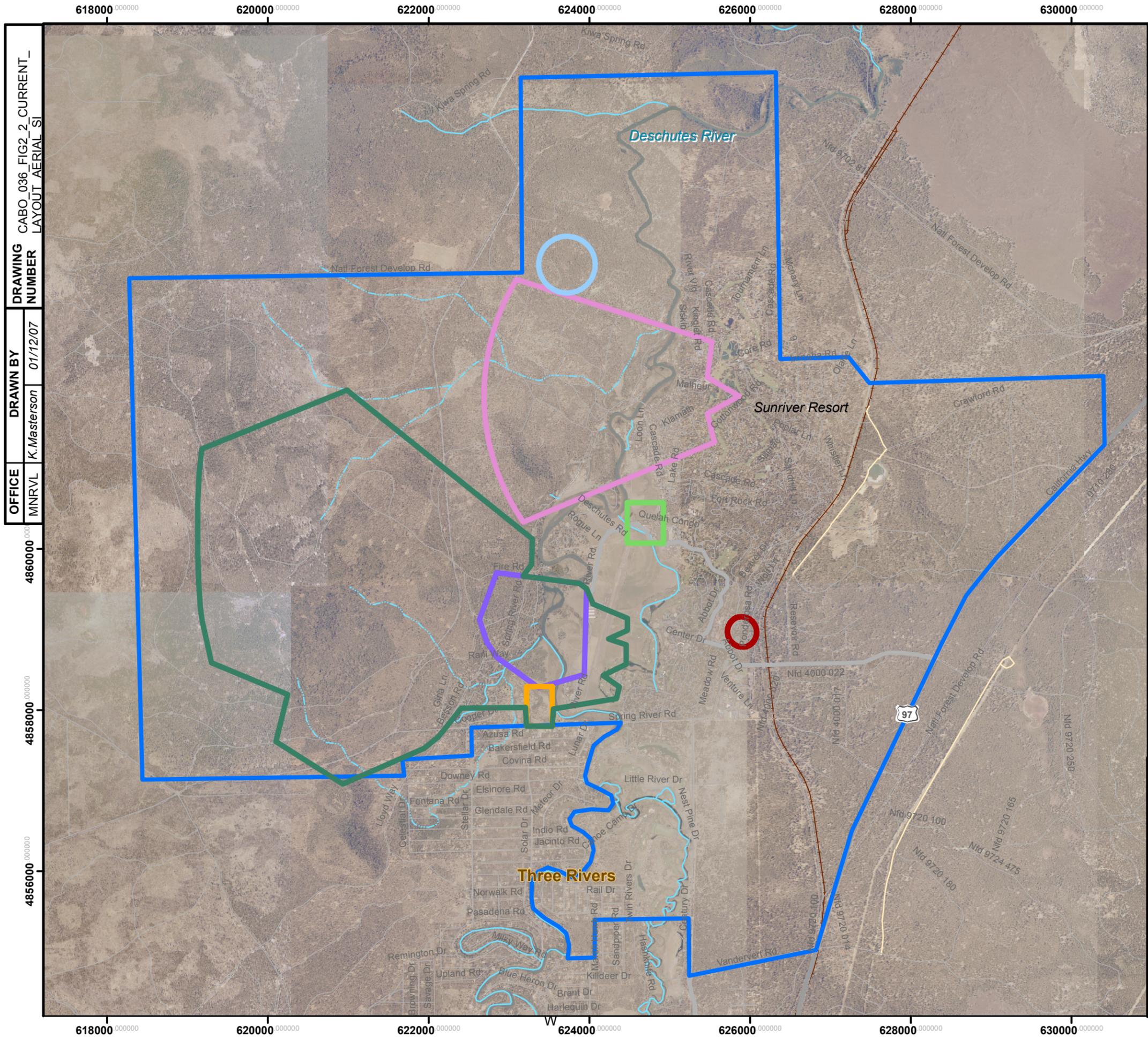


OFFICE: MNRVL
 DRAWN BY: K. Masterson
 DRAWING NUMBER: CABO_035_fig2_1_orig_layout_S1
 DATE: 03/17/07

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618000 620000 622000 624000 626000 628000 630000

4856000 4858000 4860000 4862000 4864000 4866000

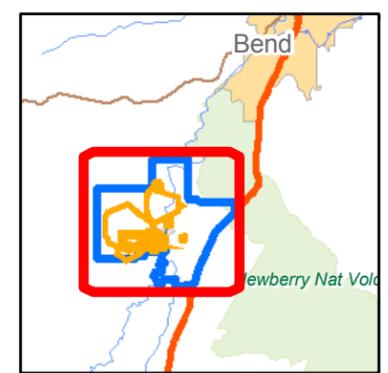
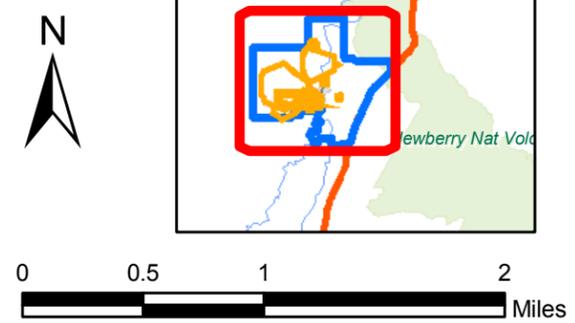


CABO_036_FIG2_2_CURRENT_LAYOUT_AERIAL_SI
 DRAWING NUMBER
 DRAWN BY
 OFFICE
 MNRVL
 K.Masterson
 01/12/07

Legend

- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary

NOTES:
 1) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.

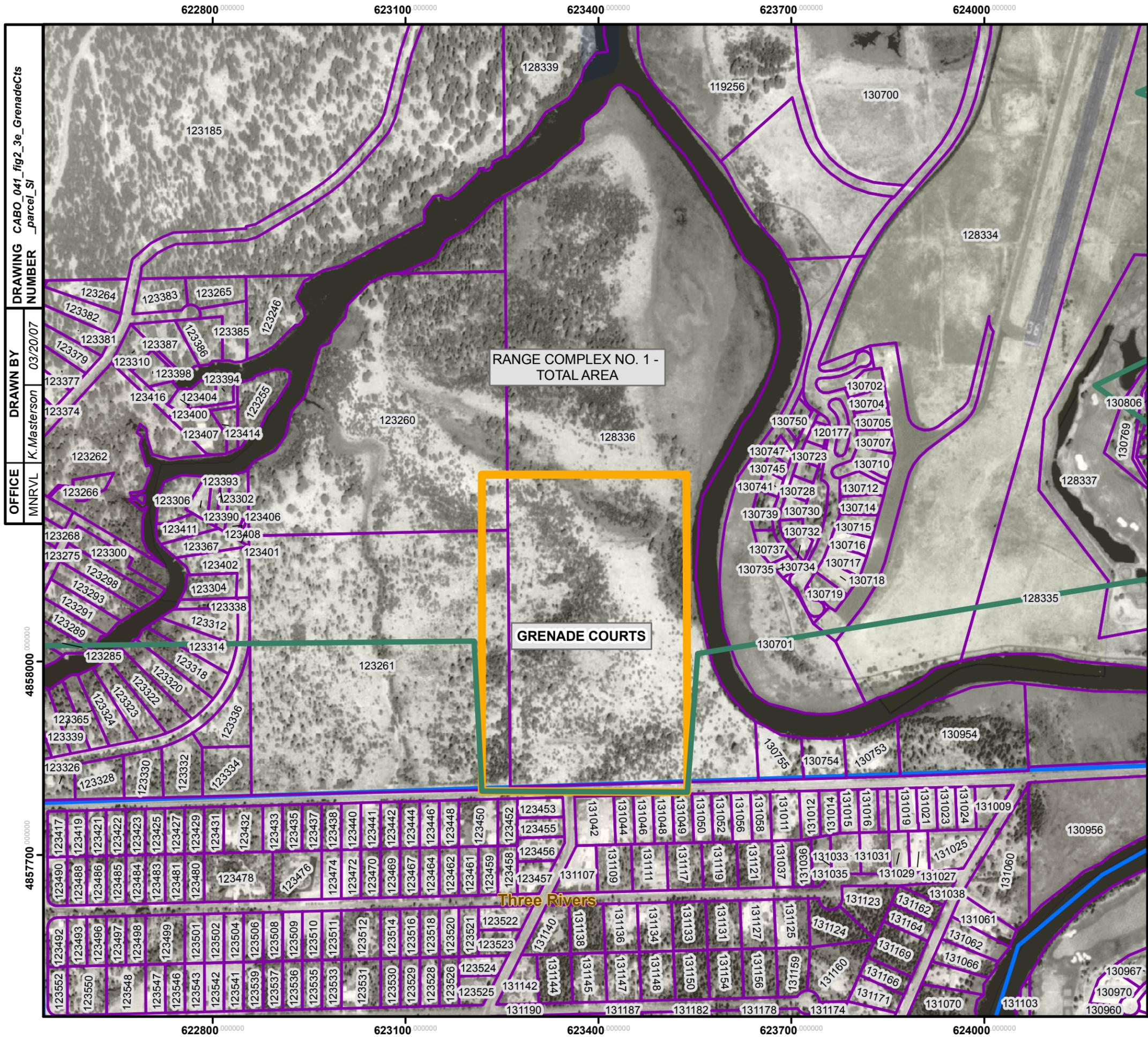


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 2-2
CURRENT AERIAL PHOTOGRAPH
 CAMP ABBOT

Shaw Environmental, Inc.



DRAWING NUMBER CABO_041_fig2_3e_parcel_Sf
DRAWN BY K.Masterson 03/20/07
OFFICE MNRVL

Legend

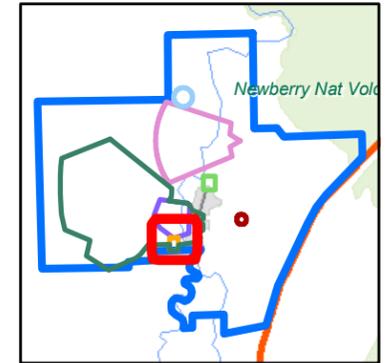
- Camp Abot FUDS Boundary
- Grenade Courts AOC Boundary
- Range Complex No. 1 AOC Boundary
- Taxlot Parcels

NOTES:

- 1) AOC boundaries were derived from the Camp Abot ASR Supplement.
- 2) Taxlot parcel data were obtained from the Deschutes County GIS office.
- 3) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.



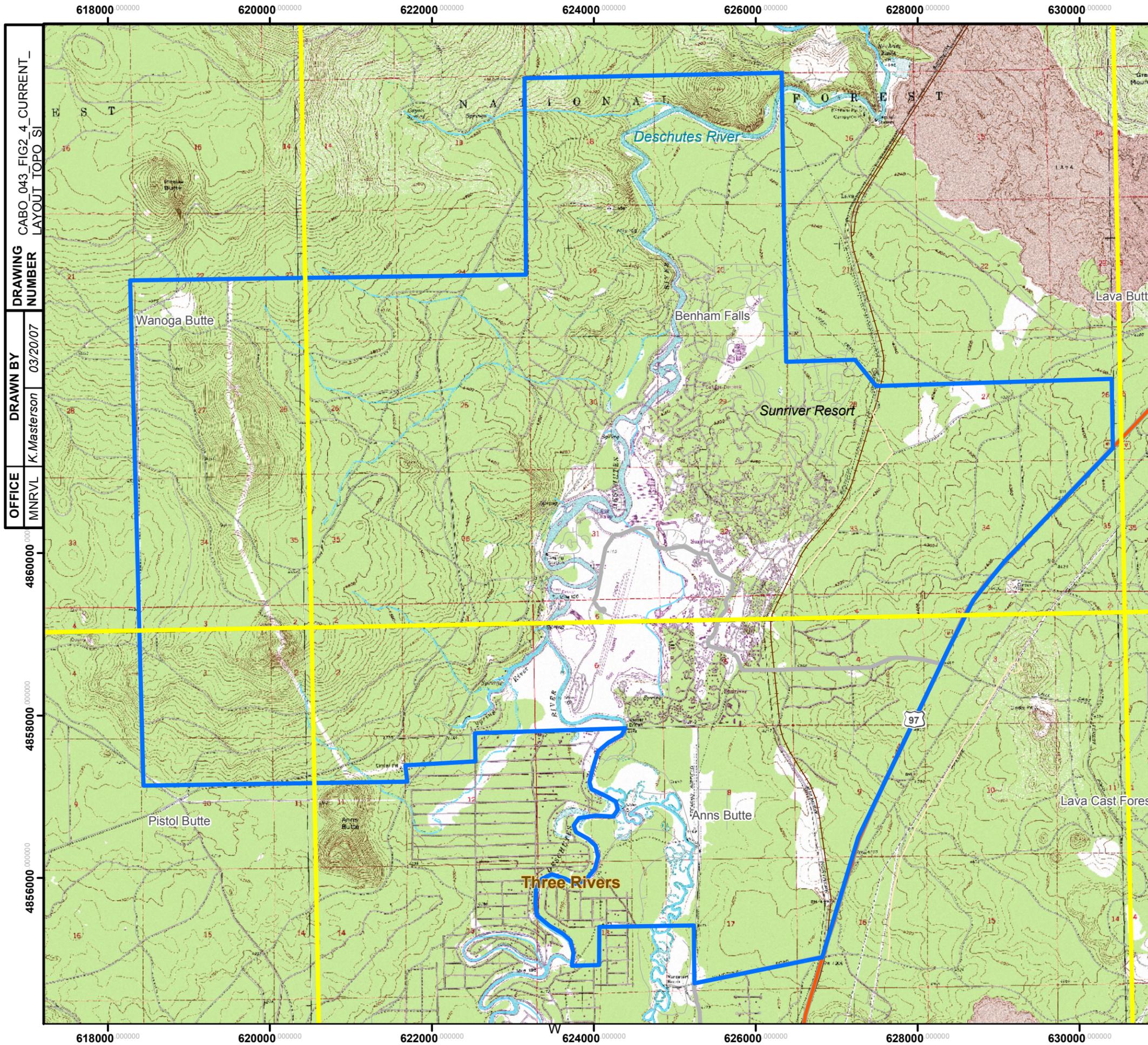
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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FIGURE 2-3E
PARCEL OWNERSHIP
GRENADE COURTS
CAMP ABBOT





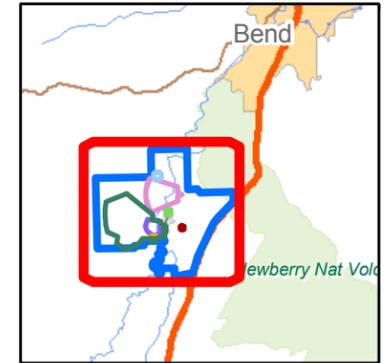
DRAWING NUMBER: CABO_043_FIG2_4_CURRENT_LAYOUT_TOPO_SI
 DRAWN BY: K.Masterson 03/20/07
 OFFICE: MNRVL

Legend

- Camp Abbot FUDS Boundary
- Quad Name
USGS Topographic Quadrangle Map Sheets

NOTES:

- 1) FUDS property boundary was derived from the Camp Abbot ASR Supplement.
- 2) USGS Topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.
- 3) USGS Topographic Quadrangles: Anns Butte, Benham Falls, Lava Butte, Lava Cast Forest, Pistol Butte, Wanoga Butte.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

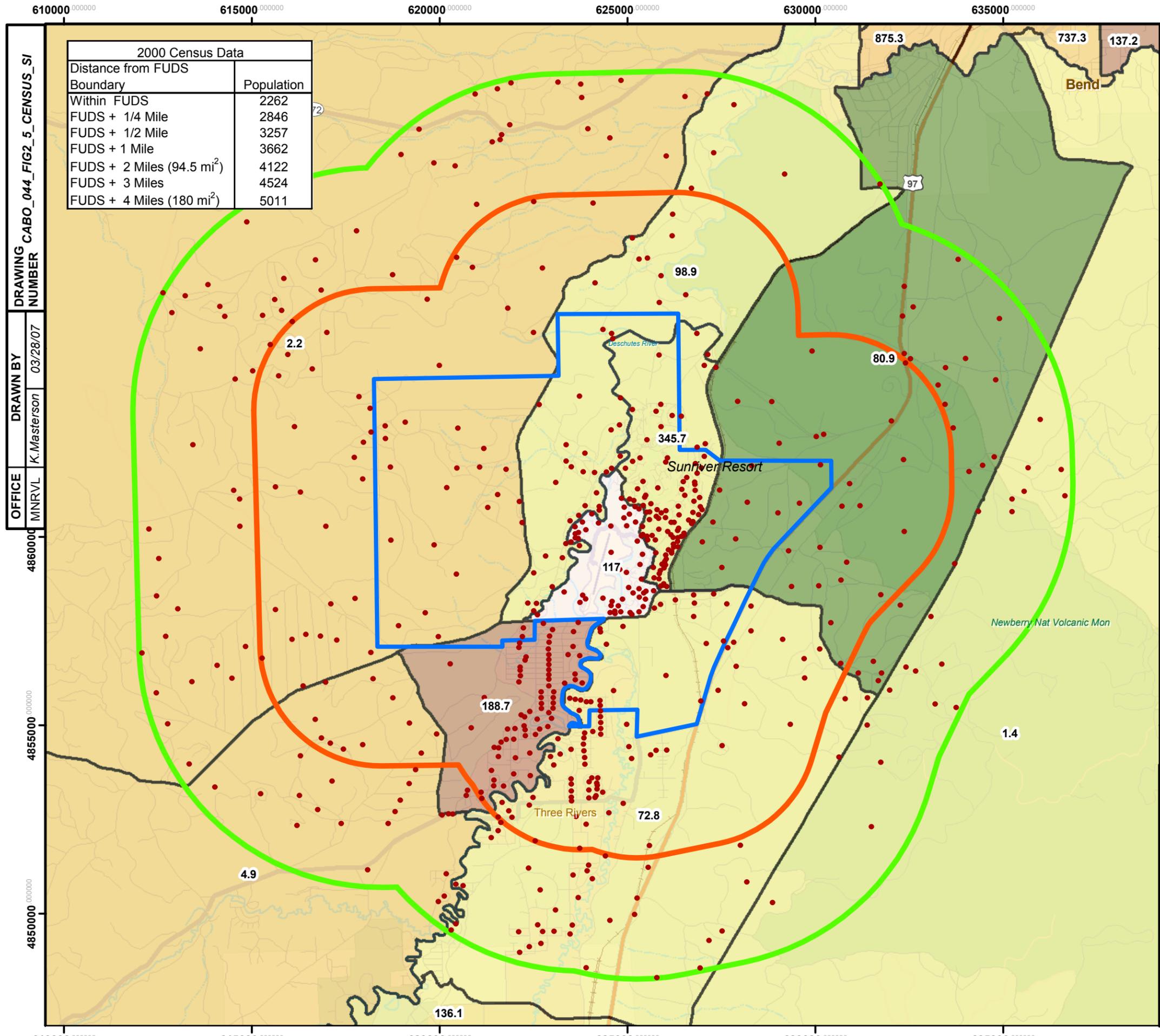


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FIGURE 2-4
CURRENT TOPOGRAPHIC MAP

CAMP ABBOT





2000 Census Data	
Distance from FUDS Boundary	Population
Within FUDS	2262
FUDS + 1/4 Mile	2846
FUDS + 1/2 Mile	3257
FUDS + 1 Mile	3662
FUDS + 2 Miles (94.5 mi ²)	4122
FUDS + 3 Miles	4524
FUDS + 4 Miles (180 mi ²)	5011

Legend

- Camp Abbot FUDS Boundary
- 2-Mile Radius from the Camp Abbot FUDS Boundary
- 4-Mile Radius from the Camp Abbot FUDS Boundary

2004 Block Group Population

- 316
- 317 - 1238
- 1239 - 1506
- 1507 - 2360
- 2361 - 3349

15.2 Number of People per Square Mile

- Census Block Centroid Unit

NOTES:
 1) The population density for the 2-mile radius (94.5 square miles) is 27.8 persons/square mile.
 2) The population density for the 4-mile radius (180 square miles) is 43.6 persons/square mile.

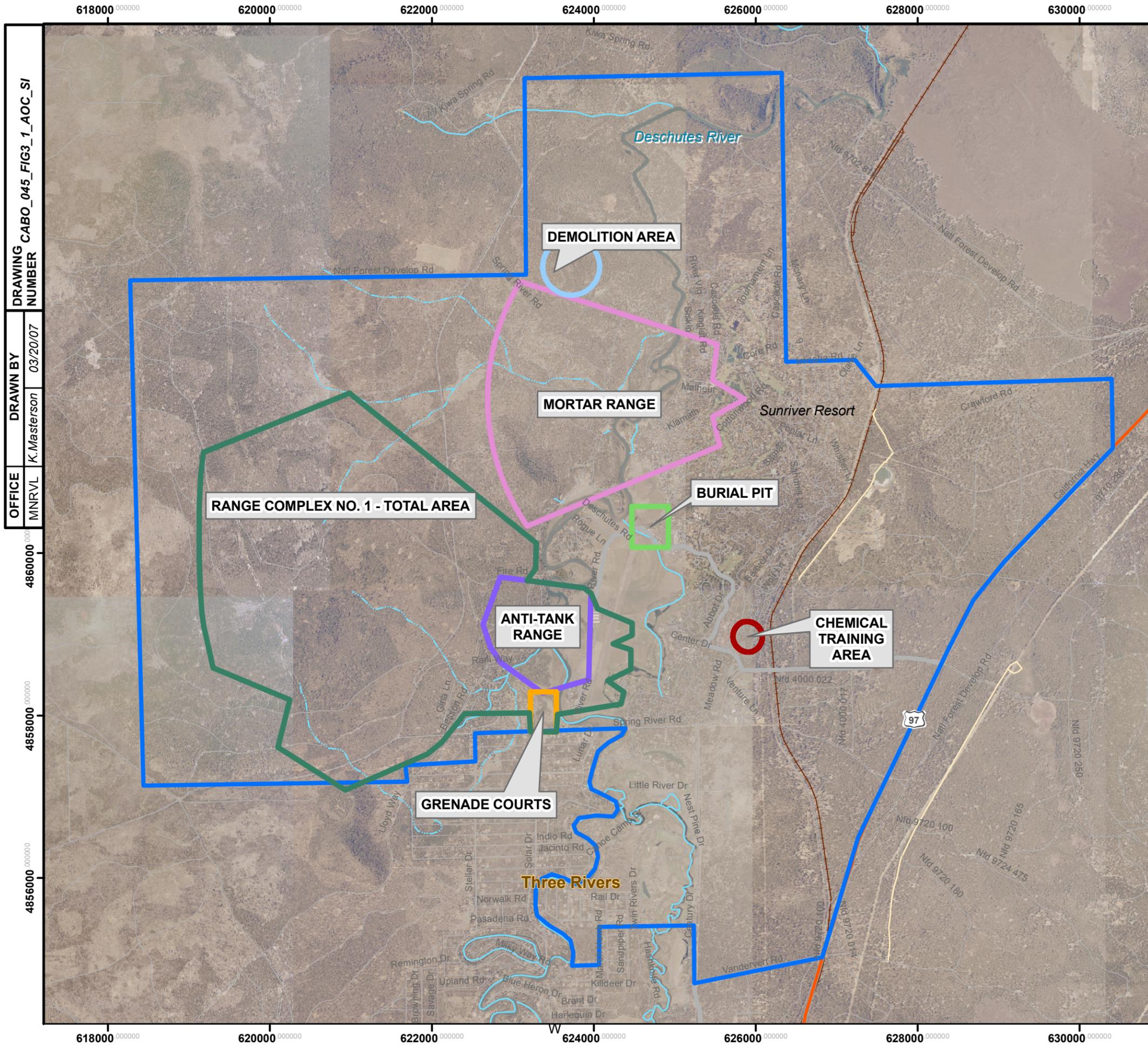
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

DRAWING CABO_044_FIG2_5_CENSUS_SI
 NUMBER
 DRAWN BY
 K. Masterson
 03/28/07
 OFFICE
 MNRVL

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FIGURE 2-5
CENSUS DATA
WITHIN A 2-MILE AND 4-MILE RADIUS OF
THE FUDS BOUNDARY
 CAMP ABBOT

Shaw Environmental, Inc.



DRAWING NUMBER
CABO_045_FIG3_1_AOC_SI

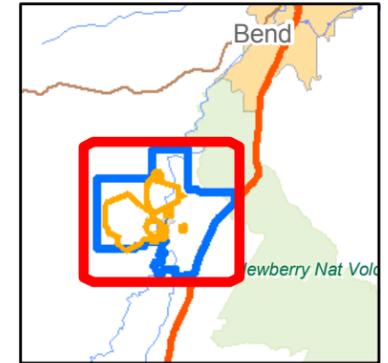
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K.Masterson
03/20/07

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Legend

-  Camp Abbot FUDS Boundary
-  Anti-Tank Range AOC Boundary
-  Burial Pit AOC Boundary
-  Chemical Training Area AOC Boundary
-  Demolition Area AOC Boundary
-  Grenade Courts AOC Boundary
-  Mortar Range AOC Boundary
-  Range Complex No. 1 AOC Boundary

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.



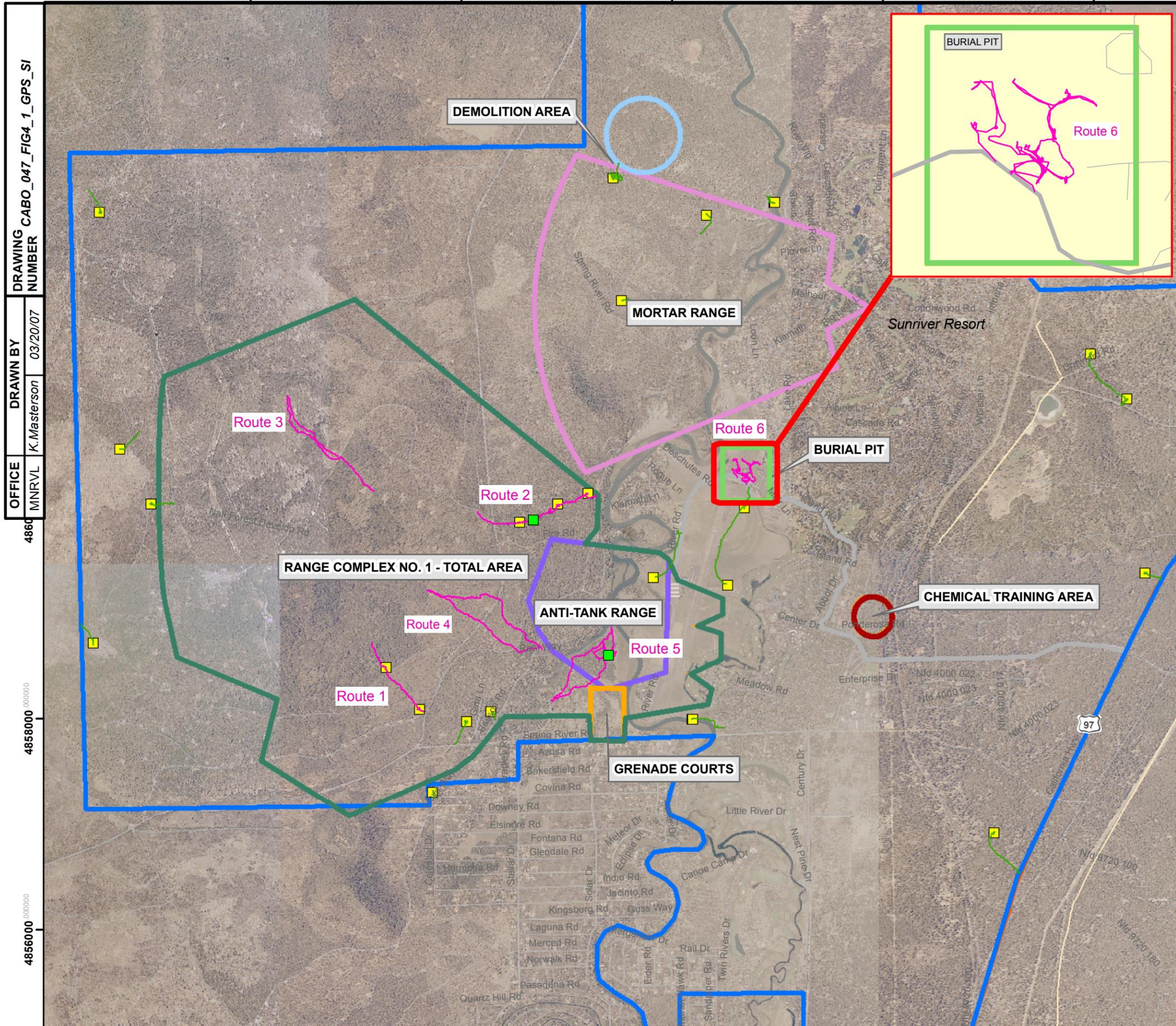
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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FIGURE 3-1
AREAS OF CONCERN
 CAMP ABBOT





DRAWING CABO_047_FIG4_1_GPS_SI

OFFICE MNRVL

DRAWN BY K.Masterson

NUMBER 03/20/07

4860000

4858000

4856000

620000 622000 624000 626000 628000

Legend

- Camp Abbot Property Boundary
- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- Field Sample
- Subsurface Anomaly
- Reconnaissance Path
- MEC Avoidance Path

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.

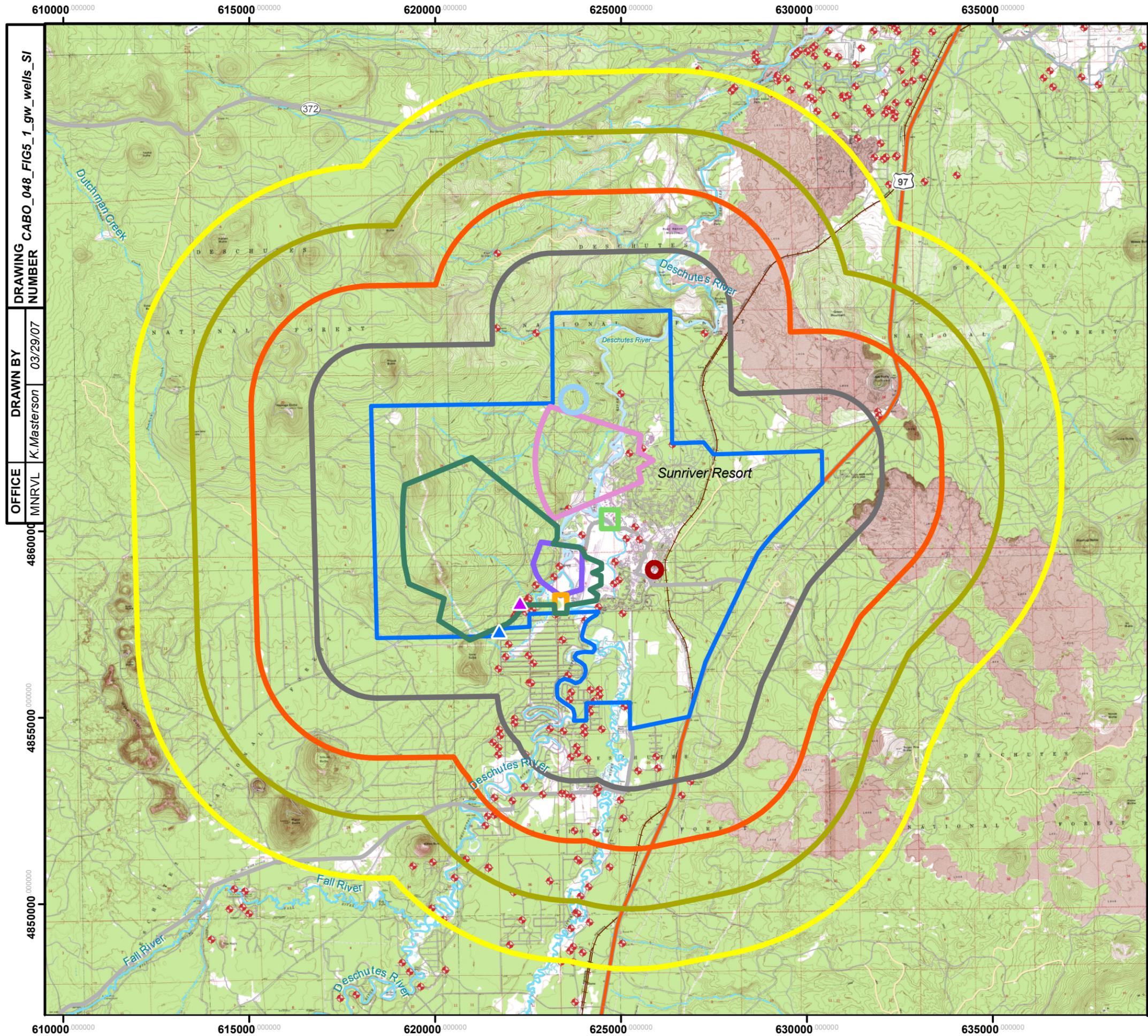
0 1,500 3,000 6,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 4-1
VISUAL RECONNAISSANCE PATHS
CAMP ABBOT

Shaw Shaw Environmental, Inc.



DRAWING CABO_048_FIG5_1_gw_wells_SI
 NUMBER
 DRAWN BY
 K.Masterson
 03/29/07
 OFFICE
 MNRVL

Legend

- Camp Abbot FUDS Boundary
- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- 1-Mile Radius from Camp Abbot Property Boundary
- 2-Mile Radius from Camp Abbot Property Boundary
- 3-Mile Radius from Camp Abbot Property Boundary
- 4-Mile Radius from Camp Abbot Property Boundary
- Groundwater Wells (Oregon WRD)
- Groundwater Sample Location
- Background Groundwater Sample Location

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) Groundwater well data were obtained from the Oregon Water Resources Department.
- 3) USGS Topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.

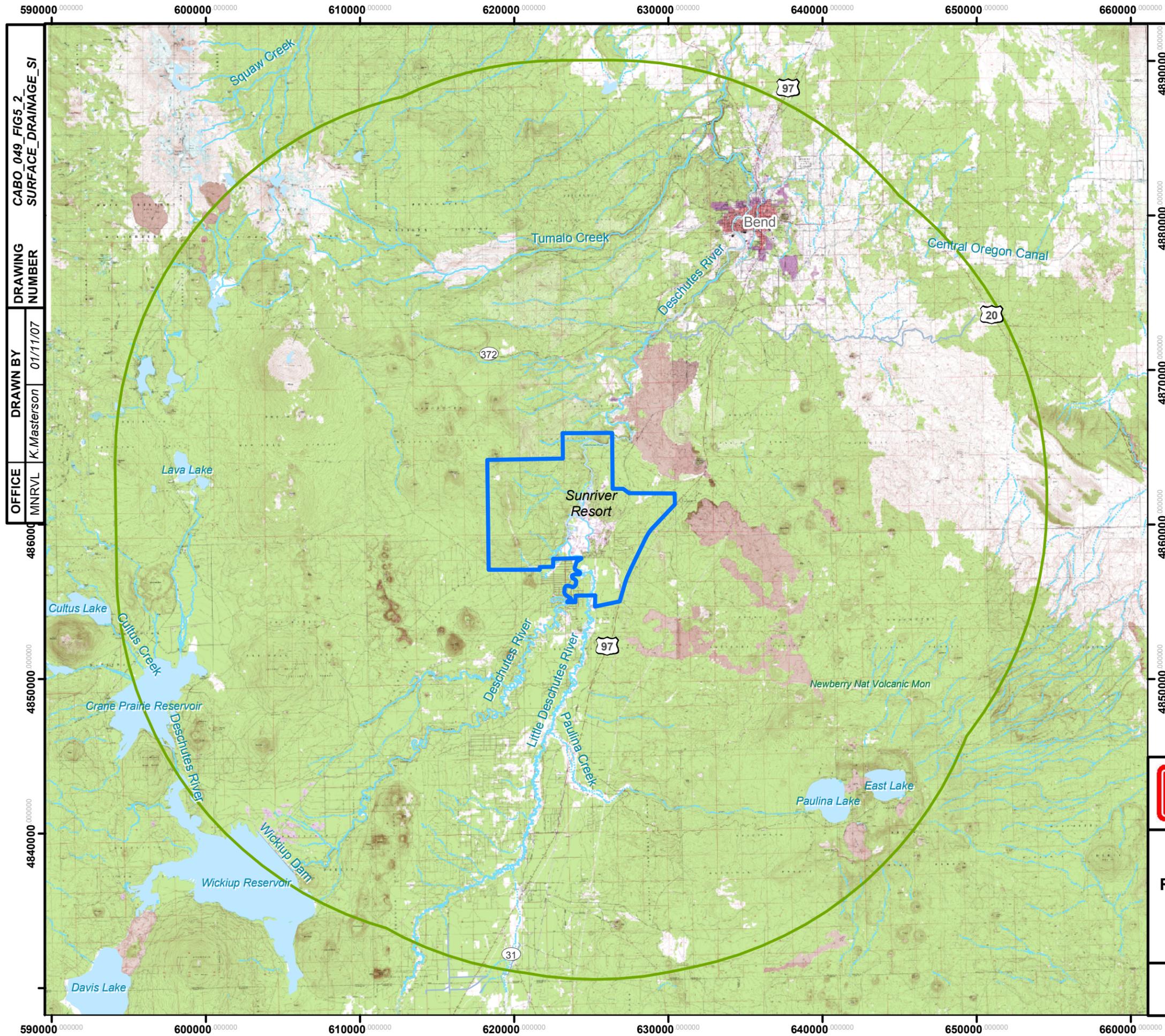
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 5-1
GROUNDWATER WELLS WITHIN
A 2-MILE AND 4-MILE RADIUS OF
THE FUDS BOUNDARY

CAMP ABBOT

Shaw Shaw Environmental, Inc.



CABO_049_FIG5_2
 SURFACE_DRAINAGE_SI
 DRAWING NUMBER
 DRAWN BY
 K.Masterson 01/11/07
 OFFICE
 MNRVL

Legend

- Camp Abbot FUDS Boundary
- 15-Mile Radius from FUDS Boundary

NOTES:

- 1) FUDS property boundary was derived from the Camp Abbot ASR Supplement.
- 2) USGS Topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

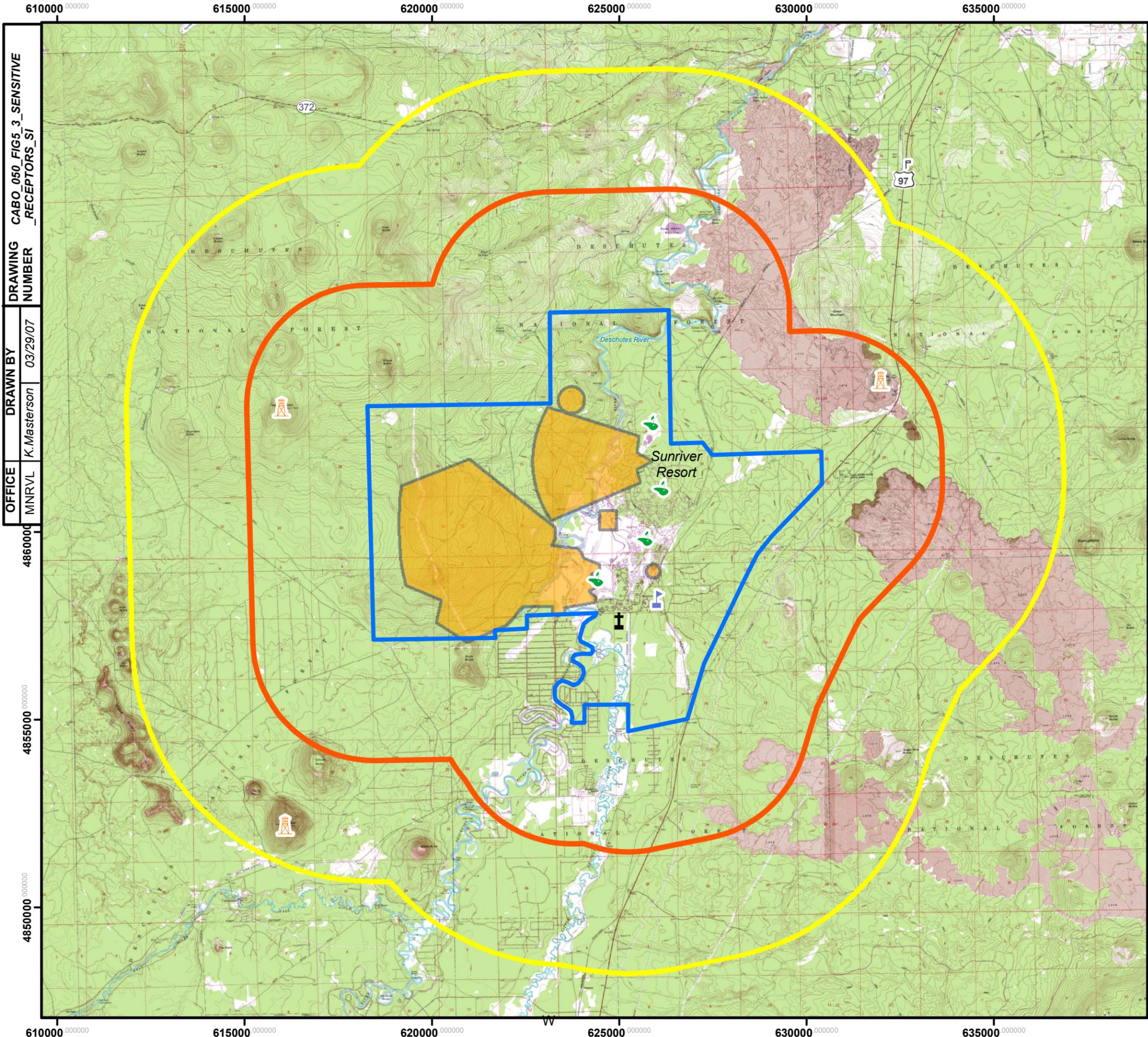


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FIGURE 5-2
REGIONAL SURFACE WATER DRAINAGE WITHIN
A 15-MILE RADIUS OF THE FUDS BOUNDARY

CAMP ABBOT



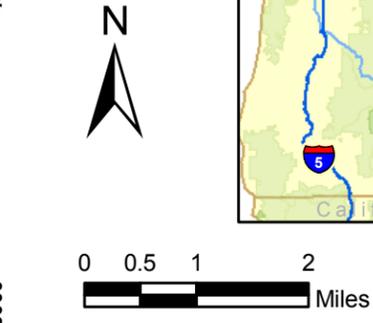


DRAWING NUMBER: CABO_050_FIG5_3_SENSITIVE_RECEPTORS_S1
 DRAWN BY: K. Masterson
 DATE: 03/29/07
 OFFICE: MNRVL
 NUMBER: 4860000

Legend

- Camp Abbot FUDS Boundary
- 2-Mile Radius from Camp Abbot FUDS Boundary
- 4-Mile Radius from Camp Abbot FUDS Boundary
- Golf Course
- Lookout Tower
- Harper Cemetery
- School

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) USGS topographic map was obtained from the U.S. Department of Agriculture, Service Center Agencies and is dated 2001.

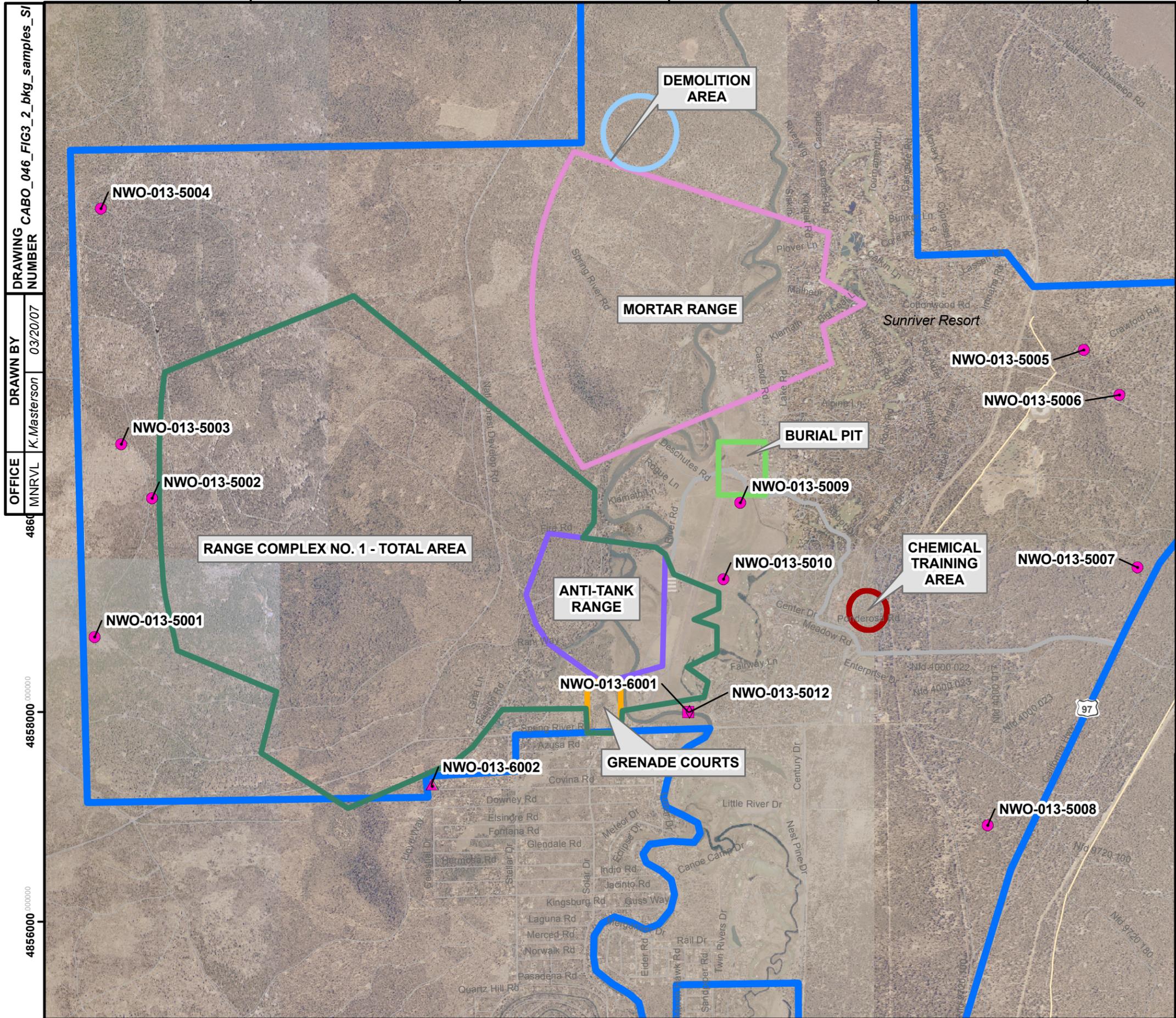


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FIGURE 5-3
SENSITIVE RECEPTORS
WITHIN A 2-MILE AND 4-MILE RADIUS
OF THE FUDS BOUNDARY
 CAMP ABBOT

Shaw Environmental, Inc.



DRAWING CABO_046_FIG3_2_bkg_samples_SI
 NUMBER
 DRAWN BY
 K.Masterson
 03/20/07
 OFFICE
 MNRVL
 4860

Legend

- Camp Abbot FUDS Boundary
- Anti-Tank Range AOC Boundary
- Burial Pit AOC Boundary
- Chemical Training Area AOC Boundary
- Demolition Area AOC Boundary
- Grenade Courts AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- Background Soil Sample Location
- ◆ Background Sediment Sample Location
- Background Surface Water Sample Location
- ▲ Background Groundwater Sample Location

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.

N

0 1,500 3,000 6,000
Feet

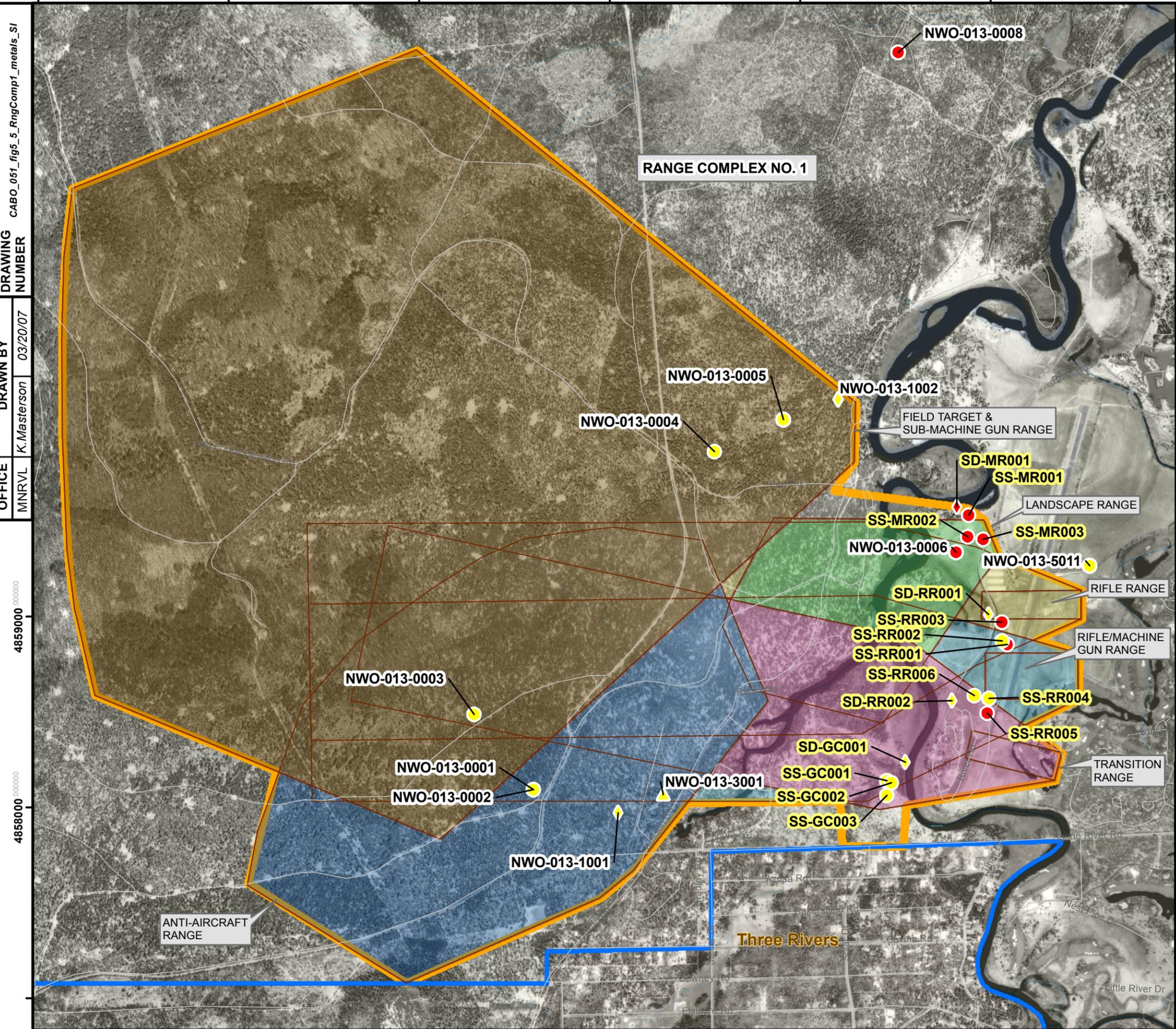
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 5-4
BACKGROUND SAMPLE LOCATIONS
 CAMP ABBOT

Shaw Environmental, Inc.

619000 620000 621000 622000 623000 624000

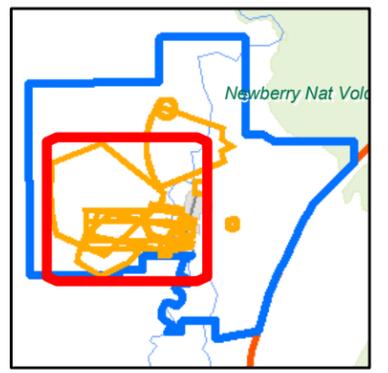
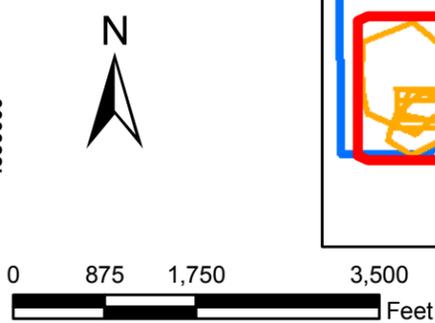


Legend

- Camp Abbot FUDS Boundary
- Range Complex No. 1
- Subrange Boundary
- Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
- Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- Sediment Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- Groundwater Sample Results Less than Background

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

SS-MR001 Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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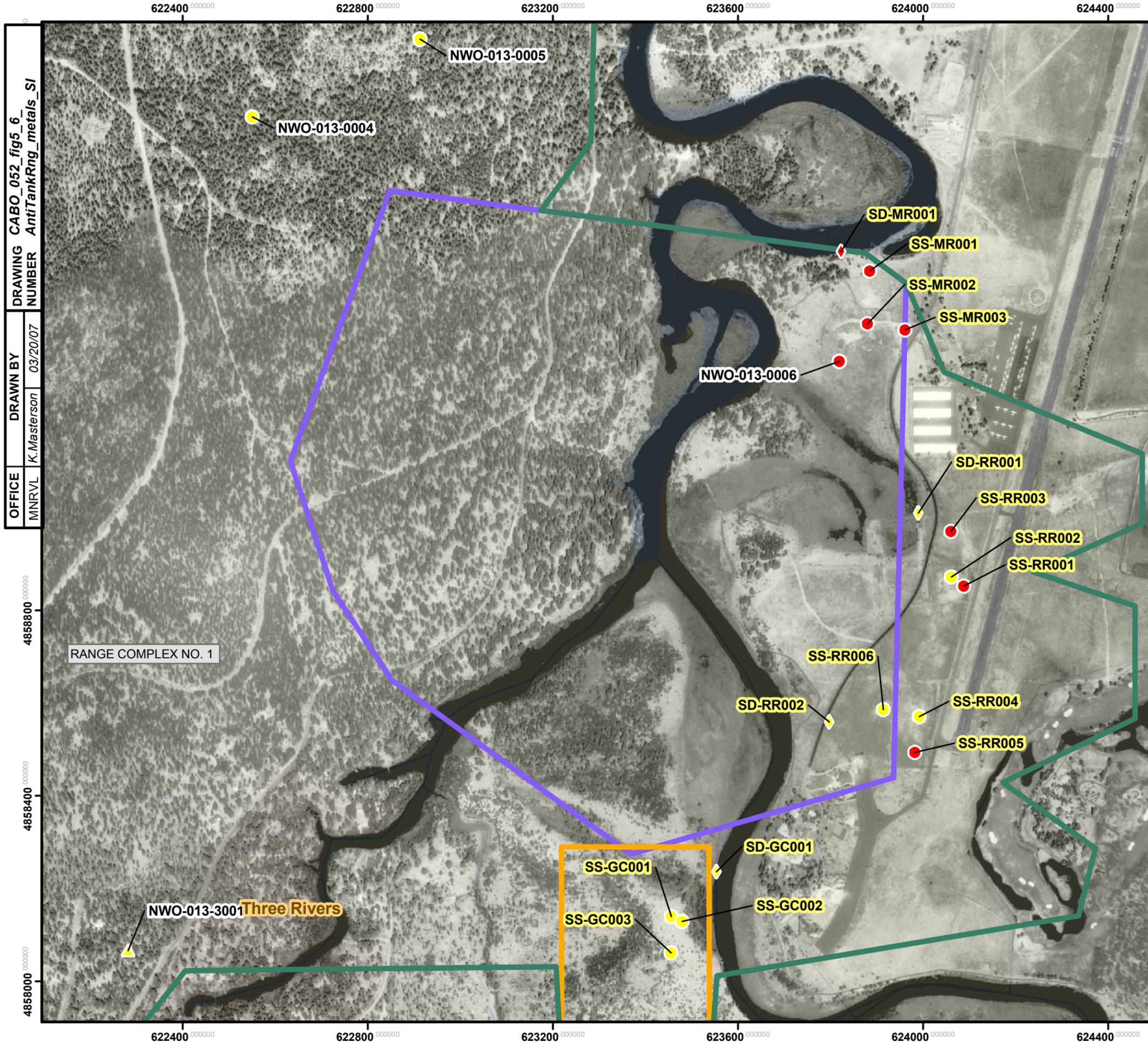
FIGURE 5-5
METALS RESULTS
RANGE COMPLEX NO. 1
 CAMP ABBOT

619000 620000 621000 622000 623000 624000

OFFICE: MNRVL
 DRAWN BY: K. Masterson
 DRAWING NUMBER: 03/20/07
 CABO_051_fig5_5_RngComp1_metals_SI

4859000
 4858000

4862000
 4861000
 4860000
 4859000



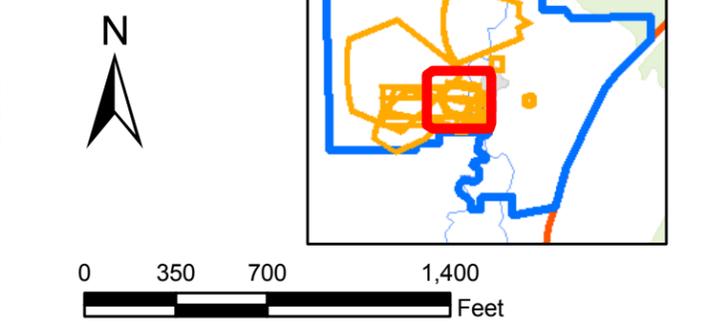
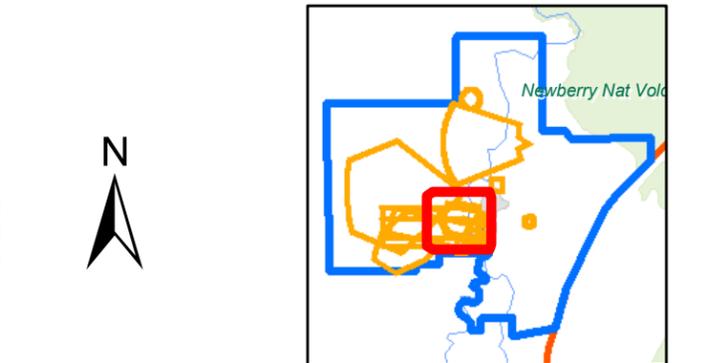
OFFICE: MNRVL
 DRAWN BY: K. Masterson
 DATE: 03/20/07
 DRAWING NUMBER: CABO_052_fig5_6
 TITLE: AntiTankRng_metals_SI

Legend

- Anti-Tank Range AOC Boundary
- Grenade Courts AOC Boundary
- Range Complex No. 1 AOC Boundary
- Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Surface Water Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- ▲ Groundwater Sample Results Less than Background and/or Less than Eco or Human Health Screening Values

NOTES:
 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
 2) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

SS-MR001 Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).

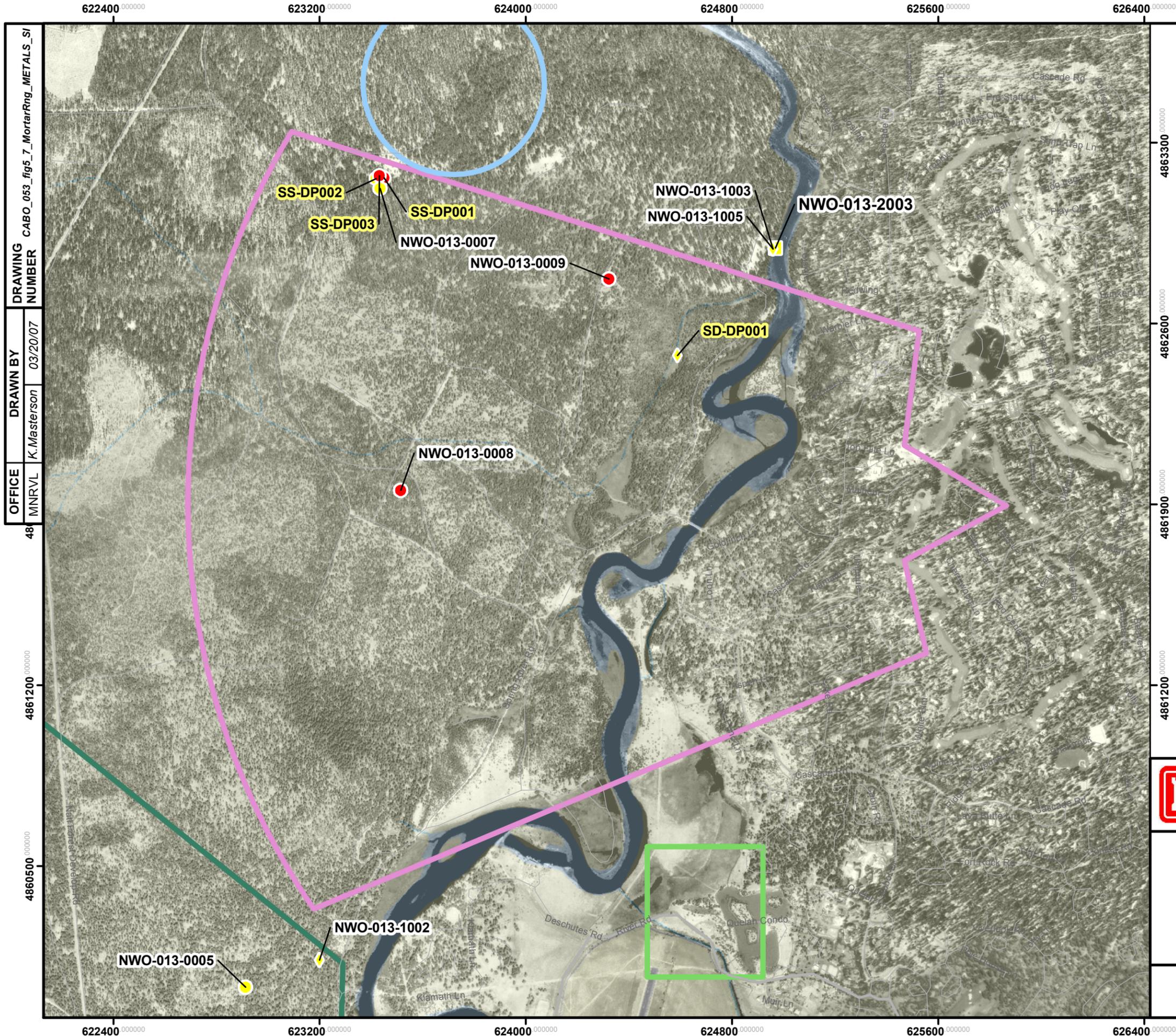


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
 OMAHA DESIGN CENTER

FIGURE 5-6
METALS RESULTS
ANTI-TANK RANGE
 CAMP ABBOT

Shaw Environmental, Inc.



622400 000000 623200 000000 624000 000000 624800 000000 625600 000000 626400 000000

4863300 000000
4862600 000000
4861900 000000
4861200 000000
4860500 000000

OFFICE
MNRVL

DRAWN BY
K. Masterson

DRAWING NUMBER
03/20/07

DRAWING NUMBER
CABO_053_fig5_7_MortarRng_METALS_SI

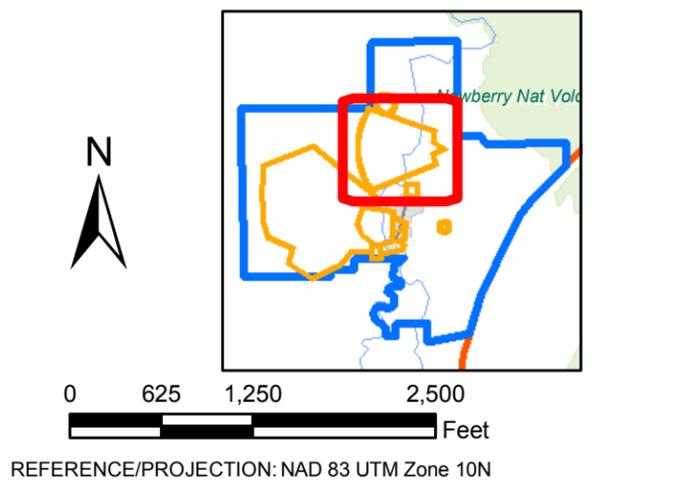
Legend

- Burial Pit AOC Boundary
- Demolition Area AOC Boundary
- Mortar Range AOC Boundary
- Range Complex No. 1 AOC Boundary
- Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Surface Water Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- Surface Water Sample Results Less than Background and/or Less than Eco or Human Health Screening Values

NOTES:

- 1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
- 2) Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

SS-MR001 Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).

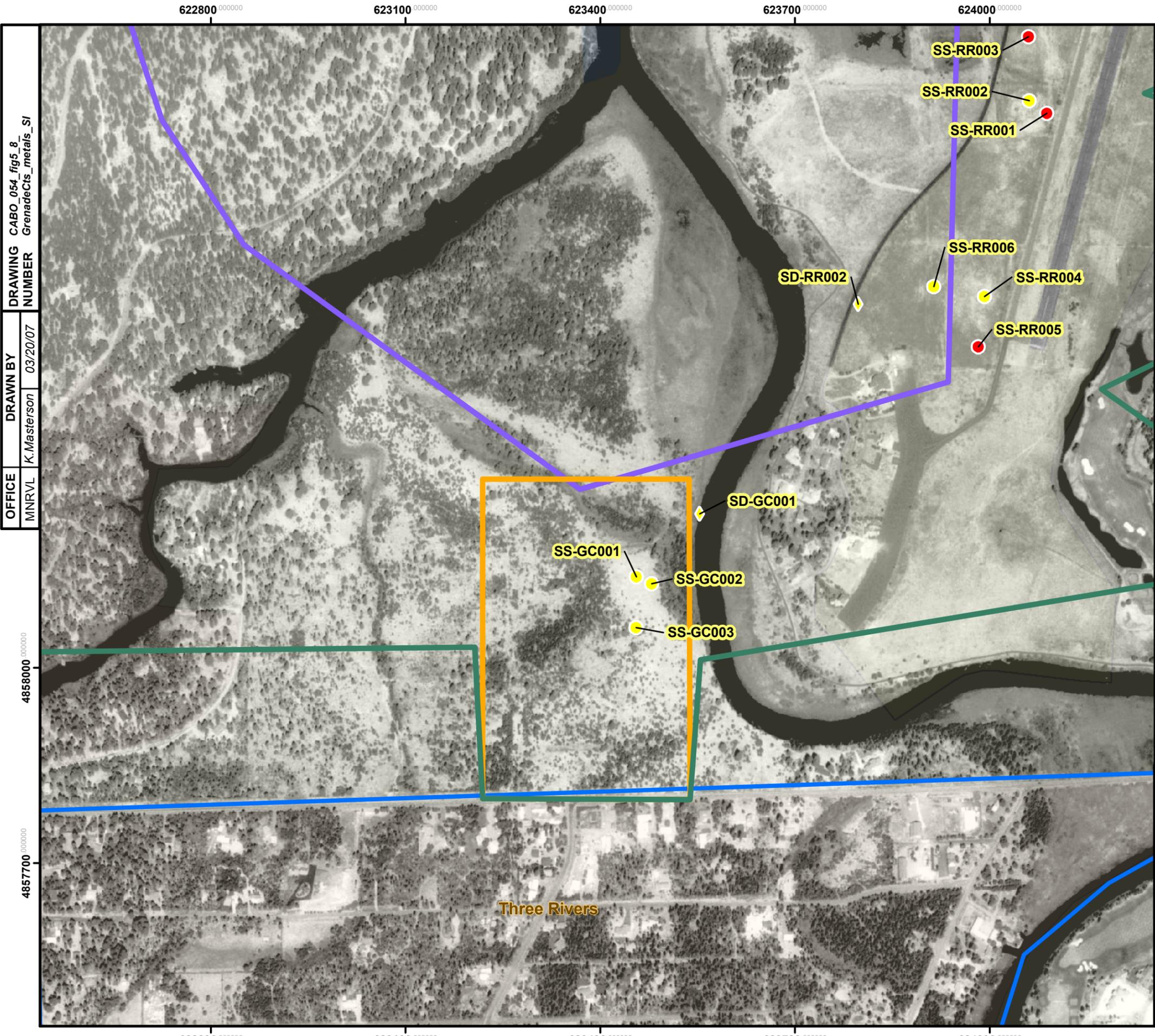


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FIGURE 5-7
METALS RESULTS
DEMOLITION AREA / MORTAR RANGE
CAMP ABBOT

Shaw Shaw Environmental, Inc.

622400 000000 623200 000000 624000 000000 624800 000000 625600 000000 626400 000000



DRAWING NUMBER: CABO_054_fig5_8 GrenadeCts_metals_SI
 DRAWN BY: K.Masterson 03/20/07
 OFFICE: MNRVL

Legend

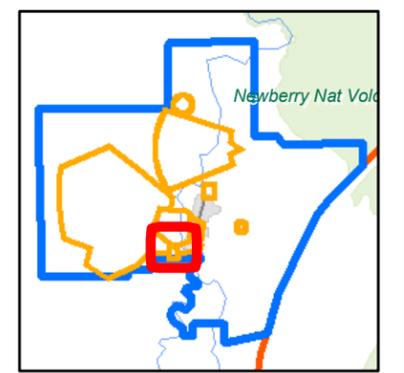
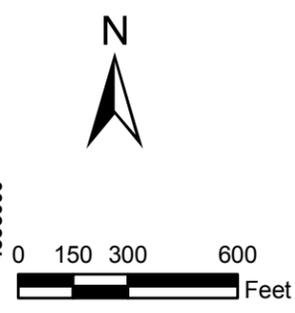
- Camp Abbot FUDS Boundary
- Anti-Tank Range AOC Boundary
- Grenade Courts AOC Boundary
- Range Complex No. 1 AOC Boundary
- Soil Samples Results Greater than Background and Greater than Eco or Human Health Screening Values
- Sediment Sample Results Greater than Background and Greater than Eco or Human Health Screening Values
- Soil Sample Results Less than Background and/or Less than Eco or Human Health Screening Values
- Surface Water Sample Results Less than Background and/or Less than Eco or Human Health Screening Values

NOTES:

- AOC boundaries were derived from the Camp Abbot ASR Supplement.
- Aerial photo (1 meter resolution) was obtained from TerraServer and is dated July 20, 1994.

Yellow highlighted sample location indicates data obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston (2005).

SS-MR001

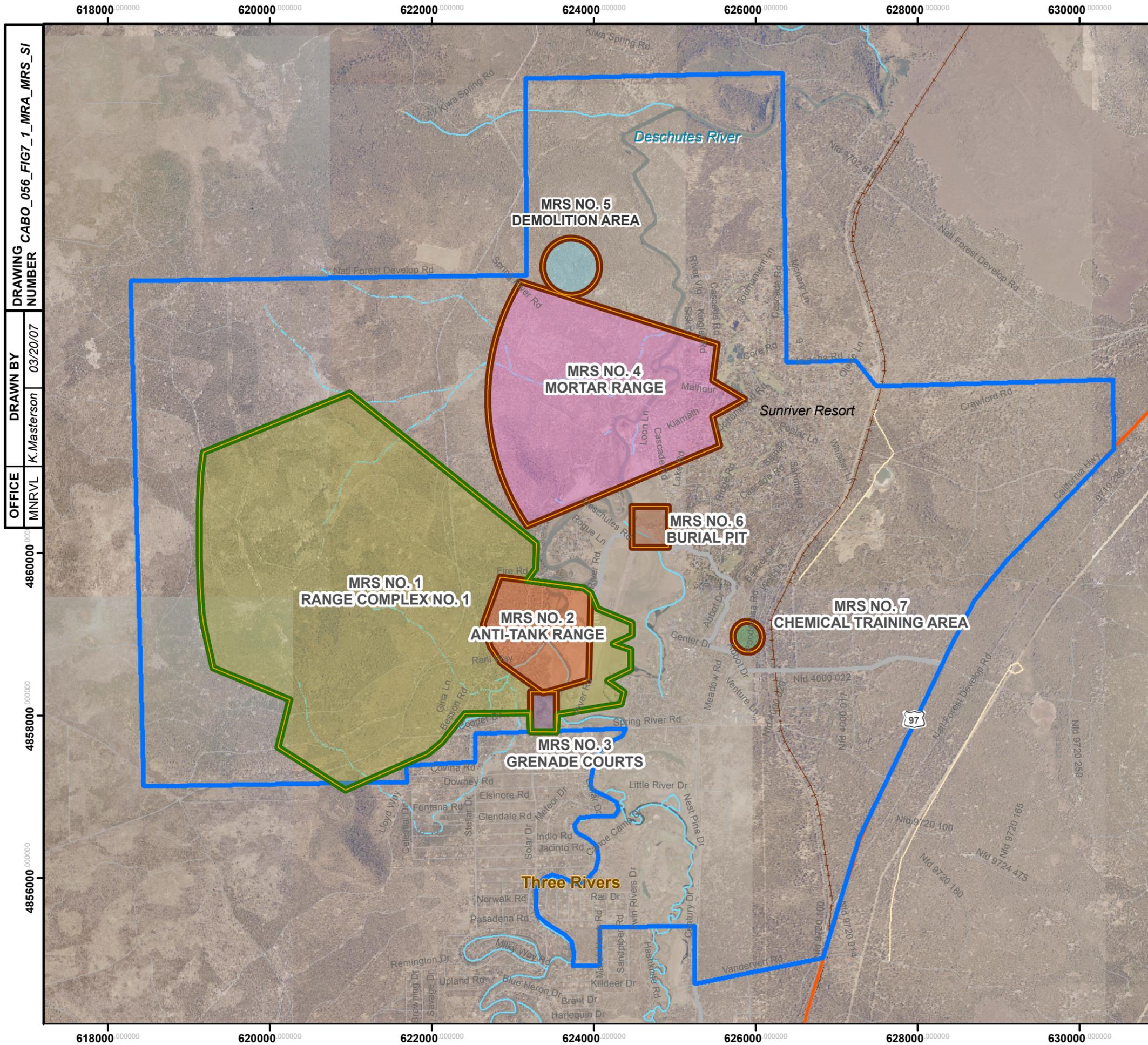


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 5-8
METALS RESULTS
GRENADA COURTS
CAMP ABBOT

Shaw Environmental, Inc.



DRAWING CABO_056_FIG7_1_MRA_MRS_SI
NUMBER

OFFICE MNRVL
DRAWN BY K.Masterson
DATE 03/20/07

4860000
4858000
4856000

618000 620000 622000 624000 626000 628000 630000

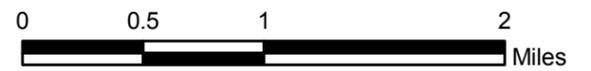
618000 620000 622000 624000 626000 628000 630000

Legend

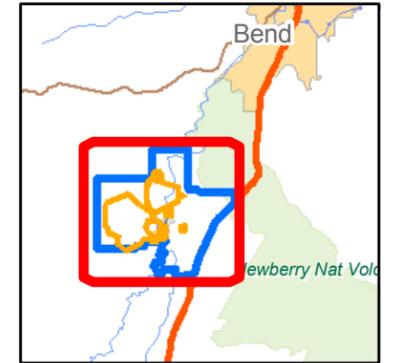
- Camp Abbot FUDS Boundary
- ASR Supplement Ranges
- MRS Boundary
- MRS No. 1 Boundary

NOTES:
1) Aerial photo was obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-AFPO National Agricultural Inventory Project (NAIP), 2003.

4866000
4864000
4862000
4860000
4858000



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 7-1
MRS BOUNDARIES
CAMP ABBOT



Tables

**Table 2-1
Munitions Information**

AOC	Munitions	Munitions Constituents
Range Complex No. 1	Small Arms General	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant, copper, zinc
	.50-caliber Machine Gun	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant, perchlorate, copper, zinc
Anti-Tank Range	M6A1, Rocket, HEAT, 2.36-inch	Pentolite (Pentaerythritol tetranitrate [PETN] and TNT), Ballistite (nitrocellulose and nitroglycerin), M400 (fuze), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M6A3, Rocket, HEAT, 2.36-inch	Pentolite (PETN and TNT), Ballistite (nitroglycerin and nitrocellulose), M400 (fuze), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M9A1 Rifle Grenade Anti-Tank	Pentolite (PETN and TNT), or TNT, cast iron (iron)
	M11A2 Practice Rifle Grenade	Inert, cast iron (iron)
	M7A1, Practice Rocket, 2.36-inch	5 Sticks of Ballistite (nitrocellulose and nitroglycerin), steel and cast iron (iron)
	M7A3, Practice Rocket, 2.36-inch	5 Sticks of Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M1A1 Anti-Tank Mine	TNT, steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M2 Anti-personnel Mine	TNT, steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
Demolition Area	Explosives Detonating Cord	PETN
	Explosives Dynamite Commercial	Nitroglycerin
	Explosives TNT	TNT
	Detonators	Mercury Fulminate, lead azide, tetryl
	Blasting Caps Electric Commercial	Sensitive explosive
	Fuzes, Boosters, or Bursters	TNT or 50/50 Pentolite, mercury fulminate, tetryl
Mortar Range	60 mm HE M49	TNT, Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	60 mm Practice M50A2	Inert with black powder pellets, forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	81 mm, HE, M43	TNT, Ballistite (nitrocellulose and nitroglycerin), forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	81 mm, TP M43A1	Black powder, forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)

Table 2-1 (Cont.)

AOC	Munitions	Munitions Constituents
Grenade Courts	Mk II, Hand Grenade, Frag	TNT (Flaked or Granular), older models used E.C. Blank Smokeless Powder (nitrocellulose) or E.C. Blank Powder (nitrocellulose, barium nitrate, potassium nitrate, charcoal, and sulfur), perchlorate, cast iron (iron)
	AN-M8 Smoke Grenade HC	Hexachloroethane-zinc, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	CN, M7, and M7A1 Hand Grenade	CN Gas, potassium bicarbonate, perchlorate, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M18 Smoke Grenade	Smoke composition, steel sheet metal, fuze – mercury fulminate
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M15, Smoke Grenade, WP	White Phosphorous, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M21, Practice Hand Grenade	Black Powder, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
Burial Pit	Small Arms General	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant, copper, zinc;
	Small Arms General-complete rounds	Lead, single (nitrocellulose)- or double-base (nitrocellulose and nitroglycerin) propellant; lead, brass
	Mk II, Hand Grenade, Frag	TNT (Flaked or Granular), older models used E.C. Blankfire Powder (nitrocellulose, barium nitrate, potassium nitrate, charcoal, and sulfur), cast iron (iron)
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M15, Smoke Grenade, WP	White Phosphorous. Steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)

Table 2-1 (Cont.)

AOC	Munitions	Munitions Constituents
Burial Pit	M6A1, Rocket, HEAT, 2.36-inch	Pentolite (PETN and TNT), Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	M7A1, Practice Rocket, 2.36-inch	5 Sticks of Ballistite (nitrocellulose and nitroglycerin), steel (iron, chromium, copper, lead, manganese, nickel, aluminum) and cast iron (iron)
	60 mm, HE, M49	TNT, Ballistite (nitrocellulose and nitroglycerin), steel
	81 mm, HE, M43	TNT, Ballistite (nitrocellulose and nitroglycerin), forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
	60 mm, Practice, M50A2	Inert with black powder pellets, forged steel (iron, chromium, copper, lead, manganese, nickel, aluminum)
AOC	Munitions	Munitions Constituents
Burial Pit (cont.)	Riot Control Agents	No data sheets provided
	Less Sensitive Explosives (Ammonium Nitrate, Explosive D, etc.	No data sheets provided
	Chemical ID, Toxic Gas Set M2	28 Heat-sealed Ampoules with 3.8 ounces of Mustard
	Toxic Chemical Munitions	No data sheets provided
Chemical Training Area	AN-M8 Smoke Grenade HC	Hexachloroethane-zinc, steel sheet metal
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	M15, Smoke Grenade, WP	White Phosphorous, steel sheet metal (iron, chromium, copper, lead, manganese, nickel, aluminum)
	Pot Tear Gas M1	Chloracetophenone mixture
	Chemical Agent Identification Set (CAIS), M1, (K955)	Mustard, Lewisite, Chloropicrin, and Phosgene, Adamsite, chloracetophenone
	Chemical Agent Identification Set, Instructional (CAIS), M2 (K942)	28 Heat-sealed Ampoules with 3.8 ounces of Mustard
	Chemical Agent Identification Set, Instructional (CAIS), M1 (K941)	24 bottles of 32 ounces of Mustard, Chloropicrin, Lewisite, Adamsite, Chloracetophenone, Triphosgene
	Toxic Chemical Munitions	Mustard, distilled mustard

Sources: USACE, 1995 and 2004b.

Table 2-2
Army Checklist for Important Ecological Places ^a
Camp Abbot

		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"/>	Numerous T&E species may occur on or near the Site, as identified by USFWS and ODFW (USACE, 1995).
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"/>	
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"/>	

Table 2-2 (Cont.)

		Yes / No	Comments
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"/>	Numerous T&E species may occur on or near the Site, as identified by USFWS and ODFW (USACE, 1995).
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 checked="" type="checkbox"/> / <input type="checkbox"/>	The Deschutes River that flows through the site is a federally designated Wild and Scenic River.
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 checked="" type="checkbox"/> / <input type="checkbox"/>	Several linear miles of wetlands occur within and near the site.
33	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Soils at the site are generally very thin to absent, with surface outcroppings of volcanic rocks.

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

**Table 5-A
Summary of Camp Abbot Background Values**

Metal	Soil Background Concentration 95th UTL/95th Percentile ^a (Based on 10 Samples) (mg/kg)	Sediment Background Concentration Based on 1 Sample ^b (mg/kg)	Groundwater Background Concentration Based on 1 Sample ^b (ug/L)	Surface Water Background Concentration Dissolved Fraction Based on 1 Sample ^b (ug/L)	Surface Water Background Concentration Total Fraction Based on 1 Sample ^b (ug/L)
Aluminum	26,600	17300	<80.2	<44.3	<21.2
Antimony	< 0.93	<0.16	<0.13	<0.13	<0.13
Barium	176	111	4.3	3.6	<2.9
Cadmium	0.59	0.25	<0.17	<0.17	<0.17
Chromium	19.2	30.8	<1.3	<1.3	<1.3
Cobalt	13	7.2	<0.086	<0.063	<0.032
Copper	23.7	25.8	<2.1	<2.1	6.4
Iron	21,300	14100	146	71.9	<5.5
Lead	4.2	3.7	<0.18	0.33	0.43
Magnesium	17,700	1850	2100	2020	7150
Manganese	586	175	9.9	4.3	1.1
Mercury	0.022	<0.0082	<0.046	<0.058	<0.035
Molybdenum	1.8 ^c	<0.28	<0.37	<0.32	<0.47
Nickel	42.4	31.4	0.39	0.61	0.37
Zinc	43.5	29.3	<0.189	<13.2	<12

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.

ug/L - micrograms per liter

UTL - Upper tolerance limit.

< - analytical result was less than value indicated

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

^b Background sample analytical results provided in Appendix G

^c Statistics based on 8 samples

**Table 5-1
Summary of Site Inspection Samples Collected
Camp Abbot**

Location	Sample Number	UTM Northing	UTM Easting	Sample Purpose	Matrix	Sample Date	Start Depth (ft)	End Depth (ft)	Laboratory Sample Number	Lead by SW-846 6020A	Perchlorate by LC/MS *	TAL Metals by SW-846 6020A	Selected Metals ** by SW-846 6020A	Mercury by SW-846 7470A/7471A	Explosives by SW-846 8330A	Nitroglycerine and PETN by SW-846 8330A (Modified)
Range Complex No. 1																
013A001	NWO-013-0001	4858093	621600	REG	SS	26-Sep-06	0.08	0.5	610006-005	X						
	NWO-013-0002	4858093	621600	FD	SS	26-Sep-06	0.08	0.5	610006-004	X						
013A002	NWO-013-0003	4858487	621288	REG	SS	23-Sep-06	0.08	0.5	609148-005	X						
013A003	NWO-013-0004	4859863	622550	REG	SS	26-Sep-06	0.08	0.5	610006-001	X						
013A004	NWO-013-0005	4860031	622913	REG	SS	27-Sep-06	0.08	0.5	609148-016				X	X	X	X
013A005	NWO-013-1001	4857972	622045	REG	SD	26-Sep-06	0.08	0.3	610006-003	X						
013A006	NWO-013-1002	4860136	623200	REG	SD	27-Sep-06	0.08	0.3	609148-017				X	X	X	X
013A008	NWO-013-3001	4858066	622282	REG	GW	27-Sep-06	0	0	610002-001		X		X	X	X	X
Anti-Tank Range																
013A007	NWO-013-0006	4859336	623819	REG	SS	25-Sep-06	0.08	0.5	609148-010				X	X	X	X
Demolition Area																
013A009	NWO-013-0007	4863123	623435	REG	SS	25-Sep-06	0.08	0.5	609148-011							X
Mortar Range																
013A010	NWO-013-0008	4861954	623515	REG	SS	25-Sep-06	0.08	0.25	609148-012				X	X	X	X
013A011	NWO-013-0009	4862772	624323	REG	SS	27-Sep-06	0.08	0.5	609148-018				X	X	X	X
013A012	NWO-013-1003	4862888	624959	REG	SD	27-Sep-06	0.08	0.3	609148-019				X	X	X	X
	NWO-013-1005	4862888	624959	FD	SD	27-Sep-06	0.08	0.3	609148-020				X	X	X	X
013A014	NWO-013-2003	4862892	624969	REG	SW	27-Sep-06	0	0	610002-002 610002-005 (Filtered)		X		X	X	X	X
Background Samples																
013A020	NWO-013-5001	4858714	618507	REG	SS	23-Sep-06	0.08	0.5	609148-006			X		X		
013A021	NWO-013-5002	4860037	619058	REG	SS	23-Sep-06	0.08	0.5	609148-009			X		X		
013A022	NWO-013-5003	4860555	618763	REG	SS	23-Sep-06	0.08	0.5	609148-008			X		X		
013A023	NWO-013-5004	4862801	618569	REG	SS	23-Sep-06	0.08	0.5	609148-007			X		X		
013A024	NWO-013-5005	4861453	627964	REG	SS	23-Sep-06	0.08	0.5	609148-002			X		X		
013A025	NWO-013-5006	4861025	628306	REG	SS	23-Sep-06	0.08	0.5	609148-001			X		X		
013A026	NWO-013-5007	4859378	628478	REG	SS	23-Sep-06	0.08	0.5	609148-003			X		X		
013A027	NWO-013-5008	4856917	627046	REG	SS	23-Sep-06	0.08	0.5	609148-004			X		X		
013A028	NWO-013-5009	4859995	624682	REG	SS	26-Sep-06	0.08	0.5	610006-002			X		X		
013A029	NWO-013-5010	4859265	624521	REG	SS	25-Sep-06	0.08	0.5	609148-013			X		X		
	NWO-013-5011	4859265	624521	FD	SS	25-Sep-06	0.08	0.5	609148-014			X		X		
013A030	NWO-013-5012	4857999	624196	REG	SD	25-Sep-06	0	0.17	609148-015			X		X		
013A031	NWO-013-6001	4857997	624185	REG	SW	25-Sep-06	0	0	610002-004 610002-006 (Filtered)		X	X		X		
013A032	NWO-013-6002	4857309	621727	REG	GW	28-Sep-06	0	0	610002-003		X	X		X		

Notes:

* DataChem internal standard operating procedure "LC/MS-CLO4-Rev2."

** Selected metals are aluminum, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, mercury, nickel, and zinc.

FD - field duplicate
ft - feet
GW - groundwater
REG - regular field sample
SDG - sample delivery group
SS - surface soil (< 0.5ft bgs)
SD - sediment
SW - surface water
TAL - target analyte list
UTM - Universal Transverse Mercator

**Table 5-2
Summary of PA/SI Sampling
Camp Abbot**

PA/SI Sample ID	UTM Northing	UTM Easting	Matrix	Sample Date	Sample Depth Start (ft)	Sample Depth End (ft)	Perchlorate	TAL Metals plus Mercury	Pesticides/PC Bs	SVOCs	NBEC
Landfill Samples											
CAFD-SS-LF001	4860383.83	624681.6	SS	14-May-04	0	0.5		X	X	X	
CAFD-SS-LF002	4860383.83	624681.6	SS	14-May-04	0.5	2		X	X	X	
CAFD-SW-LF001	4860333.52	624667.07	SW	14-May-04	0	0.25		X	X	X	
CAFD-SD-LF004	4860331.93	624677.61	SD	14-May-04	0	0.5		X	X	X	
Range Complex No. 1											
CAFD-SS-MR001	4859530.73	623885.04	SS	14-May-04	0	0.5		X			
CAFD-SS-MR002	4859417.31	623879.94	SS	14-May-04	0	0.5		X			
CAFD-SS-MR003	4859403.82	623961.16	SS	14-May-04	0	0.5		X			
CAFD-SS-RR001	4858852.12	624088.2	SS	14-May-04	0	0.5		X			
CAFD-SS-RR002	4858871.61	624061.26	SS	14-May-04	0	0.5		X			
CAFD-SS-RR003	4858969.95	624060.17	SS	14-May-04	0	0.5		X			
CAFD-SS-RR004	4858570.64	623992.21	SS	16-May-04	0	0.5		X			
CAFD-SS-RR005	4858493.26	623982.66	SS	16-May-04	0	0.5		X			
CAFD-SS-RR006	4858585.82	623914.16	SS	16-May-04	0	0.5		X			
CAFD-SD-MR001	4859573.29	623822.85	SD	16-May-04	0	0.25		X			
CAFD-SD-RR001	4859009.48	623989.78	SD	16-May-04	0	0.25		X			
CAFD-SD-RR002	4858558.94	623797.51	SD	16-May-04	0	0.25		X			
Explosive Munitions Ranges											
CAFD-SS-DP001	4863163.46	623450.8	SS	15-May-04	0	0.5		X			X
CAFD-SS-DP002	4863160.88	623420.02	SS	15-May-04	0	0.25		X			X
CAFD-SS-DP003	4863172.31	623431.83	SS	15-May-04	0	0.33		X			X
CAFD-SD-DP001	4862476.27	624588.73	SD	15-May-04	0	0.25		X			X
Grenade Court											
CAFD-SS-GC001	4858139.91	623455.83	SS	16-May-04	0	0.25		X			X
CAFD-SS-GC002	4858129.23	623479.43	SS	16-May-04	0	0.25		X			X
CAFD-SS-GC003	4858061.55	623455.38	SS	16-May-04	0	0.25		X			X
CAFD-SD-GC001	4858236.53	623553.34	SD	16-May-04	0	0.18		X			X
Camp Abbot Groundwater											
CAFD-GW-MW001	4859781.2	625171.72	GW	16-May-04	-	-	X				X

Notes:

ft - feet

GW - groundwater

NBEC - nitrogen-based explosive compounds

PCBs - polychlorinated biphenyls

SS - soil

SD - sediment

SVOCs - semivolatile organic compounds

SW - surface water

TAL - target analyte list

UTM - Universal Transverse Mercator Zone 10

Source: *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report (Weston 2005).*

Table 5-3
Range Complex No.1
Groundwater Analytical Detections and Comparison to Background
and Human Health Screening Values

Location							013A008	
Sample Date							27-Sep-06	
Sample Number							NWO-013-3001	
Sample Purpose							REG	
Fraction	Parameter	Filtered	Units	Maximum Concentration from Media Background Sample	EPA Region 9 PRGs - Tap Water	Federal Drinking Water Criteria MCLs	Result	VQ
Metals	Iron	N	ug/L	146	11000	300	38	J
Metals	Lead	N	ug/L	<0.18	No criteria	15	0.44	J
Metals	Magnesium	N	ug/L	2100	No criteria	No criteria	3140	
Metals	Manganese	N	ug/L	9.9	880	50	4.4	
Metals	Molybdenum	N	ug/L	<0.37	180	No criteria	0.72	J
Metals	Nickel	N	ug/L	0.39	730	No criteria	0.37	J

Notes:

[Bold Face] - Result exceeds Maximum Concentration from Media Background Sample

< - less than indicated value

EPA - Environmental Protection Agency

PRG - Preliminary Remediation Goal

MCL - Maximum Contaminant Level

REG - regular sample

ug/L - microgram per liter

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.

Table 5-4
Range Complex No. 1
Sediment Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values

Location						013A005		013A006		PA/SI		PA/SI		SRR	
Sample Date						26-Sep-06		27-Sep-06		16-May-04		16-May-04		16-May-04	
Sample Number						NWO-013-1001		NWO-013-1002		SD-MR001		SD-RR001		SD-RR002	
Sample Depth (bgs) (ft)						0.08 to 0.3		0.08 to 0.3		0 - 0.25		0 - 0.25		0 - 0.25	
Sample Purpose						REG		REG		REG		REG		REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	111	48	No criteria			<i>162</i>		79.5		92.2		70.9	
Metals	Chromium	mg/kg	30.8	37	210			14.2		13.1		28.4		12.2	
Metals	Copper	mg/kg	25.8	10	3100			<i>17.4</i>		24.7	JK	<i>27.4</i>	JK	20.7	JK
Metals	Iron	mg/kg	14100	20	23000			<i>20300</i>		<i>17900</i>		<i>18100</i>		7980	
Metals	Lead	mg/kg	3.7	35	400	3.7		3.9		352		2.2		3.3	
Metals	Magnesium	mg/kg	1850	No criteria	No criteria			2680		2970		6690		1890	
Metals	Manganese	mg/kg	175	1100	1800			463		213		197		86.4	
Metals	Mercury	mg/kg	<0.0082	0.2	23			0.016	J	0.07	BJK	<0.21	U	<0.14	U
Metals	Molybdenum	mg/kg	<0.28	No criteria	390			0.44	J	NA		NA		NA	
Metals	Nickel	mg/kg	31.4	18	1600			<i>24.4</i>		27.2		30.6		23.7	
Metals	Zinc	mg/kg	29.3	3	23000			36.8		28.3		52.2		36.5	

Notes:

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

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041* , Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

NA - not analyzed for analyte

ND - not detected

PRG - Preliminary Remediation Goal

REG - regular sample

VQ - validation qualifier

Validation Qualifier Definitions

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

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

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-5
Range Complex No. 1
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						013A001		013A001		013A002		013A003		013A004	
Sample Date						26-Sep-06		26-Sep-06		23-Sep-06		26-Sep-06		27-Sep-06	
Sample Number						NWO-013-0001		NWO-013-0002		NWO-013-0003		NWO-013-0004		NWO-013-0005	
Sample Depth (bgs) (ft)						0.08 to 0.5		0.08 to 0.5		0.08 to 0.5		0.08 to 0.5		0.08 to 0.5	
Sample Purpose						REG		FD		REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ								
Metals	Barium	mg/kg	176	85	No criteria									146	
Metals	Chromium	mg/kg	19.2	0.4	210									15.3	
Metals	Copper	mg/kg	23.7	50	3100									16.9	
Metals	Iron	mg/kg	21300	200	23000									20800	
Metals	Lead	mg/kg	4.2	16	400	4.3		4.3		4.6		6.3		7.7	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria									2940	
Metals	Manganese	mg/kg	586	100	1800									372	
Metals	Mercury	mg/kg	0.022	0.1	23									<0.0084	U
Metals	Molybdenum	mg/kg	1.8	2	390									0.41	J
Metals	Nickel	mg/kg	42.4	30	1600									26.6	
Metals	Zinc	mg/kg	43.5	50	23000									36.7	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

FD - field duplicate

mg/kg - milligram per kilogram

NA - not analyzed

ND - not detected

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

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

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

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-5
Range Complex No. 1
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						PA/SI Sample		PA/SI Sample		PA/SI Sample		SRR Samp 1		SRR Samp 2	
Sample Date						14-May-04		14-May-04		14-May-04		16-May-04		16-May-04	
Sample Number						SS-RR001		SS-RR002		SS-RR003		SS-RR004		SS-RR005	
Sample Depth (bgs) (ft)						0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5	
Sample Purpose						REG		REG		REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	93.6		97.9		111		92.3		88.7	
Metals	Chromium	mg/kg	19.2	0.4	210	14.3		13.4		13		12		10.3	
Metals	Copper	mg/kg	23.7	50	3100	26.8	JK	20.7	JK	22.2	JK	23.4	JK	23.1	JK
Metals	Iron	mg/kg	21300	200	23000	13300		9690		10900		8280		5470	
Metals	Lead	mg/kg	4.2	16	400	2.2		2.6		2.4		2.9		3.5	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	2110		1430		2730		2760		1950	
Metals	Manganese	mg/kg	586	100	1800	145		175		145		215		87.2	
Metals	Mercury	mg/kg	0.022	0.1	23	0.07	BJK	0.1	BJK	<0.15	U	0.07	BJK	0.11	BJK
Metals	Molybdenum	mg/kg	1.8	2	390	NA		NA		NA		NA		NA	
Metals	Nickel	mg/kg	42.4	30	1600	23.6		16.9		21.3		24.1		20.3	
Metals	Zinc	mg/kg	43.5	50	23000	54.9		36.4		33		39.1		29.6	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041, Shaw Environmental, Inc., S

< - less than indicated value

EPA - Environmental Protection Agency

FD - field duplicate

mg/kg - milligram per kilogram

NA - not analyzed

ND - not detected

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

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

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

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from Camp Abbot FUDS Preliminary Assessment/Site Inspection Report (Weston 2005).

Table 5-5
Range Complex No. 1
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values

Location						SRR Samp 3		MGR Samp 1		MGR Samp 2		MGR Samp 3	
Sample Date						16-May-04		14-May-04		14-May-04		14-May-04	
Sample Number						SS-RR006		SS-MR001		SS-MR002		SS-MR003	
Sample Depth (bgs) (ft)						0 - 0.5		0 - 0.5		0 - 0.5		0 - 0.5	
Sample Purpose						REG		REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	67.6		66.3		128		105	
Metals	Chromium	mg/kg	19.2	0.4	210	14.9		11.3		10.5		13.2	
Metals	Copper	mg/kg	23.7	50	3100	24	JK	16	JK	19.1	JK	27.2	JK
Metals	Iron	mg/kg	21300	200	23000	17700		10100		14700		17900	
Metals	Lead	mg/kg	4.2	16	400	1.7		4.8		6.3		24	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	8170		3500		2560		29.5	
Metals	Manganese	mg/kg	586	100	1800	252		214		429		374	
Metals	Mercury	mg/kg	0.022	0.1	23	0.1	BJK	0.96		0.06	BJK	<0.13	U
Metals	Molybdenum	mg/kg	1.8	2	390	NA		NA		NA		NA	
Metals	Nickel	mg/kg	42.4	30	1600	38.1		23.9		20.1		23.4	
Metals	Zinc	mg/kg	43.5	50	23000	45.8		27.2		72.8		65.7	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041, Shaw Environmental, Inc., S

< - less than indicated value

EPA - Environmental Protection Agency

FD - field duplicate

mg/kg - milligram per kilogram

NA - not analyzed

ND - not detected

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

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

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

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

U - not detected above indicated value

PA/SI Report Data are from Camp Abbot FUDS Preliminary Assessment/Site Inspection Report (Weston 2005).

Table 5-6
Explosive Munitions Ranges Surface Water Analytical Detections (Total)
and Comparison to Background, Human Health, and Ecological Screening Values

Location								013A014	
Sample Date								27-Sep-06	
Sample Number								NWO-013-2003	
Sample Purpose								REG (Total)	
Fraction	Parameter	Filtered	Units	Maximum Concentration from Media Background Sample (Total)	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Tap Water	Federal Drinking Water Criteria MCLs	Result	VQ
Metals	Iron	N	ug/L	<5.5	1000	11000	300	56.7	
Metals	Lead	N	ug/L	0.43	2.5	No criteria	15	0.24	J
Metals	Magnesium	N	ug/L	7150	82000	No criteria	No criteria	2120	
Metals	Manganese	N	ug/L	1.1	120	880	50	6.5	
Metals	Molybdenum	N	ug/L	<0.47	370	180	No criteria	0.5	J
Metals	Nickel	N	ug/L	0.37	52	730	No criteria	0.38	J

Notes:

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F100R0041*, Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

MCL - Maximum Contaminant Level

PRG - Preliminary Remediation Goal

REG - regular sample

ug/L - microgram per liter

VQ - validation qualifier

Validation Qualifier Definitions

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

**Table 5-7
Explosive Munitions Ranges Surface Water Analytical Detections (Dissolved)
and Comparison to Background, Human Health, and Ecological Screening Values**

Location								013A014	
Sample Date								27-Sep-06	
Sample Number								NWO-013-2003	
Sample Purpose								REG (Dissolved)	
Fraction	Parameter	Filtered	Units	Maximum Concentration from Media Background Sample (Dissolved)	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Tap Water	Federal Drinking Water Criteria MCLs	Result	VQ
Metals	Barium	Y	ug/L	3.6	4	No criteria	No criteria	3.3	J
Metals	Iron	Y	ug/L	71.9	1000	11000	300	95.5	
Metals	Lead	Y	ug/L	0.33	2.5	No criteria	15	0.33	J
Metals	Magnesium	Y	ug/L	2020	82000	No criteria	No criteria	2180	
Metals	Manganese	Y	ug/L	4.3	120	880	50	7.3	
Metals	Nickel	Y	ug/L	0.61	52	730	No criteria	0.35	J

Notes:

[Bold Face] - Result exceeds Maximum Concentration from Media Background Sample

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

MCL - Maximum Contaminant Level

PRG - Preliminary Remediation Goal

REG - regular sample

ug/L - microgram per liter

VQ - validation qualifier

Validation Qualifier Definitions

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

**Table 5-8
Explosive Munitions Ranges
Sediment Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						013A012		013A012		Demo Pit	
Sample Date						27-Sep-06		27-Sep-06		14-May-04	
Sample Number						NWO-013-1003		NWO-013-1005		SD-DP001	
Sample Depth (bgs) (ft)						0.08 to 0.3		0.08 to 0.3		0 - 0.25	
Sample Purpose						REG		FD		REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	111	48	No criteria	65		61.8		43.3	BJK
Metals	Chromium	mg/kg	30.8	37	210	14.1		12.5		7.4	
Metals	Copper	mg/kg	25.8	10	3100	10		10.3		21.2	JK
Metals	Iron	mg/kg	14100	20	23000	16500		16700		2830	
Metals	Lead	mg/kg	3.7	35	400	3.7		3.2		2.9	
Metals	Magnesium	mg/kg	1850	No criteria	No criteria	2860		2400		733	BJK
Metals	Manganese	mg/kg	175	1100	1800	163		174		20.1	
Metals	Mercury	mg/kg	<0.0082	0.2	23	0.0088	U	0.0065	U	0.11	BJK
Metals	Nickel	mg/kg	31.4	18	1600	23.8		20.5		13.2	
Metals	Zinc	mg/kg	29.3	3	23000	39.8		38.9		10.6	BJK

Notes:

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

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

< - less than indicated value

EPA - Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

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.

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.

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

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-9
Explosive Munitions Ranges
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						013A007	013A010	013A011	PA/SI Sample				
Sample Date						25-Sep-06	25-Sep-06	27-Sep-06	15-May-04				
Sample Number						NWO-013-0006	NWO-013-0008	NWO-013-0009	SS-DP001				
Sample Depth (bgs) (ft)						0.08 to 0.5	0.08 to 0.25	0.08 to 0.5	0 - 0.5				
Sample Purpose						REG	REG	REG	REG				
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	87.3		137		198		191	
Metals	Chromium	mg/kg	19.2	0.4	210	16.4		18.5		22.3		13.9	
Metals	Copper	mg/kg	23.7	50	3100	19		16.1		23.3		19.7	JK
Metals	Iron	mg/kg	21300	200	23000	17400		<u>23500</u>		<u>28800</u>		<u>23400</u>	
Metals	Lead	mg/kg	4.2	16	400	27.8		4.1		4.3		3	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	1510	J	2470		5400		3690	
Metals	Manganese	mg/kg	586	100	1800	187		475		496		524	
Metals	Mercury	mg/kg	0.022	0.1	23	0.027		0.015	J	0.027		0.12	U
Metals	Molybdenum	mg/kg	1.8	2	390	0.28	J	0.69	J	0.45	J	NA	
Metals	Nickel	mg/kg	42.4	30	1600	25.6		24.7		40		26.4	
Metals	Zinc	mg/kg	43.5	50	23000	37		37.1		40.2		38.8	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041* , Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

NA - analyte not analyzed for

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

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.

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.

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

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

Table 5-9
Explosive Munitions Ranges
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values

Location						PA/SI Sample		PA/SI Sample	
Sample Date						15-May-04		15-May-04	
Sample Number						SS-DP002		SS-DP003	
Sample Depth (bgs) (ft)						0 - 0.25		0 - 0.33	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	<i>145</i>		262	
Metals	Chromium	mg/kg	19.2	0.4	210	8.8		<i>13.5</i>	
Metals	Copper	mg/kg	23.7	50	3100	13.9	JK	20.4	JK
Metals	Iron	mg/kg	21300	200	23000	<i>15300</i>		<i>20800</i>	
Metals	Lead	mg/kg	4.2	16	400	3.5		3.7	
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	2340		2140	
Metals	Manganese	mg/kg	586	100	1800	<i>523</i>		645	
Metals	Mercury	mg/kg	0.022	0.1	23	0.13	U	0.12	U
Metals	Molybdenum	mg/kg	1.8	2	390	NA		NA	
Metals	Nickel	mg/kg	42.4	30	1600	16.6		19.3	
Metals	Zinc	mg/kg	43.5	50	23000	38.1		48.1	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

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

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F100R0041* , Shaw Environmental, Inc., Septer

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

NA - analyte not analyzed for

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

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.

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.

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

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

Table 5-10
Grenade Courts
Sediment Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values

Location						PA/SI Sample	
Sample Date						16-May-04	
Sample Number						SD-GC001	
Sample Depth (bgs) (ft)						0 - 0.17	
Sample Purpose						REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level^a	EPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Barium	mg/kg	111	48	No criteria	89.6	
Metals	Chromium	mg/kg	30.8	37	210	21.1	
Metals	Copper	mg/kg	25.8	10	3100	27.5	JK
Metals	Iron	mg/kg	14100	20	23000	15500	
Metals	Magnesium	mg/kg	1850	No criteria	No criteria	1900	
Metals	Manganese	mg/kg	175	1100	1800	85.2	
Metals	Nickel	mg/kg	31.4	18	1600	34.4	
Metals	Zinc	mg/kg	29.3	3	23000	21.9	

Notes:

[Bold Face] - Result exceeds Maximum Concentration from Media Background Sample

[Italicized] - Result exceeds Site Inspection Ecological Screening Level

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041* , Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

PRG - Preliminary Remediation Goal

REG - regular sample

VQ - validation qualifier

Validation Qualifier Definitions

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

BJK - The inorganic analyte was positively identified. The associated numerical value is an unknown bias estimate.

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).

**Table 5-11
Grenade Courts
Soil Analytical Detections and Comparison to Background,
Human Health, and Ecological Screening Values**

Location						PA/SI Sample		PA/SI Sample		PA/SI Sample	
Sample Date						16-May-04		16-May-04		16-May-04	
Sample Number						SS-GC001		SS-GC002		SS-GC003	
Sample Depth (bgs) (ft)						0 - 0.25		0 - 0.25		0 - 0.25	
Sample Purpose						REG		REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level ^a	EPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ
Metals	Barium	mg/kg	176	85	No criteria	<i>118</i>		<i>102</i>		<i>119</i>	
Metals	Chromium	mg/kg	19.2	.4	210	<i>11.5</i>		<i>13.9</i>		<i>12.5</i>	
Metals	Copper	mg/kg	23.7	50	3100	15.6	JK	15.8	JK	16	JK
Metals	Iron	mg/kg	21300	200	23000	<i>16500</i>		<i>19100</i>		<i>18500</i>	
Metals	Lead	mg/kg	4.2	16	400	2	JK	1.5	UJK	2	UJK
Metals	Magnesium	mg/kg	17700	No criteria	No criteria	4980		6180		5810	
Metals	Manganese	mg/kg	586	100	1800	<i>303</i>		<i>318</i>		<i>392</i>	
Metals	Nickel	mg/kg	42.4	30	1600	<i>30.2</i>		<i>35.9</i>		<i>32.7</i>	
Metals	Zinc	mg/kg	43.5	50	23000	31.1		34.2		31.3	

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

[*Italicized*] - Result exceeds Site Inspection Soil Ecological Screening Levels

a - Source - *Final Site-Specific Work Plan, Camp Abbot, FUDS ID F10OR0041*, Shaw Environmental, Inc., September 2006

EPA - Environmental Protection Agency

mg/kg - milligram per kilogram

PRG - Preliminary Remediation Goals

REG - regular sample

UTL - upper tolerance limit

VQ - validation qualifier

Validation Qualifier Definitions

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

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

PA/SI Report Data are from *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report* (Weston 2005).