



U.S. Army  
Corps of Engineers  
Omaha District



# DRAFT FINAL SITE INSPECTION REPORT

## Fort Flagler Military Reservation

### Jefferson County, WA

#### FUDS PROPERTY No. F10WA0316

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

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

July 2007



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

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**Fort Flagler Military Reservation**  
FUDS Property No. F10WA0316

Formerly Used Defense Sites  
Military Munitions Response Program

July 2007

Submitted to:

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

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## List of Acronyms

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°F	degrees Fahrenheit
ADR	Automated Data Review
AOC	area of concern
ARC	Defense Environmental Programs Fiscal Year 2006 Annual Report to Congress
ASR	Archives Search Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CN	chloroacetophenone
CSM	conceptual site model
DERP	Defense Environmental Restoration Program
DMM	discarded military munitions
DoD	Department of Defense
DOO	data quality objective
EOD	Explosive Ordnance Disposal
EDR	Environmental Data Resources, Inc.
EPA	Environmental Protection Agency
ER	Engineering Regulation
FR	Federal Register
ft	foot or feet
Ft. Flagler	Fort Flagler Military Reservation
FUDS	Formerly Used Defense Sites
GPL	GPL Laboratories, LLLP
GPS	Global Positioning System
HE	high explosive
HRS	Hazard Ranking System
HTRW	hazardous, toxic, or radioactive wastes
INPR	Inventory Project Report
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mg/kg	milligram(s) per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MTCA	State of Washington Model Toxics Control Act
NCP	National Contingency Plan
NDAI	No Department of Defense Action Indicated
NWO	Northwest Region (Omaha District Military Munitions Design Center)

## *List of Acronyms (Cont.)*

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OB/OD	open burning/open demolition
PETN	pentaerythritol tetranitrate
PRG	Preliminary Remediation Goals
PSAP	Program Sampling and Analysis Plan
QA/QC	quality assurance/quality control
RAC	Risk Assessment Code
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
SLERA	Screening-Level Ecological Risk Assessment
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SOP	standard operating procedures
SSWP	Site-Specific Work Plan
State Parks	Washington State Parks and Recreation Commission
TCRA	time-critical removal action
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USC	United States Code
USGS	United States Geological Survey
UTL	upper tolerance limit
UXO	unexploded ordnance
WA	Washington
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology

## *Glossary of Terms*

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### **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# 1 *Executive Summary*

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

## 10 *SI Objectives and Scope*

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

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

## 24 *Fort Flagler Military Reservation*

25 This report presents the results of an SI conducted at Fort Flagler Military Reservation (Ft.  
26 Flagler), FUDS property number F10WA0316, located on the west side of Puget Sound near Port  
27 Townsend in Jefferson County, Washington. Ft. Flagler was acquired by the U.S. Government  
28 in 1866 and a coastal defense artillery battery was constructed beginning in 1897. The coastal  
29 defense batteries were closed in 1945. Between 1942 and 1953, Ft. Flagler was used for  
30 amphibious training and maneuvers. Ft. Flagler was decommissioned in 1953 and the property  
31 was transferred in 1954 to the State of Washington for use as a state park.

## 32 *Technical Project Planning*

33 The approach for the SI was developed by Shaw in consultation with site stakeholders. A  
34 Technical Project Planning meeting conducted in July 2006 was attended by representatives from  
35 the USACE Omaha Design Center, USACE Seattle District, the Washington Department of

36 Ecology (WDOE), Washington State Parks and Recreation Commission (State Parks), and Shaw.  
37 The stakeholders agreed to the approach and identified 11 areas of concern (AOCs), the Range  
38 Complex (which includes all of the coastal artillery batteries), Ammunition Bunker, Transition  
39 Range 1, Transition Range 2, Gas Chamber, Rifle Grenade/Anti-Tank Rocket Range, Live  
40 Grenade Court, Practice Grenade Court, Rifle Range, Demolition Area, and Quartermaster  
41 Wharf Disposal Area, for further evaluation in the SI.

#### 42 SI Field Activities

43 SI field activities, conducted in February 2007, included a site reconnaissance to look for  
44 evidence of MEC and to avoid MEC during sampling. Samples were collected from surface soil  
45 and sediment.

#### 46 SI Recommendations

47 Results of the SI provide the basis for conclusions and/or recommendations for further actions at  
48 each of the ranges identified in the MMRP Range Inventory.

#### 49 *Range Complex*

50 The Range Complex consists of the nine artillery batteries, Transition Range 1, and the Gas  
51 Chamber. Based on historical evidence including the configuration, and limited use of the  
52 batteries, it is unlikely that munitions would have been discarded. Results from the SI field  
53 reconnaissance activities indicate there is no evidence of MEC at the Range Complex.  
54 Therefore, a recommendation for NDAI with respect to MEC is made for the Range Complex  
55 No sampling was conducted at the nine artillery batteries or Gas Chamber within the Range  
56 Complex. Significant MC from firing the artillery guns is unlikely because of infrequent use and  
57 the extended time period since use stopped. Residue from the gas used (CN-1) at the gas  
58 chamber is not expected as well. Soil and sediment sampling for lead was completed within  
59 Transition Range 1. Analytical results show that lead concentrations in soil and sediment were  
60 below background concentrations or human health and ecological screening values. Therefore, a  
61 recommendation for NDAI for MC is made for the Range Complex

#### 62 *Transition Range 2*

63 Based on historical use of the range and results of the SI field activities, there is no evidence of  
64 MEC or munitions debris (other than small arms use) at the Transition Range 2. Analytical  
65 results from soil and sediment sampling indicated that lead concentrations were below  
66 background concentrations. A recommendation for NDAI for both MEC and MC is made for  
67 Transition Range 2.

#### 68 *Rocket Range*

69 Based on historical use of the Rocket Range, previous clearance activities, and results of the SI  
70 field activities, there is evidence of MEC at this range and a moderate risk to park users.  
71 Therefore, a recommendation for RI/FS for MEC is made for the Rocket Range.

72 Analytical results from three soil samples and one sediment sample did not exceed background.  
73 Therefore, a recommendation for NDAI for MC is made for the Rocket Range.

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

#### 76 *Additional Munitions Response Sites*

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

#### 81 *Ammunition Bunker*

82 The Ammunition Bunker is not recommended to be identified as an MRS. The Ammunition  
83 Bunker is also located within the boundaries of MRS No.1 - Range Complex. While the AOC  
84 was shown on a War Department map from 1945, no evidence of the bunker could be found at  
85 the location indicated on the map. There is no evidence that the Ammunition Bunker has any  
86 MEC or MC associated with it.

#### 87 *Live Grenade Court*

88 The Live Grenade Court is recommended to be identified as an MRS. The Live Grenade Court  
89 is not within one of the existing MRSs. While no evidence of the court (throwing bays, impact  
90 area) was identified in the field due to very heavy vegetation growth, the trees at the reported  
91 location indicate that it was once cleared (younger growth forest than surrounding forest). In  
92 addition, the reported former use as a live grenade court suggests a potential for MEC and MC  
93 risk. If the Live Grenade Court is identified as an MRS, additional investigations for MEC and  
94 MC are recommended.

#### 95 *Practice Grenade Court*

96 The Practice Grenade Court is recommended to be identified as an MRS. The Practice Grenade  
97 Court is not within one of the existing MRSs. While no evidence of the court (throwing bays,  
98 impact area) was identified in the field due to very heavy vegetation growth, the trees at the  
99 reported location indicate that it was once cleared (younger growth forest than surrounding  
100 forest). In addition, the reported former use as a practice grenade court suggests a potential for  
101 MEC and MC risk. If the Practice Grenade Court is identified as an MRS, additional  
102 investigations for MEC and MC are recommended.

#### 103 *Rifle Range*

104 The Rifle Range is recommended to be identified as an MRS. The Rifle Range is within the  
105 boundary of the MRS No. 1 - Range Complex. There is direct evidence that this range was used  
106 as a rifle range and the MC risk is present based on lead concentrations above site background,

107 human health, and ecological screening values. If the Rifle Range is identified as an MRS,  
108 additional investigations for MC are recommended.

109 *Demolition Area*

110 The Demolition Area is recommended to be identified as an MRS. The Demolition Area is not  
111 within one of the existing MRSs. The War Department map (Appendix L) identified this area as  
112 a “Demolition Area Rifle Grenade”, and it appears that the location was a beach area that has  
113 been backfilled. There is no apparent surface MEC risk at this location. However, there may be  
114 a subsurface MEC or MC risk. If the Demolition Area is identified as an MRS, additional  
115 investigations for MEC and MC are recommended.

116 *Quartermaster Wharf Disposal Area*

117 The Quartermaster Wharf Disposal Area is recommended to be identified as an MRS. The  
118 Quartermaster Wharf Area is within MRS No.1 the Range Complex. The area is thought to have  
119 been used for disposal of unwanted materials. Small arms ammunition has been found on the  
120 beach and other munitions may have been discarded there as well. There is a potential risk for  
121 MEC and MC from disposal of munitions. If the Quartermaster Wharf Disposal Area is  
122 identified as an MRS, additional investigations for MEC and MC are recommended.

## 123 **1.0 Introduction**

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

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

### 134 **1.1 Project Authorization**

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

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

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

### 152 **1.2 Site Name and Location**

153 Ft. Flagler, property number F10WA0316, is located on the west side of Puget Sound, 4 miles  
154 southeast of Port Townsend in Jefferson County, WA (Figure 1-1). The former Ft. Flagler is  
155 included in the MMRP Inventory in the *Defense Environmental Programs Fiscal Year 2006*

156 *Annual Report to Congress (ARC) (DoD, 2006) and in the Inventory Project Report (INPR)*  
 157 *Supplement (USACE, 2004b), with three identified ranges and eleven subranges as follows:*

<b>Range Name</b>	<b>Range Identifier</b>	<b>Approximate Area (acres)</b>	<b>UTM Coordinates (meters)<sup>1</sup></b>
Range Complex	F10WA031602R01	27,682	N 5331074; E 522671
Battery Bankhead	F10WA031602R01-SR01	17,973	N 5329672; E 523706
Battery Calwell	F10WA031602R01-SR02	5,684	N 5331074; E 521940
Battery Downes	F10WA031602R01-SR03	5,348	N 5332161; E 521004
Battery Gratton	F10WA031602R01-SR04	8,537	N 5326888; E 526837
Battery Lee	F10WA031602R01-SR05	5,375	N 5329733; E 525170
Battery Rawlins	F10WA031602R01-SR06	6,844	N 5331074; E 521940
Battery Revere	F10WA031602R01-SR07	7,320	N 5333898; E 519236
Battery Wansboro	F10WA031602R01-SR08	5,221	N 5326461; E526816
Battery Wilhelm	F10WA031602R01-SR09	8,299	N 5335138; E 517957
Transition Range 1	F10WA031602R01-SR10	41	N 5326035; E 522914
Gas Chamber	F10WA031602R01-SR11	11	N 5326441; E 522914
Rocket Range	F10WA031602R02	25	N 5326746; E 521086
Transition Range 2	F10WA031602R03	0	N 5326788; E 521932

158 Coordinates for the ranges are in Universal Transverse Mercator, Zone 10N, NAD 83.

159 Of the 27,682 total acres reported for the Range Complex, the INPR Supplement indicates 550  
 160 acres were on land and 27,132 acres were water acres. Due to overlapping range fans, the  
 161 acreage of the individual subranges is greater than the acreage of the Range Complex itself.  
 162 Figure 1-2 shows the ranges identified in the ARC.

163 Transition Range 1 and the Gas Chamber are evaluated separately in this SI to aid in the  
 164 evaluation of impacts. However, these two subranges of the Range Complex are included in the  
 165 MRSPP scoring of the Range Complex.

166 Additional areas at the former Ft. Flagler that were not identified in the INPR Supplement and  
 167 Range Inventory are evaluated in this SI. The additional areas are:

- 168 • Ammunition Bunker
- 169 • Live Grenade Court
- 170 • Practice Grenade Court
- 171 • Rifle Range
- 172 • Demolition Area, and
- 173 • Quartermaster Wharf Disposal Area.

174 These additional areas were identified in the *Archives Search Report (ASR)* (USACE, 1995) and  
175 from a War Department map (circa 1945) (Appendix L) that was obtained at the TPP meeting.

### 176 **1.3 Purpose, Scope, and Objectives of the Site Inspection**

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

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

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

- 195 • There is no indication of MEC;
- 196 and
- 197 • MC contamination does not exceed screening levels determined from Technical
- 198 Project Planning (TPP).

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

- 200 • There is evidence of MEC hazard. MEC hazard may be indicated by direct
- 201 observation of MEC during the SI, by indirect evidence (e.g., a false crater
- 202 potentially caused by impact of unexploded ordnance [UXO]), or by a report of
- 203 MEC being found in the past without record that the area was subsequently

204 cleared;  
205 or

- 206 • MC contamination exceeds screening levels determined from TPP.

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

- 208 • High MEC hazard is identified. Shaw will immediately report any MEC findings  
209 so that USACE can determine the hazard in accordance with the MRSPP. An  
210 example of a high hazard would be finding sensitive MEC at the surface in a  
211 populated area with no barriers to restrict access;  
212 or

- 213 • Elevated MC risk is identified. Identification of a complete exposure pathway  
214 (e.g., confirming MC concentrations above health-based risk standards in a water  
215 supply well) would trigger notification of affected stakeholders. Data would be  
216 presented at a second TPP meeting regarding the possible need for a TCRA.

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

#### 221 **1.4 Munitions Response Site Prioritization Protocol**

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

## 225 **2.0 Property Description and History**

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226 The setting, history, and use of Ft. Flagler are described in the following sections. Unless  
227 otherwise referenced, this information is taken from the ASR (USACE, 2005b).

### 228 **2.1 Historical Military Use**

229 Ft. Flagler (Figure 2-1) was used primarily for coastal defense installation between 1899 and  
230 1945. During World War II, the Navy also operated an underwater listening station at Ft.  
231 Flagler. Between 1942 and 1953, troops posted at Ft Flagler also received small arms and  
232 grenade training. In 1950, all harbor defenses around Puget Sound were decommissioned  
233 including Ft. Flagler. The site was used for amphibious training and maneuvers after the coastal  
234 artillery weapons were removed. In 1953, Ft. Flagler was closed and in 1954 the property was  
235 transferred to the State of Washington for use as a state park.

### 236 **2.2 Munitions Information**

237 The type of munitions used at Ft. Flagler consisted of:

- 238 • Coastal artillery batteries ranging in size from 3-inch to 12-inch,
- 239 • Small arms,
- 240 • 37-mm portable anti-aircraft guns,
- 241 • Mark II hand grenades,
- 242 • M21 practice hand grenades,
- 243 • .50-caliber machine guns, and
- 244 • 2.36-inch and 3.5-inch anti-tank rockets.

245 Table 2-1 contains a detailed list of the munitions and associated MC reportedly used at the areas  
246 of concern (AOCs).

### 247 **2.3 Ownership History**

248 The U.S. Government acquired 550 acres of land for Ft. Flagler in 1866. Construction of the  
249 first coastal batteries did not begin until 1897. Additional acreage was acquired over the years  
250 until the site grew to 809 acres. In 1953, Ft. Flagler was closed and in 1954 the property was  
251 transferred to the State of Washington for use as a state park.

252 Ft. Flagler has permanent residents (park employees) and offers camping facilities to recreational  
253 users. The area south of Ft. Flagler is populated with private residences. Figure 2-1 shows the  
254 current land use from an aerial photograph perspective. Parcel ownership within the identified  
255 range areas is shown on Figure 2-2.

256 **2.4 Physical Setting**

257 **2.4.1 Topography and Vegetation**

258 The Ft. Flagler FUDS lies within the Puget Trough Section of the Pacific Border Physiographic  
259 Province. The elevation of the area ranges from sea level to approximately 180 feet (ft) (Figure  
260 2-3).

261 **2.4.2 Land Use**

262 The FUDS is located entirely within the boundaries of the Ft. Flagler State Park and is currently  
263 owned by the Washington State Parks and Recreation Commission (State Parks) and the United  
264 States Geological Survey (USGS), which maintains an experimental station at the northeast tip of  
265 the site. Campgrounds, picnic areas, buildings, and visitor facilities are currently in use at the  
266 FUDS.

267 **2.4.3 Nearby Population**

268 The community nearest the former Ft. Flagler is Port Townsend, WA, with an estimated  
269 population of 8,334 (U.S. Census, 2000) (Figure 2-4). Jefferson County has a 2000 estimated  
270 population of 28,666 or approximately 15.4 people per square mile. There are 212 household  
271 and 280 housing units within a 2-mile radius of the site, and 5,620 households and 6,342 housing  
272 units within a 4-mile radius of the site. Estimated population (2000 census) within a 2-mile  
273 radius and 4-mile radius of the Ft. Flagler FUDS property boundary is 361 and 12,204,  
274 respectively.

275 **2.4.4 Climate**

276 The climate at Ft. Flagler FUDS is a west coast marine type with comparatively cool, dry  
277 summers and mild but wet and cloudy winters. The area is within the “rain shadow” of the  
278 Olympic Mountains and is the driest area in western Washington State. The wettest months are  
279 generally November and December, with the driest months being July and August. The highest  
280 monthly average temperature for Port Townsend is 72.2 degrees Fahrenheit (°F) in August and  
281 the lowest monthly average temperature is 36.3 °F in January. Port Townsend’s average annual  
282 precipitation is 19.12 inches per year, with an average annual snowfall of 4 inches.

283 **2.4.5 Area Water Supply**

284 There are no groundwater wells on Ft. Flagler, and domestic water is obtained from the local  
285 municipal water supplier (Jefferson County Public Utility District No. 1), from groundwater  
286 wells located outside the FUDS boundary. The nearest private well is located approximately 250  
287 ft south of the southwest corner of the FUDS boundary. The well depth is listed as 58 ft below  
288 ground surface and the screen interval is listed as 15 to 53 ft below ground surface. Groundwater  
289 wells within a 4-mile radius of the FUDS are shown on Figure 2-5. Groundwater flow direction  
290 is outward from the interior of Marrowstone Island and the site towards Puget Sound and  
291 associated bays and inlets. The wells shown on Figure 2-5 are upgradient of Ft Flagler.

292 **2.4.6 Surface Water Features**

293 The primary surface water feature in the area is Puget Sound, a saltwater, tidal water body that  
294 surrounds the site on three sides. There are no established streams on Ft. Flagler. Figure 2-6  
295 shows the surface water features in the vicinity of Ft. Flagler.

296 **2.4.7 Geologic and Hydrogeologic Setting**

297 The Ft. Flagler FUDS lies within the Puget Trough Section of the Pacific Border Physiographic  
298 Province. The geology of the area is controlled by the last glaciation period between 12,000 and  
299 15,000 years ago. Glacial deposits consist of thick sequences of glacial till and sand and gravel.  
300 Soil at the site consists of coastal beaches, Whidbey gravelly sandy loam, and Dick loamy sand.

301 Much of the shoreline at Ft. Flagler is bordered by steep slopes that are 20 to 30 ft in height.  
302 Limited observations made during SI field activities of shoreline or slope conditions did not  
303 indicate that any identified AOCs have been impacted by erosion.

304 **2.4.7.1 Bedrock Geology**

305 Bedrock beneath Ft Flagler is Eocene (58 to 35 million years ago) fractured sandstone and shale.  
306 Depth to bedrock beneath Ft. Flagler is greater than 1,200 feet below sea level (Sinclair and  
307 Garrigues, 1994).

308 **2.4.7.2 Overburden Soils**

309 There is a very thick sequence (greater than 1,200 feet) of glacial deposits consisting of thick  
310 sequences of glacial till and sands and gravels. Soil at the site consists of coastal beaches,  
311 Whidbey gravelly sandy loam, and Dick loamy sand.

312 **2.4.7.3 Hydrogeology**

313 Groundwater occurs within the glacial deposits and water levels are generally within a few feet  
314 of sea level (Sinclair and Garrigues, 1994). Therefore, depth to groundwater can be estimated  
315 based on surface elevation. Groundwater flow direction is outward from the interior of the site  
316 towards Puget Sound and associated bays and inlets.

317 **2.4.8 Sensitive Environments**

318 The ranges and other areas of interest at the Ft. Flagler addressed by this SI are used as a State  
319 Park. The ranges and other areas do qualify as Important Ecological Places or Sensitive  
320 Environments as defined by USACE (2006) or EPA (1997), as shown in Table 2-2. Figure 2-7  
321 shows the locations of sensitive receptors such as schools and churches in the vicinity of the  
322 FUDS.

323 **2.5 Previous Investigations for MC and MEC**

324 The following summarizes previous investigations at Ft. Flagler. Previous investigations at Ft.  
325 Flagler have addressed MEC but not MC.

326 **2.5.1 Archives Search Report**

327 The USACE completed an ASR in April 2005 that compiled available information on the history  
328 and use of Ft. Flagler, with emphasis on types and areas of ordnance use and disposal. The ASR  
329 included a visit to the site in July 2003 (USACE, 2005b). The primary purpose of the site visit  
330 was to assess the presence of MEC through non-intrusive means. The ASR evaluated the  
331 following areas: Rocket Range, Rifle Range, Transition Range, Quartermaster Wharf Disposal  
332 Area, and Off Shore Ordnance Area. A Risk Assessment Code (RAC) scoring was included in  
333 the ASR. The areas scored were grouped by site usage rather than by AOC name. Possible  
334 scores ranged from 5 (low risk) to 1 (high risk). The RAC scores are presented in the table  
335 below.

<b>Area</b>	<b>RAC Score</b>	<b>MEC Found</b>
Rocket Range	5	No
Rifle Range	5	No
Transition Range	5	No
Quartermaster Wharf Disposal Area	3	No – Small Arms Only
Remaining Lands	5	No
Offshore Ordnance Area	5	No

336 The other AOCs addressed in this SI were not identified or scored in the ASR.

337 **2.5.2 Inventory Project Report Supplement**

338 The USACE completed an INPR Supplement in 2004, which compiled available information for  
339 Ft. Flagler. As noted above in Section 1.2 of this SI, the INPR Supplement identified three  
340 AOCs: the Range Complex, the Rocket Range, and Transition Range 2 (location unknown).  
341 The Range Complex consisted of the nine artillery batteries, Transition Range 1, and the Gas  
342 Chamber (USACE, 2004b).

343 **2.5.3 Other Investigations**

344 Ft. Flagler was certified as being decontaminated in 1954 by the USACE and again in 1959 by  
345 the 170<sup>th</sup> Ordnance Detachment from Fort Lewis, Washington (USACE, 2005b).

346 A Findings and Determination of Eligibility and an INPR were completed in 1991, which  
347 concluded that Ft. Flagler had been formerly used by the War Department (USACE, 1991).

348 In 1992, a TCRA was completed to locate four anti-tank rockets with live warheads that were  
349 unaccounted during military training and not located during the 1954 and 1959 visual  
350 inspections. The USACE determined that because of advances in technology for locating  
351 subsurface UXO, an additional survey should be completed to locate the unaccounted for

352 munitions (IT, 1992) and other MEC from the rocket range. The removal action included the use  
353 of magnetometers for locating subsurface MEC and munitions debris. The removal action  
354 included the 100 percent clearance of two adjacent areas within the Rocket Range. A third area  
355 within the Rocket Range was also surveyed, but at a lesser confidence than the other two areas  
356 due to very heavy vegetation. The removal action found the following items:

- 357 • 2.36-inch expended rocket motors (172 items);
- 358 • 2.36-inch rockets with live warhead (3 items);
- 359 • 2.36-inch rockets with live fuse (2 items);
- 360 • 3.5-inch expended rocket motors (2 items);
- 361 • Live training hand grenade (1 item);
- 362 • Bangalore torpedo fuse housing, inert (1 item);
- 363 • Anti-tank/anti-vehicle mines, inert (12 items); and
- 364 • Empty .30-caliber casings (16 items).

365 During an undated HTRW program, 13 underground fuel tanks were removed. MEC or MC  
366 related items were not addressed in that project (USACE, 1991).

## 367 ***2.6 Other Land Uses that May Have Contributed to Contamination***

368 No other land uses have been identified that may have contributed to contamination.

## 369 ***2.7 Past Regulatory Activities***

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

## 371 ***2.8 Previous MEC Finds***

372 The only MEC that has been located at Ft. Flagler were the three 2.36-inch rockets with live  
373 warheads, two 2.36-inch rockets with live fuzes, and one live training hand grenade during the  
374 1992 TCRA. The three rockets with live warheads were destroyed on site and the two rockets  
375 with live fuzes and live practice hand grenade were removed from the site by the Army EOD  
376 Unit from Fort Lewis.

## 377 3.0 *SI Tasks and Findings*

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378 SI tasks conducted for this FUDS property involved compiling and reviewing historical reports  
379 and information, using this information in the TPP process, preparing the *Site-Specific Work*  
380 *Plan* (SSWP), conducting field work, and preparing this SI Report. Following the TPP meeting,  
381 the SSWP was prepared to define the SI field activities necessary to collect the information  
382 needed to address the data gaps and data quality objectives (DQOs). Field work was conducted  
383 at the site between February 20 and 22, 2007.

### 384 3.1 *Technical Project Planning*

385 TPP involved compiling and reviewing historical reports and information to identify data gaps  
386 and develop a path forward. The TPP meeting for the Ft. Flagler FUDS was held on July 24,  
387 2006, and conducted in two parts. A daytime meeting was held at the Washington Department  
388 of Ecology office located in Lacey, Washington. Representatives from the USACE – Omaha  
389 Design Center and Seattle District, the Washington Department of Ecology (WDOE),  
390 Washington State Parks, and Shaw were in attendance. By agreement with the USACE, nearby  
391 landowners (other than State Parks) were not present at this meeting.

392 In the evening, a separate meeting intended to present the SI objectives to nearby landowners or  
393 interested members of the public was held at the Retreat Center at Ft. Flagler State Park. This  
394 meeting was attended by the same people that attended the earlier meeting, with three additional  
395 State Parks volunteers in attendance. No landowners or members of the general public attended.  
396 A formal site tour was not conducted as part of this meeting; however some of the areas of  
397 interest are readily visible from public roads and the park's paved pathways.

### 398 Agencies Meeting

399 **AOCs:** There was general agreement among stakeholders on SI objectives and approach. It was  
400 presented that the Range Complex included the artillery batteries, Transition Range 1, and the  
401 Gas Chamber. However, Transition Range 1 and the Gas Chamber will be evaluated separately  
402 to allow for a more efficient evaluation of impacts. Washington State Parks/WDOE  
403 representatives provided a copy of a War Department map (circa 1945) that identified several  
404 potential AOCs that were not included in the ASR. A copy of the map is included in Appendix  
405 L. Based on this map and the resulting discussion, the following AOCs were added and  
406 documented in the *TPP Memorandum* (Shaw, 2006b):

- 407 • **Demolition Area:** The Demolition Area is shown on the historic map provided by the  
408 State Park. The area is now used for a campground near the spit. The name suggests it is  
409 the OB/OD area. Comparison of topography from the old map to current maps suggests  
410 that this area has been infilled to create a raised flat area for picnicking and camping.

- 411 • **Live and Practice Grenade Courts:** The Live and Practice Grenade Courts are shown  
412 on the historic map; they are currently located within little used areas of the State Park.
- 413 • **Ammunition Bunker:** An Ammunition Bunker is shown on the historic map; it was  
414 located between Batteries Calwell and Downes.
- 415 • **Transition Range 2:** Transition Range 2 is shown on historic map; it is currently located  
416 within an unused area of the State Park. Note that this transition range was identified in  
417 the INPR Supplement but the location was unknown.

418 Other areas shown on the historical map included a Squad Tactical Area and an Embarkation  
419 Area. These sites likely did not involve the use or firing of weapons or munitions.

420 **Sampling:** Shaw agreed with WDOE that visual reconnaissance for MEC should be conducted  
421 at the battery locations. Originally, Shaw proposed conducting MC sampling around the  
422 batteries. However, based on the discussion of the configuration and use of the batteries and on  
423 observations made while driving through the park, Shaw proposed no MC sampling be  
424 conducted around the batteries because of the following reasons:

- 425 • The batteries are permanent structures in which the guns were emplaced in concrete  
426 structures and serviced by paved roads. It is unlikely that there was casual disposal of  
427 MEC in the vicinity of a battery.
- 428 • The guns were seldom used.
- 429 • Areas around the batteries are paved and contain storm drains. It is extremely unlikely  
430 that there are any remaining affected sediments from guns that were operated pre-World  
431 War II.

432 The Ft. Flagler State Park currently obtains water from the public supply. State Parks indicated  
433 there may have been a well in the past and provided research into the possibility.

434 **Concerns:** One of WDOE representative's main concerns was the camping area at the Rocket  
435 Range AOC (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw, 2006b] and SSWP  
436 [Shaw, 2007]). A UXO clearance was conducted in the adjacent wooded area in 1992.  
437 Additional review of old aerial photographs and topographic maps would be helpful to evaluate  
438 the history of this area.

### 439 **Public Meeting**

- 440 • Bob Brown, volunteer archivist for State Parks said that he and another volunteer,  
441 Howard Briggs had found "lots of archive material" at USACE Seattle. Mr. Brown found  
442 a map in the museum, showing AOCs not included in the ASR.
- 443 • Rifle Range – Reconstructed exactly as it was when used. Should be lots of lead in the  
444 berm in front of the target. There are reports that they had to build a wall on the hill  
445 behind the targets to protect the power station below Battery Lee. Mr. Brown thought  
446 that the ponds have always been there, but Mr. Briggs thought that there may have been  
447 cattle there at one time. Mike Zimmerman (State Parks) noted that the sea washed over  
448 this area a year or two ago.

- 449 • Demolition Area – Mr. Brown and Mr. Briggs do not know use of this area. Mr. Briggs  
450 said that in the 1960's there were warning signs in this area for UXO. Mr. Briggs also  
451 said that there was a concrete breakwater in this area that was removed.
- 452 • As shown on the map, there was a Transition Range just east of the main gate. An old-  
453 timer has said that this was an area used for firing.
- 454 • Grenade Courts – These are still visible. However, during field reconnaissance no  
455 ground evidence of the grenade courts was found. The only indication that the area was  
456 once cleared was that the forest trees were primarily alder and fir, while the surrounding  
457 area was a more mature forest growth consisting of fir, hemlock, and cedar.
- 458 • Areas with alder trees and no fir trees signify disturbance.
- 459 • Mr. Zimmerman had heard that during the Korean War, amphibious groups landed on the  
460 spit and that this may have been the cause of the split in the spit.
- 461 • There are two 90-millimeter (mm) sites west of the coast guard house with concrete pads  
462 still visible at low tide.
- 463 • Comparison of the map found by Mr. Brown and the present topography indicates that  
464 fill has been placed in the area of the campsite and the demolition area shown on the map.  
465 Mr. Zimmerman asked if the Seattle District would have records of this work.
- 466 • Mr. Brown thought that he had heard that there was a disposal area across the road south  
467 of Bankhead Battery.
- 468 • Part of the lagoon area near the Rifle Range is on U.S. Geological Survey (USGS)  
469 property.
- 470 • It was suggested that the retired rangers be interviewed. Mr. Zimmerman said that he  
471 could provide names.
- 472 • Greg Johnson (WDOE) said that he would like to see analysis of older aerial  
473 photographs.
- 474 • Mr. Brown indicated that it has always been State Parks policy to encourage people to  
475 stay on the trails. He and Mr. Briggs noted that there is very dense brush off most of the  
476 trails.

477 Based on the TPP meeting and subsequent evaluation of information obtained at the meeting, 11  
478 AOCs were identified and addressed in the *TPP Memorandum* (Shaw, 2006b) and the SSWP  
479 (Shaw, 2007). These AOCs are shown on Figure 3-1 and include:

- 480 • Range Complex (coastal artillery batteries),
- 481 • Ammunition Bunker,
- 482 • Transition Range 1,
- 483 • Transition Range 2,
- 484 • Gas Chamber,

- 485 • Rocket Range AOC (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw,  
486 2006b] and SSWP [Shaw, 2007]),
- 487 • Live Grenade Court,
- 488 • Practice Grenade Court,
- 489 • Rifle Range,
- 490 • Demolition Area, and
- 491 • Quartermaster Wharf Disposal Area.

492 Note that on Figure 3-1, a number of the battery range boundaries have been moved slightly to  
493 match the actual battery locations shown on the aerial photographs. In addition, the boundary of  
494 the Rocket Range has been expanded to include the surveyed boundaries of the 1992 TCRA  
495 (USACE, 1996). The boundary of Transition Range 1 has been moved to agree with that shown  
496 on the ASR and represents a more accurate location of the range.

497 TPP meeting results were documented in the *TPP Memorandum* (Shaw, 2006b), which was  
498 issued final on December 18, 2006 after incorporating comments from the stakeholders. The  
499 proposed technical approach was defined in the SSWP (Shaw, 2007), which was issued final on  
500 February 18, 2007 after incorporating comments from the stakeholders.

501 A more complete discussion of the TPP meeting is contained in Appendix B. As discussed  
502 during the TPP meeting and documented in the *TPP Memorandum* (Shaw, 2006b), the following  
503 project decision rules were developed:

504 **Based on the presence or absence of MEC, is an NDAI or is an RI/FS warranted?**

- 505 • If no evidence of MEC (non-small arms, munitions debris, or magnetic anomalies) was  
506 found during prior investigations and none is observed during SI site reconnaissance, the  
507 site will be considered a potential candidate for NDAI with respect to MEC hazard.
- 508 • If MEC was found and/or if abundant or concentrated areas of munitions debris or  
509 magnetic anomalies were observed during prior investigations or during SI site  
510 reconnaissance, the site will be considered a potential candidate for further investigation  
511 with respect to MEC hazard.
- 512 • If any evidence is identified that is inconsistent with the CSM for the site (e.g., if  
513 munitions debris indicating the potential use of high explosive (HE) munitions at a site  
514 for which the CSM was based on practice munitions), the above decision rules will be  
515 revised appropriately.

516 **Based on the presence or absence of MC, is an NDAI or is an RI/FS warranted?**

- 517 • If sample results are less than human health and ecological screening values, the site will  
518 be recommended for NDAI relative to MC.
- 519 • If sample results exceed both human health screening values and background values, the  
520 site will be recommended for additional investigation.

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

525 **Is a time-critical removal action warranted?**

- 526 • A time-critical removal action may be needed if high MEC hazard is identified. Shaw  
527 will immediately report any MEC findings so that USACE can determine the appropriate  
528 response. An example of a high hazard would be finding sensitive MEC at the surface in  
529 a populated area with no barriers to restrict access.

530 **3.2 Additional Records Research**

531 **3.2.1 Coordination with State Historic Preservation Office**

532 The Washington State Historic Preservation Office (SHPO) was contacted to determine if there  
533 are any areas of cultural or archaeological significance on FUDS property that could be impacted  
534 by SI activities at Ft. Flagler. The SHPO recommended that the State Parks and USACE  
535 archeologists review the plans and provide comments (Washington SHPO, 2006; Appendix C).  
536 The USACE Seattle District project manager reviewed sampling plans with the district  
537 archeologist and no concerns were identified. A copy of the Draft SSWP was provided to the Ft.  
538 Flagler State Park for review and comment. No concerns were raised during their review.

539 The USACE Seattle District contacted local tribes and provided opportunity for their comment  
540 on impacts to cultural resources. The tribes commented back that no additional oversight is  
541 required. However, if something of cultural significance is identified during field work, the tribe  
542 shall be notified immediately and the location avoided.

543 **3.2.2 Coordination with Natural Resources Offices**

544 The Washington Department of Fish and Wildlife (WDFW) was contacted to determine if there  
545 are threatened or endangered species that could be impacted by SI activities at Ft. Flagler.  
546 Information obtained from the WDFW indicates that there are sensitive habitats along several  
547 beaches at Ft. Flagler; however, none are in the vicinity of the proposed sampling on the beach at  
548 the Quartermaster Wharf Disposal Area. The information provided also identified two bald  
549 eagle nesting trees at Ft. Flagler. The activities performed in the vicinity of these sites did not  
550 cause disturbance.

551 The USACE Seattle District completed a *Determination of No Effect on Listed Species under the*  
552 *Endangered Species Act during Sediment Sampling at Fort Flagler State Park, Jefferson County,*  
553 *Washington, 2007* (USACE, 2007) for proposed sampling activities at Ft. Flagler. The results of  
554 the study were that planned sampling activities would have no effect on listed species. A copy of  
555 the determination is included in Appendix L.

556 **3.2.3 Historical Aerial Photographs**

557 Limited historical aerial photographs are available for the Ft. Flagler FUDS. Available historical  
558 photographs were reviewed and considered during the planning process. However, the available  
559 aerial photography was not of sufficient resolution or of sufficient scale to determine detailed  
560 surface feature such as target berms or firing lines.

561 **3.2.4 Environmental Database Search**

562 A search of available environmental records was conducted by Environmental Data Resources,  
563 Inc. (EDR, 2005). The government records search met the requirements of Standard Practice for  
564 Environmental Site Assessments (ASTM International, 2007). Search results indicated the  
565 AOCs did not appear on mapped sites in known federal, state, or local databases. NAVMAG  
566 Indian Island immediately west of Ft Flagler on Indian Island has one National Priorities Site  
567 (NPL) and one delisted NPL site and is located approximately 2 miles from the FUDS.  
568 NAVMAG Indian Island is also listed on several other federal and state lists including Resource  
569 Conservation and Recovery Act (RCRA) list identifying sites that generate, transport, store, treat,  
570 and/or dispose of hazardous waste. Additional information on the databases searched and the  
571 results for surrounding properties is included in the EDR report found in Appendix L.

572 **3.2.5 Rights of Entry**

573 Prior to mobilizing to the site, the Project Manager for the USACE Seattle District office  
574 obtained the Right of Entry from the Washington State Parks and the USGS for the property  
575 where the SI field activities were performed.

576 **3.3 Field Work**

577 SI field activities, conducted the week of February 20, 2007, included site reconnaissance and  
578 collection of surface soil and sediment samples at Transition Range 1, Transition Range 2,  
579 Rocket Range, Live Grenade Court, Rifle Range, and the Quartermaster Wharf Disposal Area.  
580 The following conditions were recorded in the field log book (Appendix D) and/or by digital  
581 photographs (Appendix E):

- 582 • Presence or absence of evidence of MEC,
- 583 • Changes, if any, in sample location because of field constraints,
- 584 • Vegetative cover, and
- 585 • Other conditions encountered that impacted sample collection.

586 **3.4 Sampling and Analysis**

587 Sampling included collection of surface soil and sediment samples at AOCs and for  
588 determination of soil and sediment background concentrations. Table 3-1 summarizes the soil  
589 and sediment sampling completed at Ft. Flagler. Samples were collected and analyzed in  
590 accordance with the SSWP (Shaw, 2007) using the standard operating procedures (SOPs) from  
591 the *Type 1 Work Plan, Site Inspections at Multiple Sites, NWO Region* (Shaw, 2006a).

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

### 594 **3.5 Laboratory Analysis and Data Quality Review**

595 The data review process compares sample results to pre-established criteria referenced in Shaw's  
596 FUDS MMRP Program Sampling and Analysis Plan (PSAP) Addendum, (Shaw, 2005) to  
597 confirm that the data are of acceptable technical quality. GPL provided Shaw with a Level 4  
598 data package including "Contract Laboratory Program (CLP)-Like" summary forms, Staged  
599 Electronic Data Deliverables (SEDD) Stage 2b (version Draft 5.0), and Automated Data Review  
600 (ADR) compatible A1, A2, & A3 files for all sample delivery groups (SDG). Shaw conducted a  
601 data assessment on all samples collected in support of this SI. One hundred percent of the  
602 analytical data have been reviewed based on EPA CLP *National Functional Guidelines for*  
603 *Organic Data Review*, October 1999 and EPA CLP *National Functional Guidelines for*  
604 *Inorganic Data Review*, October 2004. Automated Data Review software (version 8.1) was used  
605 to assist in the data validation process for all areas with the exception of initial calibration  
606 blanks, continuing calibration blanks, interference check standards, serial dilutions, and second-  
607 column confirmation which were reviewed manually. Data were evaluated against specific  
608 criteria to verify the achievement of all precision, accuracy, representativeness, completeness,  
609 comparability, and sensitivity goals established to meet the project DQOs.

610 The overall quality of the data collected is discussed in the Analytical Data QA/QC Report  
611 (Appendix G). Results of the analyses as discussed in this evaluation are indicative of the media  
612 analyzed. Some results were qualified as described in the report. No data were qualified "R" as  
613 unusable. Overall, the data reflect expected site conditions and they are fully usable for their  
614 intended purpose.

### 615 **3.6 Screening Values**

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

#### 617 **3.6.1 Background Data**

618 As agreed upon at the TPP meeting, 10 background soil samples were collected from the Ft.  
619 Flagler area and analyzed for metals. Background sample locations are shown on Figure 3-2.  
620 The background sampling locations were selected to be away from known AOCs and other areas  
621 of military activity.

622 The background soil sample analytical results were used to calculate background metal soil  
623 concentrations using published EPA Guidance (1989, 1992, 1994, 1995, and 2006). The  
624 background concentrations are either a 95<sup>th</sup> upper tolerance limit (UTL) for normally and  
625 lognormally distributed analytes or the 95<sup>th</sup> percentile for nonparametric distributed analytes.  
626 The individual background soil sample analytical results are provided in Appendix G. Table 3-2

627 lists the soil and sediment background concentrations used in this report. A summary of the soil  
628 background calculations is presented in Appendix L.

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

- 637 1. If the sample measurement is less than or equal to the sample quantitation limit, no  
638 observed release is established.
- 639 2. If the sample measurement is greater than or equal to the sample quantitation limit,  
640 then an observed release is established as follows:
  - 641 • If the background concentration is not detected (or is less than the detection limit),  
642 an observed release is established when the sample measurement equals or exceeds  
643 the sample quantitation limit.
  - 644 • If the background concentration equals or exceeds the detection limit, an observed  
645 release is established when the sample measurement is three times or more above  
646 the background concentration.

647 In the discussions for each AOC, these criteria are used to determine whether a release of MC  
648 has occurred in sediment regardless of whether the analyte is considered a hazardous substance.  
649 However, these criteria are not applied for soils because a statistically based determination of  
650 background has been established, and an exceedance of the 95<sup>th</sup> UTL or 95<sup>th</sup> percentile,  
651 depending on the individual analyte, is used to establish a release of MC.

### 652 **3.6.2 Human Health Screening Values**

653 Human health screening values for soil and sediment analytical results were established using the  
654 following reference sources:

- 655 • EPA Region 9 Preliminary Remediation Goals (PRGs) for Residential Soil.
- 656 • State of Washington Model Toxics Control Act (MTCA) Cleanup Regulation, Chapter  
657 173-340 WAC.

658 In cases where screening values were listed from both sources, the lower value is used for  
659 screening. The human health screening values are listed on Table 3-3.

### 660 **3.6.3 Ecological Screening Values**

661 According to the *Screening-Level Ecological Risk Assessment (SLERA) Guidance for FUDS*  
662 *MMRP Site Inspections* (USACE, 2006), only sites that are considered to be IEP or are to be  
663 managed for ecological purposes, require a SLERA. As shown in Table 2-2 and discussed in

664 Section 2.4.7, the site does meet some of the 33 criteria for designation as an IEP. Shaw  
665 developed a SLERA (Appendix L) using ecological screening values obtained from the WDOE  
666 Toxics Cleanup Program and other appropriate sources as described in the *TPP Memorandum*  
667 included as Appendix B in this SI Report (see Section 2.4.7). The SLERA uses these screening  
668 values to identify ecological chemicals of concern and then evaluates the pathways and receptors  
669 to determine the potential for ecological impacts. The ecological screening values for soil and  
670 sediment are listed on Table 3-4 and Table 3-5, respectively.

### 671 **3.7 *Variances from the SSWP***

672 No variances to the SSWP (Shaw, 2007) occurred during field activities.

### 673 **3.8 *Second TPP Meeting***

674 A second TPP meeting is planned after the Draft Final SI Report is issued to present the SI  
675 findings to stakeholders and reach consensus regarding conclusions.

## 676 4.0 *Range Complex*

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### 677 4.1 *History and Land Use*

678 The Range Complex is a single AOC that includes the ten coastal artillery batteries listed below:

- 679 • Battery Bankhead,
- 680 • Battery Calwell,
- 681 • Battery Downes,
- 682 • Battery Gratton,
- 683 • Battery Lee,
- 684 • Battery Rawlins,
- 685 • Battery Revere (Anti-Torpedo Boat Battery),
- 686 • Battery Wansboro,
- 687 • Battery Wilhelm, and
- 688 • Anti-Aircraft Artillery Battery.

689 Each battery consisted of a massive concrete structure that provided a base for the artillery guns,  
690 which ranged in size from 3-inch to 12-inch (see Appendix E, Photographs 43 and 44). Each  
691 battery was self contained with propulsion and projectile storage rooms and troop offices. In the  
692 ARC (DoD, 2006), the Range Complex also includes Transition Range 1 and the Gas Chamber.  
693 In this SI, these two AOCs are separated out from the batteries to allow for a more efficient  
694 evaluation of all areas. Transition Range 1 is discussed in Section 6.0 and the Gas Chamber is  
695 discussed in Section 8.0.

696 Currently, the Range Complex AOC is part of the Ft. Flagler State Park, which offers camping,  
697 boating, fishing, shoreline use, hiking, and historical interpretive information. For the  
698 foreseeable future, it is likely that the Range Complex AOC will continue to be part of the Ft.  
699 Flagler State Park.

700 The Range Complex consists of the batteries, the offshore impact areas, and the associated safety  
701 fans. The water depth in Puget Sound increases rapidly outside of the tidal zone. Water depths  
702 within 100 yards of the mean high tide are generally less than 20 ft. The Range Complex  
703 consisted of artillery batteries that fired thousands of feet out into Puget Sound, where water  
704 depths are in excess of several hundred feet and are not reasonably accessible.

705 According to the ASR the Range Complex AOC was used as a coastal defense battery. The  
706 range fans for the batteries extended beyond the FUDS boundary and over the open waters of  
707 Puget Sound. Firing of the artillery guns at near-shore targets is not expected. The configuration  
708 of the guns in the batteries would not allow downward directed firing at near-shore targets. The

709 only scenario for MEC occurring on the beach or near-shore areas (within 100 yards of shore)  
710 would be if an incomplete firing of the gun occurred and the projectile would land short of the  
711 target. No firing onto land occurred. The Anti-Torpedo Boat Battery was located at Battery  
712 Revere after the original 10-inch gun tubes were removed in 1941. It is unknown how often the  
713 artillery guns were fired or whether the firing included high explosive rounds in addition to  
714 spotting charges practice rounds. In a report dated 1933, it was stated that in the same year the  
715 two guns at Battery Revere were fired 111 and 94 times, respectively, as part of a testing  
716 program. It is not known if projectiles contained explosive charges.

## 717 **4.2 Previous Investigations**

718 A site visit was completed as part of the ASR in 2003. The ASR team did not find any notable  
719 indication of MEC or MC related the Range Complex. No evaluation of offshore areas was  
720 conducted.

## 721 **4.3 MEC Evaluation**

722 Potential MEC for the Range Complex include propellant bags and high explosive projectiles.

### 723 **4.3.1 Field Observations and Historical Evidence of MEC**

724 A visual reconnaissance of each of the Range Complex batteries was conducted to verify the  
725 CSM that no MEC was present. The visual reconnaissance consisted of walking around each of  
726 the batteries to look for evidence of MEC. The path walked during the visual reconnaissance  
727 was recorded using a hand-held Global Positioning System (GPS) unit. The visual  
728 reconnaissance tracks are shown on Figure 4-1. No evaluation of the beach areas below the  
729 batteries or the offshore area was completed.

730 Each battery consists of a massive concrete structure on which the artillery guns were mounted  
731 (see Appendix E, Photographs 43 and 44). The area around each bunker is well maintained with  
732 grass and shrubs which are well cared for. There was no evidence of MEC, nor have there ever  
733 been any reports of MEC or munitions debris associated with the batteries.

### 734 **4.3.2 MEC Risk Assessment**

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

740 Shaw completed a visual reconnaissance of the Range Complex the week of February 20, 2007.  
741 No MEC or munitions debris was observed or identified. Figure 4-1 shows the reconnaissance  
742 pathways and photograph locations for this AOC.

743 The Range Complex batteries are located on bluffs above the shoreline on Puget Sound. Battery  
744 Bankhead is located near the center of Ft. Flagler (Figure 4-1). All batteries are within Ft.  
745 Flagler State Park and are intended to be accessible and visited by park visitors. Human  
746 receptors in this AOC include park workers and visitors. Human exposure would be through  
747 direct contact with the munitions.

748 MEC has not been reported historically and none was observed during the SI reconnaissance of  
749 the Range Complex. The MEC risk for this area is considered to be low based on the following:

- 750 • No MEC or munitions debris has been reported in the over 50 years of park use; and
- 751 • The use of munitions at the Range Complex was limited to the individual batteries, which  
752 were self contained and the guns were seldom fired.
- 753 • All firing was direct toward open water of Puget Sound, where water depths are several  
754 hundred feet.

#### 755 **4.4 Munitions Constituents Evaluation**

756 Potential MC at the range complex include explosive compounds nitroguanidine, ammonium  
757 picrate, TNT, and others and metals contained in steel (chromium, copper, iron, lead, and  
758 nickel).

##### 759 **4.4.1 Terrestrial Pathway**

760 Terrestrial receptors could be exposed to MC if soil was directly affected by firing of the battery  
761 guns. As agreed to during the TPP process, based on the configuration and limited use, it is  
762 unlikely that munitions would have been discarded. Also, significant MC from firing the guns is  
763 unlikely because of infrequent use and the extended time period since use stopped. No sampling  
764 was proposed for the Range Complex. The CSM did not indicate the likely presence of MC in  
765 the surface soils.

##### 766 **4.4.2 Surface Water Pathway**

767 Because of the unlikely occurrence of MEC and MC at the batteries, the surface water exposure  
768 pathway is considered incomplete. As agreed to during the TPP process no surface water or  
769 sediment samples were to be collected.

##### 770 **4.4.3 Groundwater Pathway**

771 Because of the unlikely occurrence of MEC and MC at the batteries, the groundwater exposure  
772 pathway is considered incomplete. As agreed to during the TPP process, groundwater is not a  
773 complete pathway at Ft. Flagler and no groundwater samples were planned or collected.

774 **4.4.4 Air Pathway**

775 Because of the unlikely occurrence of MEC and MC at the batteries, the air exposure pathway is  
776 considered incomplete. As agreed to during the TPP process no air samples were collected.

## 777 **5.0 Ammunition Bunker**

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### 778 **5.1 History and Land Use**

779 The Ammunition Bunker is a single AOC that is located within the Range Complex (Figure 5-1).  
780 The location of this AOC is taken from the War Department map that was obtained during the  
781 TPP meeting. The ammunition bunker was likely used from between 1942 and 1953 to store  
782 munitions used for training during and following World War II. The War Department map is  
783 included in Appendix L.

784 The Ammunition Bunker AOC is part of the Ft. Flagler State Park, which offers camping,  
785 boating, fishing, shoreline use, hiking, and historical interpretive information. For the  
786 foreseeable future, it is likely that the Ammunition Bunker AOC will continue to be part of the  
787 Ft. Flagler State Park.

### 788 **5.2 Previous Investigations**

789 This AOC has not been previously investigated.

### 790 **5.3 MEC Evaluation**

791 The Ammunition Bunker was used between 1945 and 1953 for ammunition storage likely  
792 associated with amphibious assault training. All types of munitions used at Ft. Flagler between  
793 1945 and 1953 may have been stored here. However, munitions for the artillery batteries would  
794 probably not have been stored at this location as each battery had its own storage bunker. The  
795 types of munitions may have included small arms, training grenades containing riot control gas  
796 (chloroacetophenone [CN]), 2.36-inch and 3.5-inch practice and high explosive rockets, practice  
797 and live hand grenades, and candles, etc that were used for gas training.

#### 798 **5.3.1 Field Observations and Historical Evidence of MEC**

799 A visual reconnaissance was completed in the area of the reported Ammunition Bunker between  
800 Batteries Calwell and Downes. No evidence of the presence of the Ammunition Bunker was  
801 found. Figure 5-1 shows the reconnaissance pathways for this AOC. The reconnaissance area is  
802 very heavily forested with thick underbrush and no indication (structure or foundation) of the  
803 bunker was found. There was no MEC located or munitions debris identified during the visual  
804 reconnaissance. There have been no reports of MEC or munitions debris at this AOC.

#### 805 **5.3.2 MEC Risk Assessment**

806 The following presents a qualitative assessment of the risk associated with potential MEC. A  
807 MEC assessment is provided to convey relative risk on a scale from low to high and is not  
808 intended to be a thorough risk assessment as would be conducted for an RI/FS.

809 Shaw completed a visual reconnaissance of the Ammunition Bunker AOC the week of February  
810 20, 2007. No MEC or munitions debris was observed or identified. MEC has not been reported  
811 historically and none was observed during the SI reconnaissance of the AOC. The MEC risk for  
812 this area is considered to be low based on the following:

- 813 • No MEC or munitions debris has been reported in the over 50 years of park use;
- 814 • No MEC or munitions debris was identified during the SI visual reconnaissance.
- 815 • The only information available on the location of the Ammunition Bunker is from a  
816 historical map.

#### 817 **5.4 Munitions Constituents Evaluation**

818 Potential MC from the Ammunition Bunker include explosive compounds and metals contained  
819 in steel (chromium, copper, iron, lead, and nickel), perchlorate in fuze and rocket propellant, and  
820 lead from bullets.

##### 821 **5.4.1 Terrestrial Pathway**

822 Terrestrial receptors may be exposed to MC if munitions were disposed or discarded to the soil  
823 near the Ammunition Bunker. As agreed to during the TPP process, a soil sample would be  
824 collected from this AOC if evidence of MEC or munitions debris were located during the visual  
825 reconnaissance. As discussed above in Section 5.3.1, no MEC or munitions debris was identified  
826 at this AOC and therefore no soil samples were collected.

##### 827 **5.4.2 Surface Water Pathway**

828 As agreed to during the TPP process, the surface water pathway at Ft. Flagler was to be assessed  
829 through sediments as there is no continuously running streams at Ft. Flagler. Surface water and  
830 sediment receptors may be exposed to MC if munitions were disposed or discarded to the soil  
831 near the Ammunition Bunker. As agreed to during the TPP process, a sediment sample would be  
832 collected from this AOC if evidence of MEC or munitions debris were located during the visual  
833 reconnaissance. As discussed above in Section 5.3.1, no MEC or munitions debris was identified  
834 at this AOC and therefore no sediment samples were collected.

##### 835 **5.4.3 Groundwater Pathway**

836 Groundwater was initially considered a potentially affected media because it is present within  
837 100 ft of ground surface. However, the groundwater pathway is not complete as there is no  
838 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP  
839 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were  
840 planned or collected.

841 **5.4.4 Air Pathway**

842 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
843 particles. However, air is not an affected media under current land use, thus the pathway is  
844 incomplete.

## 845 **6.0 Transition Range 1**

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### 846 **6.1 History and Land Use**

847 Transition Range 1 is a single AOC shown on Figure 6-1. The boundaries of this AOC were  
848 taken from the INPR Supplement. The Transition Range consisted of individual firing lanes  
849 which soldiers transitioned along, engaging targets from various positions (fox hole, window,  
850 and prone) and at varying distances. In the ARC (DoD, 2006), Transition Range 1 is included in  
851 the Range Complex as well as the Gas Chamber. In this SI, Transition Range 1 and the Gas  
852 Chamber AOCs are separated out from the batteries to allow for a more efficient evaluation of all  
853 areas.

854 Currently, the Transition Range 1 AOC is part of the Ft. Flagler State Park, which offers  
855 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. The  
856 AOC is located south of the Cantonment Area, park administrative offices, and visitor areas and  
857 near Battery Wansboro. The park waste water treatment plant is within the footprint of the AOC.  
858 Hiking trails traverse the Transition Range 1 AOC. For the foreseeable future, it is likely that the  
859 Transition Range 1 AOC will continue to be part of the Ft. Flagler State Park.

860 According to the INPR Supplement Transition Range 1 was used between 1942 and 1953 for  
861 small arms use.

### 862 **6.2 Previous Investigations**

863 The ASR field team visited the location of Transition Range 1 and did not note any specific  
864 features, other than the berm between the range and the cantonment area.

### 865 **6.3 MEC Evaluation**

866 Because this AOC was used for small arms only (.50-caliber ammunition was not used), MEC  
867 (other than small arms) is not expected to be present.

#### 868 **6.3.1 Field Observations and Historical Evidence of MEC**

869 A visual reconnaissance of Transition Range 1 was completed during the week of February 20,  
870 2007. The northern end of the range is used for picnicking and the waste-water treatment plant is  
871 also located nearby. The remainder of the AOC is heavily wooded with thick undergrowth. The  
872 only evidence of the range is a berm that runs east to west (Appendix E, Photo 24), which may  
873 have been a protective berm behind the firing line due to its proximity to the cantonment area.  
874 No evidence of firing positions or target areas was identified during the visual reconnaissance.  
875 Figure 6-1 shows the reconnaissance pathway for this AOC.

876 **6.3.2 MEC Risk Assessment**

877 The following presents a qualitative assessment of the risk associated with potential MEC. A  
878 MEC assessment is provided to convey relative risk on a scale from low to high and is not  
879 intended to be a thorough risk assessment as would be conducted for an RI/FS.

880 Shaw completed a visual reconnaissance of the Transition Range 1. No MEC or munitions  
881 debris was observed or identified. MEC has not been reported historically and none was  
882 observed during the SI reconnaissance of the AOC. The MEC risk for this area is considered to  
883 be low based on the following:

- 884 • The AOC is a Transition Range and only small arms were reportedly used. No MEC or  
885 munitions debris has been reported in the over 50 years of park use;
- 886 • No MEC or munitions debris was identified during the SI visual reconnaissance.

887 **6.4 Munitions Constituents Evaluation**

888 Potential MC for Transition Range 1 is lead from bullets.

889 **6.4.1 Terrestrial Pathway**

890 Terrestrial receptors may be exposed to MC if the soil was directly exposed to lead from the  
891 firing of small arms. Two surface soil samples (NWO-039-0002 and NWO-039-0003) were  
892 proposed and collected and analyzed for lead by EPA Method SW-846 6020A. Sample locations  
893 and results are shown on Figure 6-2. Soil sample locations were selected in the field as indicated  
894 in the SSWP. Because no range surface features (firing points or targets) were identified,  
895 locations were selected based on proximity to locations shown in the SSWP and accessibility.

896 The soil samples were collected from the upper 6 inches of soil after the removal of forest litter  
897 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*  
898 *Work Plan* (Shaw, 2006a). Each sample was sieved by the laboratory with a # 10 sieve prior to  
899 analysis to remove any particulate lead.

900 **6.4.1.1 Comparison to Background Data**

901 The detected lead concentrations were compared to the soil background concentrations. The  
902 comparison is shown on Table 6-1. The detected lead concentrations of 13.8 milligrams per  
903 kilogram (mg/kg) (sample NWO-039-0002) and 18.6 mg/kg (sample NWO-039-0003) were  
904 below the Ft. Flagler background concentration of 32.6 mg/kg.

905 **6.4.1.2 Comparison to Human Health Screening Values**

906 Soil analytical results are only compared to human health screening values if background  
907 concentrations are exceeded. Because there were no exceedances of background concentrations,  
908 no comparison is completed.

909 **6.4.1.3 Comparison to Ecological Screening Values**

910 As stated in the decision rules (Section 3.1), soil analytical results are only compared to  
911 ecological screening values if background concentrations are exceeded. Because there were no  
912 exceedances of background concentrations, no comparison is completed.

913 **6.4.2 Surface Water Pathway**

914 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors  
915 for sediments are park workers, visitors, and wildlife. One sediment sample (NWO-039-1002)  
916 was proposed and collected and analyzed for lead by EPA Method SW-846 6020A. The sample  
917 location and results are shown on Figure 6-2.

918 The sediment sample was collected from a low area where water appeared to collect. The  
919 sediment sample was a discrete sample. The sample was sieved by the laboratory with a # 10  
920 sieve prior to analysis to remove any particulate lead.

921 **6.4.2.1 Comparison to Background Data**

922 The sediment sample (NWO-039-1002) lead analytical result (40.4 mg/kg) was compared to the  
923 sediment background concentration of 12.8 mg/kg (Table 6-2). As discussed in Section 3.6.1 a  
924 significant exceedance of background is indicted if the sample result is greater than 3 times the  
925 background value. According to this rule, the Transition Range 1 sediment sample significantly  
926 exceeded background (a ratio of 3.2). It is noted that the sediment result is only 1.2 times the  
927 background value for soil.

928 **6.4.2.2 Comparison to Human Health Screening Values**

929 The sediment lead analytical result (40.4 mg/kg) significantly exceeded the background  
930 concentration (12.8 mg/kg) but did not exceed the human health screening value of 400 mg/kg.

931 **6.4.2.3 Comparison to Ecological Screening Values**

932 The sediment lead analytical result (40.4 mg/kg) significantly exceeded the background  
933 concentration (12.8 mg/kg) but did not exceed the ecological screening value of 260 mg/kg.

934 **6.4.3 Groundwater Pathway**

935 Groundwater was initially considered a potentially affected media because it is present within  
936 100 ft of ground surface. However, the groundwater pathway is not complete as there is a  
937 limited source of MC and no downgradient groundwater users in the area. As agreed to during  
938 the TPP process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples  
939 were planned or collected.

940 **6.4.4 Air Pathway**

941 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
942 particles. However, air is not an affected media under current land use, thus the pathway is  
943 incomplete.

## 944 7.0 *Transition Range 2*

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### 945 7.1 *History and Land Use*

946 Transition Range 2 is a single AOC shown on Figure 7-1. The location of this AOC is only  
947 known from the War Department map that was obtained during the TPP meeting. This War  
948 Department map is included in Appendix L. The INPR Supplement (USACE, 2004b) identified  
949 Transition Range 2, but the location was unknown. The Transition Range likely consisted of  
950 individual firing lanes which soldiers transitioned along, engaging targets from various positions  
951 (fox hole, window, and prone) and at varying distances.

952 Currently, the Transition Range 2 AOC is part of the Ft. Flagler State Park, which offers  
953 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. The  
954 AOC is located along the southern boundary of the State Park, near the main entrance road. An  
955 access road traverses the southern boundary of the Transition Range 2 AOC. It is likely that for  
956 the foreseeable future, the Transition Range 2 AOC will continue to be part of the Ft. Flagler  
957 State Park.

958 According to the INPR Supplement, available information indicated that ranges of this type were  
959 typically 55 x 130 yards in size and contained 12 targets; however, the location of the AOC was  
960 not known. Small arms were used at the AOC between 1942 and 1954

### 961 7.2 *Previous Investigations*

962 There have been no previous investigations at this AOC.

### 963 7.3 *MEC Evaluation*

964 Because this AOC was used for small arms only, MEC (other than small arms) is not expected to  
965 be present.

#### 966 7.3.1 *Field Observations and Historical Evidence of MEC*

967 A visual reconnaissance of Transition Range 2 was completed during the week of February 20,  
968 2007. The location of the range is in a very heavily wooded area with dense undergrowth. No  
969 visual evidence of the range could be identified due to the heavy vegetation. The only indication  
970 that the area was once cleared was that the forest trees were primarily alder and fir, while the  
971 surrounding area was a more mature forest growth consisting of fir, hemlock, and cedar. The  
972 length and coverage of the visual reconnaissance routes indicated in the SSWP could not be  
973 achieved due to the thick vegetation preventing traverse. No evidence of firing positions or  
974 target areas was identified during the visual reconnaissance, or could be observed on aerial  
975 photographs. Figure 7-1 shows the reconnaissance pathway completed for this AOC.

976 **7.3.2 MEC Risk Assessment**

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

981 Shaw completed a visual reconnaissance of the Transition Range 2. No MEC or munitions  
982 debris was observed or identified. MEC has not been reported historically and none was  
983 observed during the SI reconnaissance of the AOC. The MEC risk for this area is considered to  
984 be low based on the following:

- 985 • The AOC is a Transition Range and only small arms were reportedly used. No MEC or  
986 munitions debris has been reported in the over 50 years of park use;
- 987 • No MEC or munitions debris was identified during the SI visual reconnaissance.

988 **7.4 Munitions Constituents Evaluation**

989 Potential MC for Transition Range 2 is lead from bullets.

990 **7.4.1 Terrestrial Pathway**

991 Terrestrial receptors may be exposed to MC if the soil was directly exposed to lead from the  
992 firing of small arms. Two surface soil samples (NWO-039-0004 and NWO-039-0005) were  
993 proposed and collected and analyzed for lead by EPA Method SW-846 6020A. Sample locations  
994 and results are shown on Figure 7-2. Soil sample locations were selected in the field as indicated  
995 in the SSWP. Because no range surface features (firing points or targets) were identified,  
996 sampling locations were selected based on proximity to locations shown in the SSWP and  
997 accessibility.

998 The soil samples were collected from the upper 6 inches of soil after the removal of forest litter  
999 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*  
1000 *Work Plan* (Shaw, 2006a). Each sample was sieved by the laboratory with a # 10 sieve prior to  
1001 analysis to remove any particulate lead.

1002 **7.4.1.1 Comparison to Background Data**

1003 The detected lead concentrations of 6.7 mg/kg (NWO-039-0004) and 8.5 mg/kg (NWO-039-  
1004 0005) were compared to the soil background concentration (32.6 mg/kg). The comparisons are  
1005 shown on Table 7-1. The detected lead concentrations for both samples were below the Ft.  
1006 Flagler background concentration.

1007 **7.4.1.2 Comparison to Human Health Screening Values**

1008 Soil analytical results are only compared to human health screening values if background  
1009 concentrations are exceeded. Because there were no exceedances of background concentrations,  
1010 no comparison is completed.

1011 **7.4.1.3 Comparison to Ecological Screening Values**

1012 Soil analytical results are only compared to ecological screening values if background  
1013 concentrations are exceeded. Because there were no exceedances of background concentrations,  
1014 no comparison is completed.

1015 **7.4.2 Surface Water Pathway**

1016 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors  
1017 for sediments are park workers and visitors and wildlife. One sediment sample (NWO-039-  
1018 1003) and a field duplicate (NWO-039-1004) were proposed and collected and analyzed for lead  
1019 by EPA Method SW-846 6020A. The sample location and results are shown on Figure 7-2.

1020 The sediment sample was collected from a low area where water collected. The sediment sample  
1021 was a discrete sample. The sample was sieved by the laboratory with a # 10 sieve prior to  
1022 analysis to remove any particulate lead.

1023 **7.4.2.1 Comparison to Background Data**

1024 The sediment sample and field duplicate lead analytical results of 28.4 mg/kg (NWO-039-1003)  
1025 and 22 mg/kg (NWO-039-1004) were compared to the sediment background concentration of  
1026 12.8 mg/kg (Table 7-2). As discussed in Section 3.6.1 a significant exceedance of background is  
1027 indicated if the sample result is greater than 3 times the background value. The Transition Range  
1028 2 sediment sample and field duplicate do not significantly exceed background.

1029 **7.4.2.2 Comparison to Human Health Screening Values**

1030 Sediment analytical results are only compared to human health screening values if background  
1031 concentrations are significantly exceeded. Because there were no significant exceedances of  
1032 background concentrations, no comparison is completed.

1033 **7.4.2.3 Comparison to Ecological Screening Values**

1034 Sediment analytical results are only compared to ecological screening values if background  
1035 concentrations are significantly exceeded. Because there were no significant exceedances of  
1036 background concentrations, no comparison is completed.

1037 **7.4.3 Groundwater Pathway**

1038 Groundwater was initially considered a potentially affected media because it is present within  
1039 100 ft of ground surface. However, the groundwater pathway is not complete as there is no  
1040 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP  
1041 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were  
1042 planned or collected.

1043 **7.4.4 Air Pathway**

1044 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
1045 particles. However, air is not an affected media under current land use, thus the pathway is  
1046 incomplete.

## 1047 **8.0 Gas Chamber**

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### 1048 **8.1 History and Land Use**

1049 The Gas Chamber is a single AOC shown on Figure 8-1. The boundaries of this AOC were  
1050 taken from the INPR Supplement. The Gas Chamber was located in rooms inside the bunker of  
1051 Battery Wansboro after the artillery guns were removed. According to the INPR Supplement the  
1052 Gas Chamber was used between 1942 and 1954 to familiarize and train troops in the use of gas  
1053 masks. The room used for the gas chamber is empty. In the ARC (DoD, 2006), the Gas  
1054 Chamber is included in the Range Complex as well as Transition Range 1. In this ASR, the Gas  
1055 Chamber and Transition Range 1 AOCs are separated out from the batteries to allow for a more  
1056 efficient evaluation of all areas.

1057 Currently, the Gas Chamber AOC is part of the Ft. Flagler State Park, which offers camping,  
1058 boating, fishing, shoreline use, hiking, and historical interpretive information. The AOC is  
1059 located within Battery Wansboro on the southeast side of the FUDS. The AOC is used by  
1060 visitors on a daily basis. For the foreseeable future, it is likely that the Gas Chamber AOC will  
1061 continue to be part of the Ft. Flagler State Park.

### 1062 **8.2 Previous Investigations**

1063 The ASR team visited the gas chamber and reported that there was no remaining evidence of the  
1064 gas chamber.

### 1065 **8.3 MEC Evaluation**

1066 The only munitions identified as used at this AOC were gas grenades containing riot control  
1067 agent CN-1.

#### 1068 **8.3.1 Field Observations and Historical Evidence of MEC**

1069 The SI field team visited the location of the gas chamber and found no evidence of the chamber.  
1070 There have been no reports of any MEC or riot control gas canisters found at Ft. Flagler.

#### 1071 **8.3.2 MEC Risk Assessment**

1072 The following section presents a qualitative assessment of the risk associated with potential  
1073 MEC, as based on historical documentation. A MEC assessment is provided to convey relative  
1074 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be  
1075 conducted for an RI/FS.

1076 Shaw completed a visual reconnaissance of the Gas Chamber AOC. No MEC or munitions  
1077 debris was observed or identified. MEC has not been reported historically and none was

1078 observed during the SI reconnaissance of the AOC. The MEC risk for this area is considered to  
1079 be low based on the following:

- 1080 • The AOC is a gas chamber that was used to familiarize troops with the use of gas masks.  
1081 No munitions other than a riot control gas grenade would have been used in the chamber;
- 1082 • No MEC or munitions debris was identified during the SI visual reconnaissance.

#### 1083 ***8.4 Munitions Constituents Evaluation***

1084 Potential MC is CN gas that is generated either by burning a candle or activating a riot control  
1085 grenade.

##### 1086 ***8.4.1 Terrestrial Pathway***

1087 The use of the gas chamber was within rooms contained in the concrete bunker of Battery  
1088 Wansboro. As agreed to during the TPP process, riot control agents are not persistent and any  
1089 release to soil would be expected to be neutralized by weathering and time and not be present in  
1090 the soil today. There is no complete soil pathway and no soil samples were planned or collected  
1091 from this AOC.

##### 1092 ***8.4.2 Surface Water Pathway***

1093 Riot control agents are not persistent and any release to sediment or surface water would be  
1094 expected to be neutralized by weathering and time and not be present today. There is no  
1095 complete sediment or surface water pathway and no samples were planned or collected from this  
1096 AOC.

##### 1097 ***8.4.3 Groundwater Pathway***

1098 Groundwater is considered a potentially affected media because it is present within 100 ft of  
1099 ground surface. However, riot control agents are not persistent and any release to soil and  
1100 eventually groundwater would be expected to be neutralized by weathering and time and not be  
1101 present in the soil today. There is no complete groundwater pathway and no groundwater  
1102 samples were planned or collected.

##### 1103 ***8.4.4 Air Pathway***

1104 Air is a potential medium of concern because of the possibility of inhalation of contaminated soil  
1105 particles. However, air is not an affected media under current land use, thus the pathway is  
1106 incomplete.

## 1107 **9.0 Rocket Range**

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### 1108 **9.1 History and Land Use**

1109 The Rocket Range AOC (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw, 2006b]  
1110 and SSWP [Shaw, 2007]) was an amphibious assault training area located near the lower  
1111 campground at the Ft. Flagler State Park. This AOC is shown on Figure 9-1. A portion of this  
1112 AOC was cleared of UXO in 1992 (USACE, 1997) during a TCRA. The TCRA is discussed  
1113 below in Section 9.2. This AOC includes a 1000-inch Machine Gun Range, which was  
1114 identified on the War Department map that was obtained during the TPP meeting. The War  
1115 Department map is included in Appendix L.

1116 Currently, the Rocket Range AOC is part of the Ft. Flagler State Park, which offers camping,  
1117 boating, fishing, shoreline use, hiking, and historical interpretive information. A camping area is  
1118 located within this AOC. For the foreseeable future, it is likely that the Range Complex AOC  
1119 will continue to be part of the Ft. Flagler State Park.

1120 According to the ASR the Rocket Range was used between 1942 and 1954 for amphibious  
1121 assault exercises. Munitions used included 3.5-inch and 2.36-inch rockets, and small arms. The  
1122 1000-inch/Machine Gun Range included small arms and machine gun use. The two areas are  
1123 included as one AOC in this SI. The location of the beach portion of this AOC coincides with  
1124 the Debarkation Area identified in the War Department map (Appendix L). The map identified  
1125 the Debarkation Area as having “beach obstacles.”

### 1126 **9.2 Previous Investigations**

1127 In 1992, a UXO clearance was completed in the area of the Rocket Range. The objective of the  
1128 UXO clearance project was to “locate, identify, segregate, and dispose of suspected explosive  
1129 ordnance, inert ordnance, explosives, and ordnance debris” (IT, 1992). Geophysical surveys  
1130 using magnetometers were used to clear the surface and subsurface of UXO and munitions  
1131 debris. A section of the beach adjacent to the range was also cleared. The initial survey area  
1132 (Phase 1) was thought to be the most likely area of UXO contamination. However, the project  
1133 boundaries were later extended to the east to include additional impact area (Phase 2 area).  
1134 Figure 9-2 shows the area of the TCRA. The area contained within Phases 1 and 2 were “100  
1135 percent cleared” (USACE, 1997) and all UXO and munitions related debris were removed and  
1136 disposed. The area within Phase 3 was heavily timbered with heavy undergrowth. No brush  
1137 clearing was done in the Phase 3 area and a very limited clearance was performed because of the  
1138 heavy vegetation. Within the Phase 3 area, 3 live 2.36-inch rockets with warheads were found.  
1139 These were detonated by the 27<sup>th</sup> Army EOD unit from Fort Lewis. The following MEC and  
1140 munitions debris were recovered during the 1992 removal action.

- 1141 • 2.36-inch expended rocket motors (172 items);

- 1142 • 2.36-inch rockets with live warhead (3 items);
- 1143 • 2.36-inch rockets with live fuse (2 items);
- 1144 • 3.5-inch expended rocket motors (2 items);
- 1145 • 1 live training hand grenade;
- 1146 • 1 Bangalore torpedo fuse housing, inert;
- 1147 • Anti-tank/anti-vehicle mines, inert (12 items); and
- 1148 • Empty .30-caliber casings (16 items).

1149 The USACE issued a Closure Report for the range in 1996 (USACE, 1996). The Closure Report  
1150 evaluated three alternatives for the Rocket Range. The alternatives were: No Further Action;  
1151 Perform Additional Ordnance and Explosive Detection and Removal; and Barricade the  
1152 Ordnance and Explosive Site. The report concluded that based on the assessment of previous  
1153 removal activities and present safety risk to the general public, the No Further Action was  
1154 selected. The report concluded that the Phase 1 and 2 areas have been cleared of “recoverable  
1155 OE, with complete QC performed. The 100 percent search and removal action performed has  
1156 significantly reduced the public risk of exposure to OE.” For the Phase 3 area, No Further  
1157 Action was selected based on limited accessibility because of dense vegetation and excessive  
1158 cost to remove the dense vegetation to make geophysical investigation effective (USACE, 1996)

### 1159 **9.3 MEC Evaluation**

1160 Potential MEC within the Rocket Range AOC are listed on Table 2-1 and include rockets, hand  
1161 grenades, mines, and small arms. Explosive hazards from the mines and small arms are not  
1162 expected.

#### 1163 **9.3.1 Field Observations and Historical Evidence of MEC**

1164 A visual reconnaissance of the Rocket Range in the vicinity of the Phase 3 area of the 1992  
1165 TCRA was completed during the week of February 20, 2007. The location of the reconnaissance  
1166 area is in very heavily wooded area with dense undergrowth. No MEC or munitions debris was  
1167 identified. Figure 9-1 shows the reconnaissance pathway for this AOC.

1168 Historical evidence from the 1992 removal action indicates that no MEC or munitions debris  
1169 remains in the Phase 1 and 2 areas. However, the Phase 3 area may contain additional UXO or  
1170 munitions debris.

#### 1171 **9.3.2 MEC Risk Assessment**

1172 The following section presents a qualitative assessment of the risk associated with potential  
1173 MEC, as based on historical documentation. A MEC assessment is provided to convey relative

1174 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be  
1175 conducted for an RI/FS.

1176 The potential for MEC at the Rocket Range within the Phase 1 and 2 areas of the 1992 removal  
1177 action is low. However, within the Phase 3 area the potential is moderate. This is based on the  
1178 following:

- 1179 • A thorough UXO clearance was completed for the Phase 1 and 2 areas in 1992.
- 1180 • A USACE Closure Report (USACE, 1996) concluded that the clearance performed in the  
1181 Phase 1 and 2 areas had significantly reduced the risk to the public.
- 1182 • The Closure Report concluded that while the clearance was not totally completed, the  
1183 trees and dense vegetation provide a natural barricade to public accessibility.

#### 1184 **9.4 Munitions Constituents Evaluation**

1185 Potential MC for this AOC include explosives (including nitroglycerin and pentaerythritol  
1186 tetranitrate [PETN]), metals from steel (chromium, copper, iron, lead, and nickel), lead from  
1187 bullets, and perchlorate used in propellant for 3.5-inch rockets.

##### 1188 **9.4.1 Terrestrial Pathway**

1189 Terrestrial receptors may be exposed to MC because of releases from munitions that were used at  
1190 the Rocket Range. As agreed to during the TPP process three surface soil samples (NWO-039-  
1191 0006, NWO-039-0007, and NWO-039-0008) and one field duplicate (NWO-039-0009) were  
1192 proposed and collected and analyzed for select metals by EPA Method SW-846 6020A and  
1193 explosives, including nitroglycerine and pentaerythritol tetranitrate (PETN) using EPA Method  
1194 SW-846 8330A. Soil samples for perchlorate were not identified in the TPP Memo (Shaw  
1195 2006b) or SSWP (Shaw, 2007). Due to the high solubility of perchlorate in water and the large  
1196 amounts of precipitation that occurs at Ft Flagler, perchlorate is not expected to remain in the  
1197 soil. Sample locations and results are shown on Figures 9-3 and 9-4. The select metals list  
1198 consisted of chromium, copper, iron, lead, molybdenum, and nickel. These metals were selected  
1199 based on the expected metal constituents of sheet metal and cast iron munitions bodies and  
1200 bullets. Aluminum and manganese were also included in the select metals analysis list as they  
1201 may be useful in determining naturally occurring concentrations of metals in soils using the  
1202 method of Myers and Thorbjornsen (2004).

1203 The soil samples were collected from the upper 6 inches of soil after the removal of forest litter  
1204 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*  
1205 *Work Plan* (Shaw, 2006a). Samples NWO-039-0006 and NWO-039-0007 were collected from  
1206 locations where MEC or munitions debris were located during the 1992 removal action. The  
1207 location of sample NWO-039-0008 was selected from a location within the reconnaissance area  
1208 of the AOC near the location identified in the SSWP.

1209 **9.4.1.1 Comparison to Background Data**

1210 The detected metals concentrations in soil are listed on Table 9-1. There were no exceedances of  
1211 the SI background soil concentrations in any sample. Explosives were not detected.

1212 **9.4.1.2 Comparison to Human Health Screening Values**

1213 Soil analytical results are only compared to human health screening values if background  
1214 concentrations are exceeded. Because there were no exceedances of background concentrations,  
1215 no comparison is completed.

1216 **9.4.1.3 Comparison to Ecological Screening Values**

1217 Soil analytical results are only compared to ecological screening values if background  
1218 concentrations are exceeded. Because there were no exceedances of background concentrations,  
1219 no comparison is completed.

1220 **9.4.2 Surface Water Pathway**

1221 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors  
1222 for sediments are park workers and visitors and wildlife. One sediment sample (NWO-039-  
1223 1005) was proposed and collected and analyzed for select metals by EPA Method SW-846  
1224 6020A and explosives, including nitroglycerine and PETN, using EPA Method SW-846 8330A.  
1225 The sample location and results are shown on Figures 9-3 and 9-4.

1226 The sediment sample was collected from a low area where water collected. The sediment sample  
1227 was a discrete sample.

1228 **9.4.2.1 Comparison to Background Data**

1229 The sediment sample metals analytical results were compared to the sediment background  
1230 concentrations (Table 9-2). As discussed in Section 3.6.1 a significant exceedance of  
1231 background is indicted if the sample result is greater than 3 times the background value. The  
1232 Rocket Range sediment sample analytical results do not significantly exceeded background  
1233 concentrations. No explosives were detected.

1234 **9.4.2.2 Comparison to Human Health Screening Values**

1235 Sediment analytical results are only compared to human health screening values if background  
1236 concentrations are exceeded. Because there were no exceedances of background concentrations,  
1237 no comparison is completed.

1238 **9.4.2.3 Comparison to Ecological Screening Values**

1239 Sediment analytical results are only compared to ecological screening values if background  
1240 concentrations are exceeded. Because there were no exceedances of background concentrations,  
1241 no comparison is completed.

1242 **9.4.3 Groundwater Pathway**

1243 Groundwater was initially considered a potentially affected media because it is present within  
1244 100 ft of ground surface. However, the groundwater pathway is not complete as there is no  
1245 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP  
1246 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were  
1247 planned or collected.

1248 **9.4.4 Air Pathway**

1249 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
1250 particles. However, air is not an affected media under current land use, thus the pathway is  
1251 incomplete.

## 1252 ***10.0 Live Grenade Court***

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### 1253 ***10.1 History and Land Use***

1254 The Live Grenade Court is a single AOC as shown on Figure 10-1. This AOC is located in the  
1255 southeast corner of the FUDS and Ft. Flagler State Park and just north of the Practice Grenade  
1256 Court AOC. The AOC was used to train troops in the use of live grenades. The location of this  
1257 AOC is taken from the War Department map that was obtained during the TPP meeting. The  
1258 War Department map is included in Appendix L.

1259 Currently, the Live Grenade Court AOC is part of the Ft. Flagler State Park, which offers  
1260 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. For the  
1261 foreseeable future, it is likely that the Live Grenade Court AOC will continue to be part of the Ft.  
1262 Flagler State Park.

1263 The court is assumed to be used by the Army between 1942 and 1954. The court was used for  
1264 training in the use of live (explosive) and/or training hand grenades. Grenades were thrown from  
1265 individual throwing bays constructed from sandbags or concrete, or from a trench. Grenades  
1266 were thrown toward targets in an impact area approximately 25 yards from the throwing line (see  
1267 Figure 11 Conceptual Site Model Grenade Court; Appendix J). A danger area of approximately  
1268 600 ft beyond the court boundary would have been established around each court.

### 1269 ***10.2 Previous Investigations***

1270 There have been no previous investigations of this AOC. The AOC is only known from a War  
1271 Department map (Appendix L)

### 1272 ***10.3 MEC Evaluation***

1273 The likely munitions used included the Mk II fragmentation hand grenade. M21 practice  
1274 grenades, which contained only small spotting charges of black powder, may also have been  
1275 used. These munitions were in common usage during the period of use of this grenade court.

#### 1276 ***10.3.1 Field Observations and Historical Evidence of MEC***

1277 A visual reconnaissance survey of the Live Grenade Court was completed on February 20, 2007.  
1278 The location of the court is in a very heavily wooded area with dense undergrowth. No visual  
1279 evidence of the court could be identified due to the heavy vegetation. The only indication that  
1280 the area was once cleared was that the forest trees were primarily alder and fir, while the  
1281 surrounding area was a more mature forest growth consisting of fir, hemlock, and cedar. The  
1282 length and coverage of the visual reconnaissance routes indicated in the SSWP could not be  
1283 achieved due to the thick vegetation preventing traverse. No evidence of throwing bays or target  
1284 areas were identified during the visual reconnaissance, or on review of aerial photographs.  
1285 Figure 10-1 shows the reconnaissance pathway for this AOC.

1286 **10.3.2 MEC Risk Assessment**

1287 The following section presents a qualitative assessment of the risk associated with potential  
1288 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is  
1289 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1290 Based on the assumed presence of the Live Grenade Court from the War Department map  
1291 (Appendix L), the types of live munitions used at the court (Mk II Fragmentation Hand  
1292 Grenade), and the dense vegetation surrounding and within the Live Grenade Court the risk  
1293 associated with potential MEC is low.

1294 **10.4 Munitions Constituents Evaluation**

1295 Potential MC for the Live Grenade Court are explosives, cast iron, and steel (chromium, copper,  
1296 iron, lead, and nickel).

1297 **10.4.1 Terrestrial Pathway**

1298 Terrestrial receptors may be exposed to MC if there were releases from munitions that were used  
1299 at the Live Grenade Court. As agreed to during the TPP process, one surface soil sample (NWO-  
1300 039-0010) was proposed and collected and analyzed for select metals by EPA Method SW-846  
1301 6020A and explosives, including nitroglycerine and PETN using EPA Method SW-846 8330A.  
1302 The sample location and results are shown on Figures 10-2 and 10-3.

1303 The soil sample was collected from the upper 6 inches of soil after the removal of forest litter  
1304 (leaves, twigs, fir needles) and composited using the wheel method described in the *Final Type I*  
1305 *Work Plan* (Shaw, 2006a). The sample was collected from near the assumed center of the  
1306 grenade court as no evidence of target areas was identified during the reconnaissance.

1307 **10.4.1.1 Comparison to Background Data**

1308 Results from the metals analysis were compared to site background concentrations. Chromium  
1309 (36.3 mg/kg) and nickel (85.8 mg/kg) were detected above their respective background  
1310 concentrations of 35.2 mg/kg and 80.2 mg/kg. Explosives were not detected.

1311 **10.4.1.2 Comparison to Human Health Screening Values**

1312 Soil analytical results that exceeded background concentrations were compared to human health  
1313 screening values. The analytical results for chromium (36.3 mg/kg) and nickel (85.8 mg/kg)  
1314 were below their respective EPA Region 9 PRGs of 210 mg/kg and 1,600 mg/kg, respectively  
1315 (Table 10-1).

1316 **10.4.1.3 Comparison to Ecological Screening Values**

1317 Soil analytical results that exceeded background concentrations were compared to ecological  
1318 screening values. The analytical result for chromium (36.3 mg/kg) was below its respective  
1319 ecological screening level of 42 mg/kg. The analytical result for nickel (85.8 mg/kg) was above  
1320 the ecological screening level of 30 mg/kg. A SLERA was completed for the elevated nickel

1321 concentration in soil. The evaluation concluded that while the sample concentration exceeded  
1322 the most conservative screening level (plants), the site background concentration (80.2 mg/kg)  
1323 also exceeded the screening level by a nearly equal amount. This suggests that the screening  
1324 value is not appropriate for this site. The soil invertebrate and wildlife screening values are  
1325 higher than the background and sample concentrations. A copy of the SLERA is provided in  
1326 Appendix L. Based on this evaluation, the nickel concentration in soil is not an ecological  
1327 concern.

#### 1328 *10.4.2 Surface Water Pathway*

1329 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors  
1330 for sediments are park workers and visitors and wildlife. As agreed to during the TPP process no  
1331 sediment samples were to be collected from the Live Grenade Court as the land surface is flat  
1332 and no overland flow is expected.

#### 1333 *10.4.3 Groundwater Pathway*

1334 Groundwater was initially considered a potentially affected media because it is present within  
1335 100 ft of ground surface. However, the groundwater pathway is not complete as there is no  
1336 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP  
1337 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were  
1338 planned or collected.

#### 1339 *10.4.4 Air Pathway*

1340 Air is a potential medium of concern because of the possibility of inhalation of contaminated soil  
1341 particles. However, air is not an affected media under current land use, thus the pathway is  
1342 incomplete.

## 1343 **11.0 Practice Grenade Court**

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### 1344 **11.1 History and Land Use**

1345 The Practice Grenade Court is a single AOC as shown on Figure 11-1. This AOC is located in  
1346 the southeast corner of the FUDS and Ft. Flagler State Park and just south of the Live Grenade  
1347 Court AOC. The location of this AOC is taken from the War Department map that was obtained  
1348 during the TPP meeting. This War Department map is included in Appendix L. The AOC was  
1349 used to train troops in the use of grenades using either inert grenades or grenades with small  
1350 spotting charges.

1351 Currently, the Practice Grenade Court AOC is part of the Ft. Flagler State Park, which offers  
1352 camping, boating, fishing, shoreline use, hiking, and historical interpretive information. For the  
1353 foreseeable future, it is likely that the Practice Grenade Court AOC will continue to be part of the  
1354 Ft. Flagler State Park. The AOC is within a heavily forested area with heavy underbrush.

1355 The AOC is assumed to have been used between 1942 and 1954 similar to other troop training  
1356 activities at Ft. Flagler. The courts were used for training in the use of practice and/or training  
1357 hand grenades. Grenades were thrown from individual throwing bays constructed from sandbags  
1358 or concrete, or from a trench. Grenades were thrown toward targets in an impact area  
1359 approximately 25 yards from the throwing line (see Figure 11 Conceptual Site Model Grenade  
1360 Court; Appendix J). No danger area would have been established around a practice grenade  
1361 court.

### 1362 **11.2 Previous Investigations**

1363 There have been no previous investigations of this AOC. The AOC is only known from a War  
1364 Department map (Appendix L)

### 1365 **11.3 MEC Evaluation**

1366 The munitions used at the practice courts likely would have included the Mk1A1 training  
1367 grenades, an inert device made of cast iron with the approximate shape, size, and weight of an  
1368 actual hand grenade. The munitions used at the practice court may also have included the M21  
1369 practice grenades, reusable devices which contained only small charges of black powder to  
1370 simulate the detonation of a live grenade. These munitions were in common use for the period of  
1371 use of this practice court.

#### 1372 **11.3.1 Field Observations and Historical Evidence of MEC**

1373 A visual reconnaissance survey of the Practice Grenade Court was completed on February 20,  
1374 2007. The location of the court is in a very heavily wooded area with dense undergrowth. No  
1375 visual evidence of the range could be identified due to the heavy vegetation. The only indication  
1376 that the area was once cleared was that the forest trees were primarily alder and fir, while the

1377 surrounding area was a more mature forest growth consisting of fir, hemlock, and cedar. The  
1378 length and coverage of the visual reconnaissance routes indicated in the SSWP could not be  
1379 achieved due to the thick vegetation preventing traverse. No evidence of throwing bays or target  
1380 areas were identified during the visual reconnaissance, or from review of aerial photographs.  
1381 Figure 11-1 shows the reconnaissance pathway for this AOC.

### 1382 *11.3.2 MEC Risk Assessment*

1383 The following section presents a qualitative assessment of the risk associated with potential  
1384 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is  
1385 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1386 Based on the assumed presence of the Practice Grenade Court from the War Department map  
1387 (Appendix L) and the types of practice munitions used at the court that only contained a small  
1388 spotting charge (Mk 1A1 Practice Hand Grenade and M21 Practice Hand Grenade), the risk  
1389 associated with potential MEC is low.

## 1390 *11.4 Munitions Constituents Evaluation*

1391 Potential MC for the Practice Grenade Court would be metals from steel (chromium, copper,  
1392 iron, lead, and nickel). The only explosive was black powder, which consists of potassium  
1393 nitrate, sulfur, and charcoal.

### 1394 *11.4.1 Terrestrial Pathway*

1395 Terrestrial receptors may be exposed to MC if there were releases from munitions that were used  
1396 at the Practice Grenade Court. As agreed to during the TPP process, there are no MC of concern  
1397 associated with practice grenades. No soil samples were collected from this practice grenade  
1398 court.

### 1399 *11.4.2 Surface Water Pathway*

1400 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors  
1401 for sediments are park workers and visitors and wildlife. As agreed to during the TPP process,  
1402 no sediment samples were to be collected from the Practice Grenade Court as the potential MC is  
1403 iron from grenade bodies and black powder, which contains no hazardous substances. In  
1404 addition, the land surface at the Practice Grenade Court is flat and no overland flow is expected.

### 1405 *11.4.3 Groundwater Pathway*

1406 Groundwater was initially considered a potentially affected media because it is present within  
1407 100 ft of ground surface. However, the groundwater pathway is not complete as there is no  
1408 source of MC and no downgradient groundwater users in the area. As agreed to during the TPP  
1409 process, groundwater is not a complete pathway at Ft. Flagler. No groundwater samples were  
1410 planned or collected.

1411 **11.4.4 Air Pathway**

1412 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
1413 particles. However, air is not an affected media under current land use, thus the pathway is  
1414 incomplete.

## 1415 **12.0 Rifle Range**

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### 1416 **12.1 History and Land Use**

1417 The Rifle Range is a single AOC shown on Figure 12-1. According to the ASR there was a rifle  
1418 range near the lighthouse when Ft. Flagler was first built. The butt to this range was torn down  
1419 in 1932 to salvage lead and copper from the expended bullets. A new range was reportedly built  
1420 on the same location during World War II. The range was used to train troops in the use of small  
1421 arms.

1422 Currently, the Rifle Range AOC is part of the Ft. Flagler State Park, which offers camping,  
1423 boating, fishing, shoreline use, hiking, and historical interpretive information. This AOC is  
1424 located near the lighthouse at Marrowstone Point. Hiking trails traverse the Rifle Range AOC,  
1425 and an interpretive trail occupies the rifle range location.

1426 The target area was cleared of brush by State Park volunteers and one of the targets was  
1427 reconstructed. The configuration of this range is firing from south to north. The berm in front of  
1428 the targets is clearly visible and State Park volunteers have reported that a wall was built behind  
1429 the targets to protect the power plant below Battery Lee. For the foreseeable future, it is likely  
1430 that the Range Complex AOC will continue to be part of the Ft. Flagler State Park.

1431 According to the ASR, the Rifle Range was used between 1942 and 1954 for small arms use, and  
1432 use of the area as a range likely occurred as far back as 1900.

### 1433 **12.2 Previous Investigations**

1434 The INPR, INPR Supplement, and ASR identified the Rifle Range. The ASR team visited the  
1435 Rifle Range and noted that the range was positioned such that “the land between the firing lines  
1436 and the butts is a wetland affected by tides...; the range couldn’t be used for anything other than  
1437 a known distance range for rifles or carbines.”

### 1438 **12.3 MEC Evaluation**

1439 Because this AOC was used for small arms only, MEC (other than small arms) is not expected to  
1440 be present.

#### 1441 **12.3.1 Field Observations and Historical Evidence of MEC**

1442 A visual reconnaissance, without the use of a magnetometer, was completed on February 22,  
1443 2007. During the visual reconnaissance, the field team noted a target berm and a reconstructed  
1444 target. No MEC or munitions debris was identified.

1445 The ASR field team noted that because of the wetlands area between the firing lines and target  
1446 the range would only have been used for small arms use.

1447 **12.3.2 MEC Risk Assessment**

1448 The following section presents a qualitative assessment of the risk associated with potential  
1449 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is  
1450 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1451 The CSM for this range is that it was used only for small arms training. This was confirmed  
1452 during the SI field reconnaissance. Based on this, the risk associated with potential MEC is low  
1453 at the Rifle Range.

1454 **12.4 Munitions Constituents Evaluation**

1455 The potential MC for the Rifle Range is lead.

1456 **12.4.1 Terrestrial Pathway**

1457 Terrestrial receptors may be exposed to MC if the soil was directly exposed to lead from the  
1458 firing of small arms. Two surface soil samples (NWO-039-0011 and NWO-039-0012) were  
1459 proposed and collected and analyzed for lead by EPA Method SW-846 6020A. Sample locations  
1460 and results are shown on Figure 12-2. Soil sample locations were from the top and bottom of the  
1461 target berm as indicated in the SSWP.

1462 The soil samples were collected from the upper 6 inches of soil after the removal of vegetation  
1463 and composited using the wheel method described in the *Final Type I Work Plan* (Shaw, 2006a).  
1464 Each sample was sieved by the laboratory with a # 10 sieve prior to analysis to remove any  
1465 particulate lead.

1466 **12.4.1.1 Comparison to Background Data**

1467 The detected lead concentrations were compared to the soil background concentrations. The  
1468 comparison is shown on Table 12-1. The detected lead concentrations of 235 mg/kg (sample  
1469 NWO-039-0011) and 587 mg/kg (sample NWO-039-0012) were above the Ft. Flagler  
1470 background concentration of 32.6 mg/kg.

1471 **12.4.1.2 Comparison to Human Health Screening Values**

1472 Soil lead analytical results are only compared to human health screening values if background  
1473 concentrations are exceeded. Analytical results from both samples exceeded background. The  
1474 lead analytical results were compared to the EPA Region 9 Residential PRG of 400 mg/kg. Only  
1475 the result from sample NWO-039-0012 (587 mg/kg) exceeded the human health screening value  
1476 of 400 mg/kg.

1477 **12.4.1.3 Comparison to Ecological Screening Values**

1478 Soil lead analytical results are only compared to ecological screening values if background  
1479 concentrations are exceeded. Analytical results from both samples exceeded background. The  
1480 lead analytical results were compared to the ecological screening value of 50 mg/kg. Both  
1481 sample results exceed the screening value. A SLERA was completed for the elevated lead

1482 concentration. The SLERA concluded that the lead concentration exceeded both the plant, soil  
1483 invertebrate, and wildlife ecological screening values and that the elevated lead concentration is  
1484 a concern at the Rifle Range. A copy of the SLERA is included in Appendix L.

#### 1485 *12.4.2 Surface Water Pathway*

1486 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors  
1487 for sediments are park workers and visitors and wildlife. One sediment sample (NWO-039-  
1488 1006) was proposed and collected and analyzed for lead by EPA Method SW-846 6020A. The  
1489 sample location and results are shown on Figure 12-2.

1490 A discrete sediment sample was collected from in front of the target berm where soils may have  
1491 washed down the slope. The sample was sieved by the laboratory with a # 10 sieve prior to  
1492 analysis to remove any particulate lead.

##### 1493 *12.4.2.1 Comparison to Background Data*

1494 The sediment sample (NWO-039-1006) lead analytical result (219 mg/kg) was compared to the  
1495 sediment background concentration of 12.8 mg/kg (Table 12-2). As discussed in Section 3.6.1, a  
1496 significant exceedance of background is indicated if the sample result is greater than 3 times the  
1497 background value. The Rifle Range sediment sample significantly exceeded background.

##### 1498 *12.4.2.2 Comparison to Human Health Screening Values*

1499 The sediment lead analytical result (219 mg/kg) significantly exceeded the background  
1500 concentration (12.8 mg/kg) but did not exceed the human health screening value of 400 mg/kg.

##### 1501 *12.4.2.3 Comparison to Ecological Screening Values*

1502 The sediment lead analytical result (219 mg/kg) significantly exceeded the background  
1503 concentration (12.8 mg/kg) but did not exceed the ecological screening value of 260 mg/kg.

#### 1504 *12.4.3 Groundwater Pathway*

1505 Groundwater was initially considered a potentially affected media because it is present within  
1506 100 ft of ground surface. However, the groundwater pathway is not complete as there are no  
1507 downgradient groundwater users in the area. As agreed to during the TPP process, groundwater  
1508 is not a complete pathway at Ft. Flagler. No groundwater samples were planned or collected.

#### 1509 *12.4.4 Air Pathway*

1510 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
1511 particles. Air may be an affected media due to the high (10 ft) berm and exposure to wind.  
1512 Exposure to soil particles through inhalation is included in the development of health-based  
1513 screening values for soil. As described in Section 12.4.1, one soil sample contained lead above  
1514 the human health screening value.

## 1515 **13.0 Demolition Area**

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### 1516 **13.1 History and Land Use**

1517 The Demolition Area is a single AOC shown on Figure 13-1. This AOC was not identified until  
1518 the TPP meeting, when the location was shown on the old War Department map (Appendix L).  
1519 The AOC is located in the northwest corner of the FUDS in an embayment. The War  
1520 Department map indicated the area was within a tidal zone that flooded at each high tide. The  
1521 area has since been backfilled with gravel and soil to create a picnic and camping area that is  
1522 several feet above the high tide mark. The grass is mowed regularly during the growing season.  
1523 The depth to the demolition area may be as much as 10 ft, based on comparison of current land  
1524 elevation and likely elevation of tidal zone prior to backfilling. All that is known of this area is  
1525 from the War Department Map and the notation “Demolition Area.” Based on the name of the  
1526 area from the War Department map, the area is thought to have been an OB/OD area, where  
1527 munitions that were no longer useful or damaged were destroyed.

1528 Currently, the Demolition Area AOC is part of the Ft. Flagler State Park, which offers camping,  
1529 boating, fishing, shoreline use, hiking, and historical interpretive information. This AOC is  
1530 located near the lower campground, and used for picnicking, camping, and beach combing. For  
1531 the foreseeable future, it is likely that the Demolition Area AOC will continue to be part of the  
1532 Ft. Flagler State Park.

1533 There is no record of the dates of use for the Demolition Area. However, based on use of other  
1534 training ranges and maneuver areas, the likely period of use is 1942 to 1954.

### 1535 **13.2 Previous Investigations**

1536 There have been no previous investigations at this AOC.

### 1537 **13.3 MEC Evaluation**

1538 The types of munitions destroyed at this AOC are unknown. However, on the War Department  
1539 map legend the words “Rifle Grenade” were written under “Demolition Area.” This may  
1540 indicate that rifle grenades (M6A1, M7A1, M28, and M29 rockets) used at the Debarkation Area  
1541 and Rocket Range were the munitions destroyed at the AOC. There is also the potential that  
1542 discarded propellant bags and high explosives from the artillery batteries were also detonated at  
1543 this location.

#### 1544 **13.3.1 Field Observations and Historical Evidence of MEC**

1545 A visual reconnaissance of the Demolition Area was completed on February 22, 2007. The  
1546 visual reconnaissance was completed along the shoreline where potential MEC or munitions  
1547 debris might be visible due to shoreline erosion. No evidence of MEC or munitions debris was  
1548 found. There have been no historical finds of MEC or debris at this AOC.

1549 **13.3.2 MEC Risk Assessment**

1550 The following section presents a qualitative assessment of the risk associated with potential  
1551 MEC, as based on historical documentation. A MEC assessment is provided to convey relative  
1552 risk on a scale from low to high and is not intended to be a thorough risk assessment as would be  
1553 conducted for an RI/FS.

1554 Based on the assumed former use of this AOC as a demolition area and the fact that the area has  
1555 been backfilled, the risk of encountering MEC on the ground surface is considered low. MEC  
1556 may be present in the subsurface.

1557 **13.4 Munitions Constituents Evaluation**

1558 Potential MC at this AOC include chromium, copper, iron, lead, molybdenum, and nickel, and  
1559 explosives including nitroglycerin and PETN.

1560 **13.4.1 Terrestrial Pathway**

1561 Terrestrial receptors may be exposed to MC if there were releases from munitions that were  
1562 disposed at Demolition Area. As agreed to during the TPP process, no soil samples were  
1563 collected from this AOC. The area has been backfilled with soil as much as 10 ft thick. The soil  
1564 is assumed to be free of MC and no soil sampling was necessary. MC could be present in  
1565 subsurface soils where munitions were destroyed. No subsurface soil sampling was completed  
1566 as agreed to during the TPP process.

1567 **13.4.2 Surface Water Pathway**

1568 The surface water pathway at Ft. Flagler is evaluated through sediments. The potential receptors  
1569 for sediments are park workers and visitors and wildlife. As agreed to during the TPP process no  
1570 sediment samples were to be collected from the Demolition Area as the CSM did not indicate the  
1571 likely presence of MC in sediments due to the buried nature of the AOC.

1572 **13.4.3 Groundwater Pathway**

1573 Groundwater was initially considered a potentially affected media because it is present within  
1574 100 ft of ground surface. However, the groundwater pathway is not complete as there are no  
1575 downgradient groundwater users in the area. As agreed to during the TPP process, groundwater  
1576 is not a complete pathway at Ft. Flagler. No groundwater samples were planned or collected.

1577 **13.4.4 Air Pathway**

1578 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
1579 particles. However, air is not an affected media under current land use, thus the pathway is  
1580 incomplete.

## 1581 *14.0 Quartermaster Wharf Disposal Area*

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### 1582 *14.1 History and Land Use*

1583 The Quartermaster Wharf Disposal Area is a single AOC shown on Figure 14-1. The boundaries  
1584 of this AOC were taken from the ASR. The boundary has been expanded to the west, toward the  
1585 shore to account for additional beach area that may have been used for disposal. Figure 14-1  
1586 indicates the extent of the expansion of the boundary. The Quartermaster Wharf Disposal Area  
1587 AOC consists of the beach south of the old wharf. According to the ASR this AOC was used as  
1588 a disposal area, and several rounds of .30-caliber ammunition were recovered from the area by a  
1589 State Park volunteer. The ASR indicated that it appeared that unwanted supplies were disposed  
1590 to the beach.

1591 Currently, the Quartermaster Wharf Disposal Area AOC is part of the Ft. Flagler State Park,  
1592 which offers camping, boating, fishing, shoreline use, hiking, and historical interpretive  
1593 information. This AOC is located near Battery Wansboro, and makes up the eastern shore of the  
1594 Park. For the foreseeable future, it is likely that the Quartermaster Wharf Disposal Area AOC  
1595 will continue to be part of the Ft. Flagler State Park.

### 1596 *14.2 Previous Investigations*

1597 The only previous investigation was the visit by the ASR team in 2003.

### 1598 *14.3 MEC Evaluation*

1599 Potential MEC for the Quartermaster Wharf Disposal Area includes all munitions used at Ft.  
1600 Flagler as listed on Table 2-1.

#### 1601 *14.3.1 Field Observations and Historical Evidence of MEC*

1602 The only reported munitions recovered from this area are small arms rounds. However, other  
1603 ordnance may have been disposed.

#### 1604 *14.3.2 MEC Risk Assessment*

1605 The following section presents a qualitative assessment of the risk associated with potential  
1606 MEC. A MEC assessment is provided to convey relative risk on a scale from low to high and is  
1607 not intended to be a thorough risk assessment as would be conducted for an RI/FS.

1608 Based on the assumed former use of this AOC as a disposal area for discarded supplies from the  
1609 Quartermaster Wharf, the finding of small arms rounds on the beach, and constant wave action  
1610 on the beach that would weather any MEC, the risk of encountering MEC on the beach is  
1611 considered low.

1612 **14.4 Munitions Constituents Evaluation**

1613 Potential MC for the Quartermaster Wharf Disposal Area includes explosives (including  
1614 nitroglycerin and PETN) and metals. However, because the area may have been used to dispose  
1615 of materials other than munitions that contained metals, metals were not considered a chemical  
1616 of concern for this AOC. This was as agreed to during the TPP process.

1617 **14.4.1 Terrestrial Pathway**

1618 Terrestrial receptors may be exposed to MC if there were releases from munitions that were  
1619 disposed at the Quartermaster Wharf Disposal Area. One soil sample (NWO -039-0013) was  
1620 collected from the beach south of Quartermaster Wharf. The sample was analyzed for  
1621 explosives, including nitroglycerin and PETN using EPA Method SW-846-8330A. Metals were  
1622 not included in the analysis suite as disposal of materials containing metals other than munitions  
1623 may have impacted the beach. The sampling location and results are shown in Figure 14-2.

1624 **14.4.1.1 Comparison to Background Data**

1625 There were no detections of explosive compounds in the sample from Quartermaster Wharf  
1626 Disposal Area.

1627 **14.4.2 Surface Water Pathway**

1628 The potential receptors for sediments are park workers and visitors and wildlife. There were no  
1629 detections of explosive compounds in the sample from Quartermaster Wharf Disposal Area, and  
1630 thus there is no exposure to the surface water pathway.

1631 **14.4.3 Groundwater Pathway**

1632 The exposure pathway to groundwater is interrupted by the presence of the Puget Sound tidal  
1633 zone. Any potential exposure to groundwater would be circumvented by the exposure to surface  
1634 water. Thus, the groundwater pathway is incomplete for the Quartermaster Wharf Disposal  
1635 Area.

1636 **14.4.4 Air Pathway**

1637 Air is a potential medium of concern if there is a possibility of inhalation of contaminated soil  
1638 particles. However, air is not an affected media under current land use, thus the pathway is  
1639 incomplete.

## 1640 *15.0 Summary and Conclusions*

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1641 The conclusions of the SI are presented in this section. Recommendations for further action are  
1642 presented in Section 16.0. Updated CSMs are presented in Appendix J.

1643 The former Ft. Flagler is included on the MMRP Inventory in the ARC (DoD, 2006), and in the  
1644 *INPR Supplement* (USACE, 2004b). Three ranges were identified: The Range Complex, Rocket  
1645 Range, and Transition Range 2. The Range Complex contains 11 subranges, including all 9  
1646 artillery batteries, Transition Range 1 and the Gas Chamber. The MMRP Inventory listed  
1647 Transition Range 2; however, the location was not specified and the *INPR Supplement* stated  
1648 that the location was unknown. The ASR (USACE, 2005b) identified a Rifle Range and the  
1649 Quartermaster Wharf Disposal Area.

1650 Information obtained at the TPP meeting identified additional areas of munitions use at Ft.  
1651 Flagler. These additional areas included the Ammunition Bunker, the location of Transition  
1652 Range 2, Live and Practice Grenade Courts, and a Demolition Area.

1653 During the TPP process, the ranges identified in the MMRP Inventory, the ASR, and at the TPP  
1654 meeting were organized into 11 AOCs. The organization allowed for the development of data  
1655 needs and sampling strategies. Transition Range 1 and the Gas Chamber were named as their  
1656 own AOCs, rather than grouping them in the Range Complex with the artillery batteries. The 11  
1657 AOCs at Ft. Flagler include the Range Complex (includes all artillery bunkers), Ammunition  
1658 Bunker, Transition Range 1, Transition Range 2, Gas Chamber, Rocket Range, Live Grenade  
1659 Court, Practice Grenade Court, Rifle Range, Demolition Area, and Quartermaster Wharf  
1660 Disposal Area.

1661 For MRSPP scoring, Transition Range 1 and the Gas Chamber are included in The Range  
1662 Complex.

### 1663 *15.1 Range Complex*

1664 No MEC or evidence of MEC, or munitions debris was encountered during the SI visual  
1665 reconnaissance at the land area of the Range Complex. No evaluation of the beach, near-shore,  
1666 or offshore areas was completed. The artillery gun configuration at the batteries would not allow  
1667 downward firing at near-shore targets. All firing from the artillery batteries was at targets  
1668 located several thousand feet out in the open waters of Puget Sound, where water depths are as  
1669 much as several hundred feet. The risk associated with exposure to potential MEC is low.

1670 As agreed to during the TPP process, no soil or sediment samples were planned or collected from  
1671 the Range Complex. The storage and use of propellants and projectiles at the artillery batteries  
1672 was entirely within each battery and transportation of all munitions was along well maintained  
1673 roads.

1674 **15.2 Ammunition Bunker**

1675 No MEC, evidence of MEC, or munitions debris was encountered during the SI visual  
1676 reconnaissance in the area of the reported Ammunition Bunker. The Ammunition Bunker is only  
1677 known from a War Department map (Appendix L). The location shown on the map was  
1678 searched and no evidence of the bunker was found. The risk associated with potential MEC is  
1679 low.

1680 Provisional soil and sediment samples were identified for this AOC if evidence of MEC or  
1681 munitions debris were located. As discussed above no evidence of the presence of the bunker or  
1682 MEC or munitions debris was identified. Therefore, no soil or sediment sampling was  
1683 completed.

1684 **15.3 Transition Range 1**

1685 The northern portion of the AOC is used for picnicking and parking. The park's waste water  
1686 treatment plant is also located in the northern part of the AOC. The remainder of the AOC is  
1687 heavily wooded with thick undergrowth. Transition Range 1 is a small arms range and no MEC,  
1688 other than small arms would be expected. A visual reconnaissance of Transition Range 1 was  
1689 completed and no MEC or munitions debris was identified. The risk associated with potential  
1690 MEC is low.

1691 Two surface soil samples and one sediment sample were collected from the AOC and analyzed  
1692 for lead only. Lead concentrations in both soil samples were below the Ft. Flagler soil  
1693 background concentration. The lead concentration in the sediment sample significantly exceeded  
1694 (three times background) the sediment background concentration, but was below the human  
1695 health and ecological screening values.

1696 **15.4 Transition Range 2**

1697 Transition Range 2 is a small arms range and no MEC, other than small arms would be expected.  
1698 The AOC is heavily forested with thick undergrowth. No evidence of the range was found  
1699 during the visual reconnaissance and no MEC or munitions debris was identified. The risk  
1700 associated with potential MEC is low.

1701 Two surface soil samples and one sediment sample were collected from the AOC and analyzed  
1702 for lead. Lead concentrations in both soil samples were below the Ft. Flagler soil background  
1703 concentration. The lead concentration in the sediment sample did not significantly exceed the  
1704 sediment background concentration. Therefore, no comparison to human health or ecological  
1705 screening values was completed.

1706 **15.5 Gas Chamber**

1707 The Gas Chamber was located within rooms inside of the bunker for Battery Wansboro. The  
1708 AOC was visited during the SI field activities and found no evidence of the chamber other than

1709 the rooms in the bunker. The only munitions reported to have been used were gas grenades  
1710 containing riot control agent CN-1, which have low explosive hazard. No MEC or munitions  
1711 debris were identified during the visit. The risk associated with potential MEC is low.

1712 As agreed to during the TPP process no sampling of the gas chamber was completed.

### 1713 *15.6 Rocket Range*

1714 The Rocket Range (Rifle Grenade/Anti-Tank Rocket Range in TPP Memo [Shaw, 2006b] and  
1715 SSWP [Shaw, 2007]) AOC was an amphibious assault training area located near the lower  
1716 campground at the Ft. Flagler State Park. A portion of this AOC was cleared of UXO in 1992  
1717 (USACE, 1997) during a TCRA. This AOC includes a 1000-inch Machine Gun Range, which  
1718 was identified on the War Department map that was obtained during the TPP meeting (Appendix  
1719 L).

1720 During the 1992 TCRA, two areas of the AOC had a 100 percent clearance completed and in a  
1721 third area only a limited clearance was completed due to thick forest and heavy undergrowth.

1722 During the TCRA over 200 munitions items were recovered and disposed of, including three  
1723 2.36-inch rockets with live warheads. A closure report for the area covered during the TCRA  
1724 was completed in 1996 (USACE, 1996) and the No Further Action alternative was selected  
1725 based on an assessment of previous clearance activities and present risk to public.

1726 During the SI, a visual reconnaissance was completed in the area that received only a limited  
1727 clearance during the TCRA. No MEC, evidence of MEC, or munitions debris was found. There  
1728 is potential for MEC to be present in areas within the AOC that did not receive 100 percent  
1729 clearance. The risk associated with potential MEC is moderate.

1730 Three soil samples and one sediment sample were collected from this AOC. The samples were  
1731 analyzed for select metals and explosives, including nitroglycerin and PETN. The soil and  
1732 analytical results were all below site background concentrations, and the results from the  
1733 sediment sample did not significantly exceed background concentrations. No explosive  
1734 compounds were detected in any sample. Because all results were below background  
1735 concentrations no evaluation of human health or ecological risk was completed.

### 1736 *15.7 Live Grenade Court*

1737 The Live Grenade Court is located in the southeast corner of the site. The location is only  
1738 known from a War Department map, circa 1945. A visual reconnaissance was completed during  
1739 the SI and no surface features were identified that could be related to the court. The only  
1740 indication that the area was once cleared was that the forest trees were primarily alder and fir  
1741 while the surrounding forest was fir, hemlock, and cedar (older growth forest). Munitions used  
1742 at the Live Grenade Court included Mk II fragmentation hand grenades and M21 practice hand  
1743 grenades. No evidence of MEC or munitions debris was located. However, because of the

1744 heavy vegetation, the presence of MEC may have been undetected. The risk associated with  
1745 potential MEC is low.

1746 One soil sample was collected from the Live Grenade Court. There were no sediment samples  
1747 collected from the Live Grenade Court. Chromium and nickel were detected above their  
1748 respective background concentration. These results were compared to human health risk  
1749 screening values and were below the screening values. Based on this, there is no risk to human  
1750 health at the Live Grenade Court. These results were also compared to ecological risk screening  
1751 values. The detected chromium concentration was below the ecological risk screening value, but  
1752 the nickel concentration was above. A SLERA was completed for the elevated nickel  
1753 concentration in soil. The evaluation concluded that while the sample concentration exceeded  
1754 the most conservative screening level (plants), the site background concentration also exceeded  
1755 the screening level by a nearly equal amount. This suggests that the screening value is not  
1756 appropriate for this site. The soil invertebrate and wildlife screening values are higher than the  
1757 background and sample concentrations. Based on this evaluation the nickel concentration in soil  
1758 is not an ecological concern.

### 1759 *15.8 Practice Grenade Court*

1760 The Practice Grenade Court is located in the southeast corner of the site. The location is only  
1761 known from a War Department map, circa 1945. A visual reconnaissance was completed during  
1762 the SI and no surface features were identified that could be related to the court. The only  
1763 indication that the area was once cleared was that the forest trees were primarily alder and fir  
1764 while the surrounding forest was fir, hemlock, and cedar (older growth forest). Munitions used  
1765 at the Practice Grenade Court consisted of M21 practice hand grenades and MK 1 1A1 practice  
1766 hand grenade. Both have explosive charges. No evidence of MEC or munitions debris was  
1767 located. The risk associated with potential MEC is low.

1768 As agreed to during the TPP process no soil or sediment samples were collected from the  
1769 Practice Grenade Court, due to the low risk of MC constituents (black powder and iron from  
1770 grenade bodies.

### 1771 *15.9 Rifle Range*

1772 The Rifle Range is located in the northeast corner of the FUDS and was used for training troops  
1773 in the use of small arms. Only small arms were used at the AOC. No evidence of MEC or  
1774 munitions debris was located during a visual reconnaissance of the AOC. The risk associated  
1775 with potential MEC is low.

1776 Two soil samples and one sediment sample was collected from in from of the target berm at the  
1777 AOC and analyzed for lead only. The lead concentration in both soil samples exceeded the  
1778 background concentration for lead. One soil sample exceeded the human health risk screening  
1779 value and both soil samples exceeded the ecological risk screening value. A SLERA was

1780 completed for the elevated lead concentration in soil. The SLERA concluded that the lead  
1781 concentration exceeded both the plant, soil invertebrate, and wildlife ecological screening values  
1782 and that the elevated lead concentration is a concern at the Rifle Range.

1783 The lead concentration in the sediment sample significantly exceeded the background  
1784 concentration. The sediment sample lead concentration was below the human health risk  
1785 screening value and the ecological risk screening value.

### 1786 *15.10 Demolition Area*

1787 The Demolition Area is located in the northwest corner of the FUDS near the lower camping  
1788 area. The AOC is known only from a War Department map, circa 1945. The War Department  
1789 map indicated the area was within a tidal zone that flooded at each high tide. The area has since  
1790 been backfilled with gravel and soil to create a picnic and camping area that is several feet above  
1791 the high tide mark. The grass is mowed regularly during the growing season. The depth to the  
1792 demolition area may be as much as 10 ft. All that is known of this area is from the War  
1793 Department Map and the notation "Demolition Area." The area is thought to have been an  
1794 OB/OD area, where munitions that were no longer useful or damaged were destroyed.

1795 A visual reconnaissance was completed during the SI field activities. No MEC, evidence of  
1796 MEC, or munitions debris was identified. The risk associated with potential MEC at the surface  
1797 is low. However, the potential for subsurface MEC is unknown.

1798 As agreed to during the TPP process no soil or sediment sample were to be collected from this  
1799 AOC. This was based on the assumption that the demolition area was buried under several feet  
1800 to as much as 10 feet of soil. As with MEC, the potential for MC in subsurface soils is unknown.

### 1801 *15.11 Quartermaster Wharf Disposal Area*

1802 This AOC is on the beach located south of the old Quartermaster Wharf. It is suspected that the  
1803 beach was used to dispose of damaged or unwanted supplies. Several rounds of .30 caliber  
1804 ammunition was recovered from this area by a park volunteer.

1805 A visual reconnaissance of the AOC was completed during the SI field work, no evidence of  
1806 MEC or munitions debris was identified. The risk associated with potential MEC at the surface  
1807 is low.

1808 One sample from the beach was collected and analyzed for explosives only. Metals were not  
1809 analyzed for, as disposal of non-munitions items that may also have contained metals would also  
1810 likely be present. There were no explosive compounds detected in the sample.

## 1811 ***16.0 Recommendations***

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1812 Results of the SI provide the basis for conclusions and/or recommendations for further actions at  
1813 each of the AOCs. This section is organized to provide recommendations for the three ranges  
1814 identified in the ARC (DoD, 2006). Additional recommendations are made for other areas  
1815 identified during the TPP process that should be identified as MRS.

### 1816 ***16.1 Range Complex***

1817 The Range Complex consists of the nine artillery batteries, Transition Range 1, and the Gas  
1818 Chamber. Based on historical evidence including the configuration, and limited use of the  
1819 batteries, it is unlikely that munitions would have been discarded. Results from the SI field  
1820 reconnaissance activities indicate there is no evidence of MEC on land areas of the Range  
1821 Complex. The beach and offshore areas of the Range were not evaluated due to the limited MEC  
1822 exposure potential and accessibility. Therefore, a recommendation for NDAI with respect to  
1823 MEC is made for the Range Complex

1824 No sampling was conducted at the nine artillery batteries or Gas Chamber within the Range  
1825 Complex. Significant MC from firing the artillery guns is unlikely because of infrequent use and  
1826 the extended time period since use stopped. No sampling was conducted from the beach and  
1827 offshore areas of the Range Complex because of the unlikely presence of MC on the beach and  
1828 inaccessibility of the offshore target areas. Residue from the gas used (CN-1) at the gas chamber  
1829 is not expected as well. Soil and sediment sampling for lead was completed within Transition  
1830 Range 1. Analytical results show that lead concentrations in soil and sediment were below  
1831 background concentrations or human health and ecological screening values. Therefore, a  
1832 recommendation for NDAI for MC is made for the Range Complex.

### 1833 ***16.2 Rocket Range***

1834 Based on historical use of the Rocket Range (Rifle Grenade/Anti-Tank Rocket Range, previous  
1835 clearance activities, and results of the SI field activities, there is evidence of MEC at this range  
1836 and a moderate risk to park users. Therefore, a recommendation for RI/FS for MEC is made for  
1837 the Rocket Range.

1838 Analytical results from three soil samples and one sediment sample did not exceed background.  
1839 Therefore, a recommendation for NDAI for MC is made for the Rocket Range.

### 1840 ***16.3 Transition Range 2***

1841 Based on historical use of the range and results of the SI field activities, there is no evidence of  
1842 MEC or munitions debris (other than small arms use) at the Transition Range 2. Analytical  
1843 results from soil and sediment sampling indicated that lead concentrations were below

1844 background concentrations. A recommendation for NDAI for both MEC and MC is made for  
1845 Transition Range 2.

#### 1846 **16.4 Removal Actions**

1847 Section 1.3 identified as one of the decision rules, evaluation of whether a TCRA is warranted.  
1848 A TCRA would be warranted if a high MEC hazard or elevated MC risk was identified. There is  
1849 no indication that a high MEC risk is present at Ft. Flagler. No MEC was identified during the  
1850 SI or ASR field activities and there have been no reports of MEC since the TCRA completed in  
1851 1992.

#### 1852 **16.5 Munitions Response Areas**

1853 Results of the SI field activities provide the basis for identifying MRSs and, as appropriate,  
1854 munitions response areas (MRAs) and for scoring each MRS using the MRSPP. A MRA is any  
1855 area on a defense site that is known or suspected to contain MEC or MC, and may contain one or  
1856 more MRS.

1857 Based on the use and physical distribution of the AOCs at Ft. Flagler, three MRSs are identified  
1858 (Figure 16-1):

- 1859 • MRS No. 1 – Range Complex,
- 1860 • MRS No. 2 – Rocket Range, and
- 1861 • MRS No. 3 – Transition Range 2.

1862 MRSPP scoring is provided in Appendix K.

1863 For the purposes of scoring, the Range Inventory list is used, as per USACE direction. MRS No.  
1864 1 – Range Complex consists of those subranges listed in Section 1.2, including all artillery  
1865 batteries and associated offshore target areas, Transition Range 1, and the Gas Chamber. MRS  
1866 No. 2 is the Rocket Range, and MRS No. 3 is Transition Range 2.

#### 1867 **16.6 Other AOCs**

1868 Based on USACE guidance, only those ranges identified in the ARC (DoD, 2006) are assigned  
1869 to an MRA/MRS and scored using the MRSPP protocols until DoD can determine the eligibility  
1870 of the other AOCs. Recommendations for identification for those remaining AOC are made  
1871 below.

##### 1872 **16.6.1 Ammunition Bunker**

1873 The Ammunition Bunker is not recommended to be identified as an MRS. The Ammunition  
1874 Bunker is also located within the boundaries of MRS No.1 - Range Complex. While the AOC  
1875 was shown on a War Department map from 1945, no evidence of the bunker could be found at  
1876 the location indicated on the map. There is no evidence that the Ammunition Bunker has any  
1877 MEC or MC associated with it.

1878 **16.6.2 Live Grenade Court**

1879 The Live Grenade Court is recommended to be identified as an MRS. The Live Grenade Court  
1880 is not within one of the existing MRSs. While no evidence of the court (throwing bays, impact  
1881 area) was identified in the field due to very heavy vegetation growth, the trees at the reported  
1882 location indicate that it was once cleared (younger growth forest than surrounding forest). In  
1883 addition, the reported former use as a live grenade court suggests a potential for MEC and MC  
1884 risk. If the Live Grenade Court is identified as an MRS, additional investigations for MEC and  
1885 MC are recommended.

1886 **16.6.3 Practice Grenade Court**

1887 The Practice Grenade Court is recommended to be identified as an MRS. The Practice Grenade  
1888 Court is not within one of the existing MRSs. While no evidence of the court (throwing bays,  
1889 impact area) was identified in the field due to very heavy vegetation growth, the trees at the  
1890 reported location indicate that it was once cleared (younger growth forest than surrounding  
1891 forest). In addition, the reported former use as a practice grenade court suggests a potential for  
1892 MEC and MC risk. If the Practice Grenade Court is identified as an MRS, additional  
1893 investigations for MEC and MC are recommended.

1894 **16.6.4 Rifle Range**

1895 The Rifle Range is recommended to be identified as an MRS. The Rifle Range is within the  
1896 boundary of the MRS No. 1 - Range Complex. There is direct evidence that this range was used  
1897 as a rifle range and the MC risk is present based on lead concentrations above site background,  
1898 human health, and ecological screening values. If the Rifle Range is identified as an MRS,  
1899 additional investigations for MC are recommended.

1900 **16.6.5 Demolition Area**

1901 The Demolition Area is recommended to be identified as an MRS. The Demolition Area is not  
1902 within one of the existing MRSs. The War Department map (Appendix L) identified this area as  
1903 a "Demolition Area Rifle Grenade", and it appears that the location was a beach area that has  
1904 been backfilled. There is no apparent surface MEC risk at this location. However, there may be  
1905 a subsurface MEC or MC risk. If the Demolition Area is identified as an MRS, additional  
1906 investigations for MEC and MC are recommended.

1907 **16.6.6 Quartermaster Wharf Disposal Area**

1908 The Quartermaster Wharf Disposal Area is recommended to be identified as an MRS. The  
1909 Quartermaster Wharf Area is within MRS No.1 the Range Complex. The area is thought to have  
1910 been used for disposal of unwanted materials. Small arms ammunition has been found on the  
1911 beach and other munitions may have been discarded there as well. There is a potential risk for

1912 MEC and MC from disposal of munitions. If the Quartermaster Wharf Disposal Area is  
1913 identified as an MRS, additional investigations for MEC and MC are recommended.

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## *Figures*



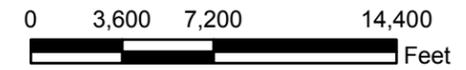
OFFICE: MNRVL  
 DRAWN BY: K. Masterson  
 DRAWING NUMBER: 05/08/07  
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**Legend**

Ft. Flagler Military Reservation FUDS Boundary

**NOTES:**

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Topographic maps (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



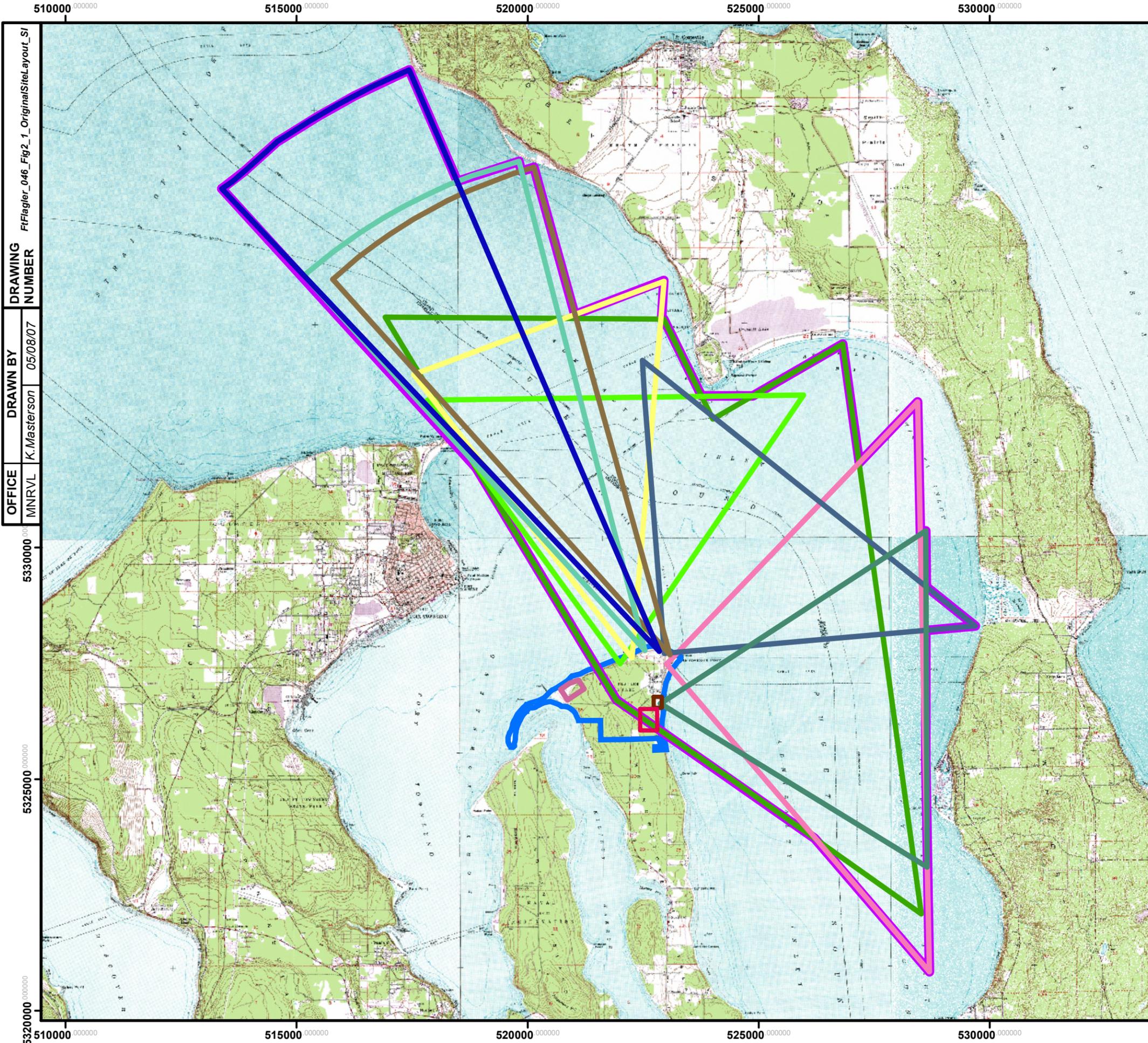
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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OMAHA DESIGN CENTER

**FIGURE 1-1**  
**SITE LOCATION**  
 FORT FLAGLER MILITARY RESERVATION





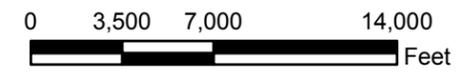
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 DATE: 05/08/07  
 OFFICE: MNRVL  
 SCALE: 5330000

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Ranges Identified in the MMRP Range Inventory**
- Range Complex No. 1
- Battery Bankhead
- Battery Calwell
- Battery Downes
- Battery Gratton
- Battery Lee
- Battery Rawlins
- Battery Revere
- Battery Wansboro
- Battery Wilhelm
- Gas Chamber
- Rocket Range
- Transition Range 1

**NOTES:**

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo obtained from the U.S. Geological Survey and is dated 1967.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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**FIGURE 1-2**  
**RANGE CONFIGURATION FROM THE**  
**MMRP RANGE INVENTORY**  
 FORT FLAGLER MILITARY RESERVATION



519850 000000 520800 000000 521750 000000 522700 000000 523650 000000



**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- 1992 UXO Clearance Area
- Ranges Included in the MMRP Range Inventory**
- Range Complex No. 1
- Gas Chamber
- Rocket Range
- Transition Range 1

**NOTES:**

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

F:\Flagler\_047\_Fig2\_2\_CurrentAerial\_SI  
 DRAWING NUMBER  
 DRAWN BY  
 K.Masterson 06/21/07  
 OFFICE  
 MNRVL

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 5326400 000000  
 5325600 000000



0 600 1,200 2,400 Feet

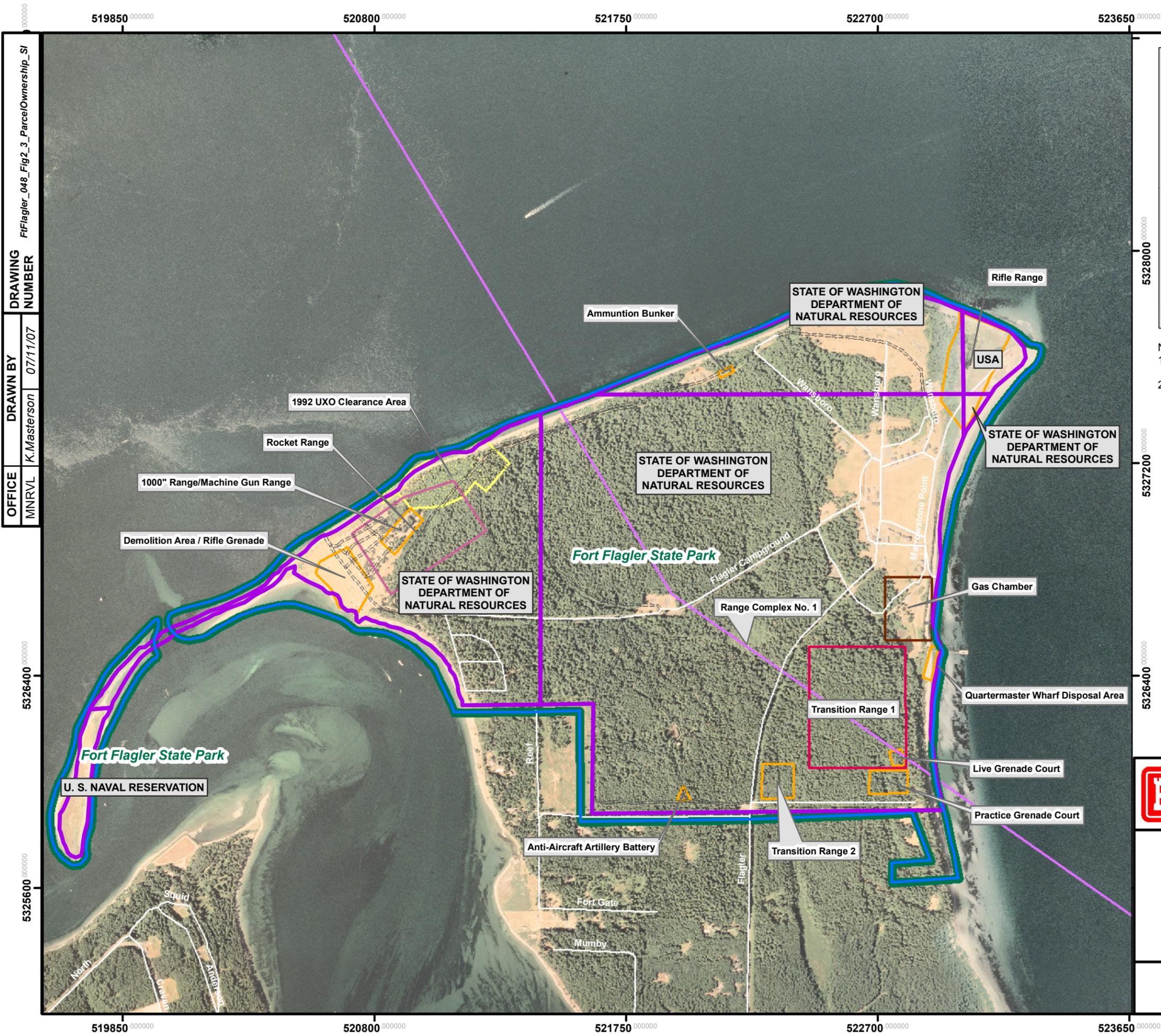
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 2-1**  
**CURRENT LAND USE**  
FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.

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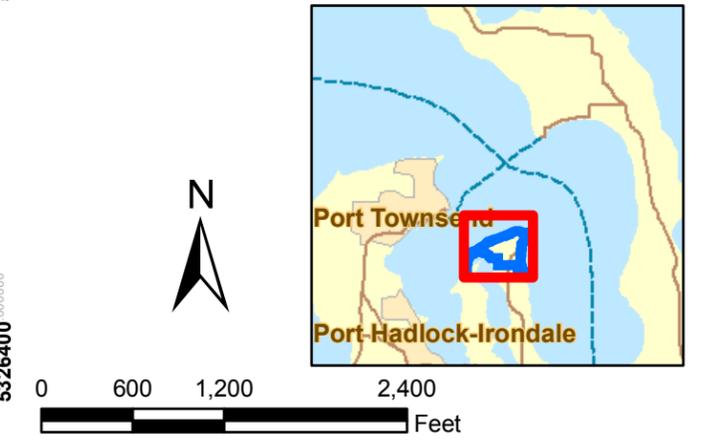
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 OFFICE: MNRVL  
 DATE: 07/11/07

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Parcel Ownership Boundary
- Ranges Identified in the MMRP Range Inventory**
- Range Complex No. 1
- Gas Chamber
- Rocket Range
- Transition Range 1
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area
- Fort Flagler State Park

**NOTES:**

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

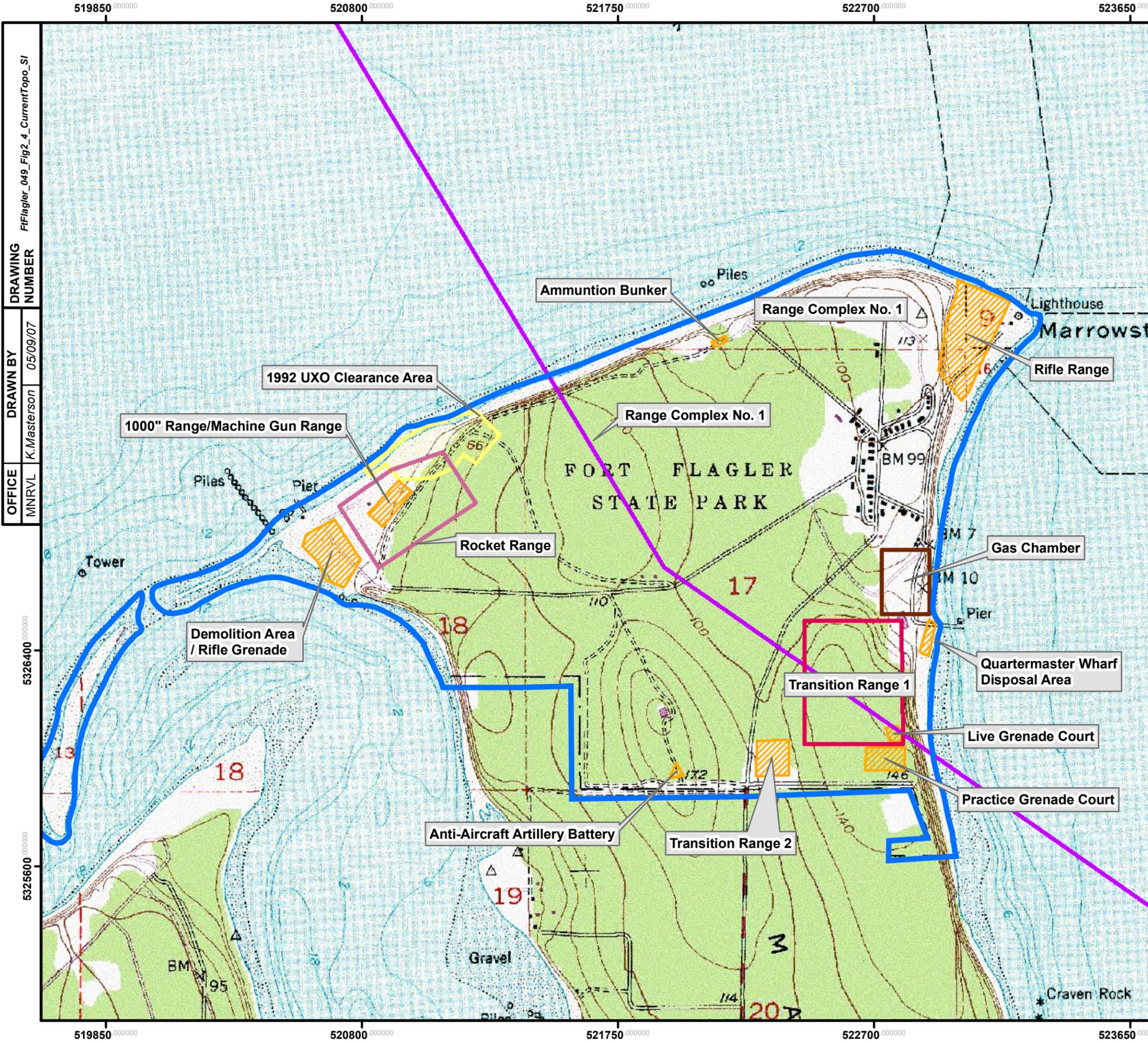


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 2-2**  
**PARCEL OWNERSHIP**  
 FORT FLAGLER MILITARY RESERVATION

**Shaw** Shaw Environmental, Inc.

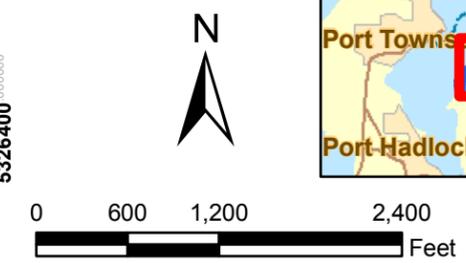
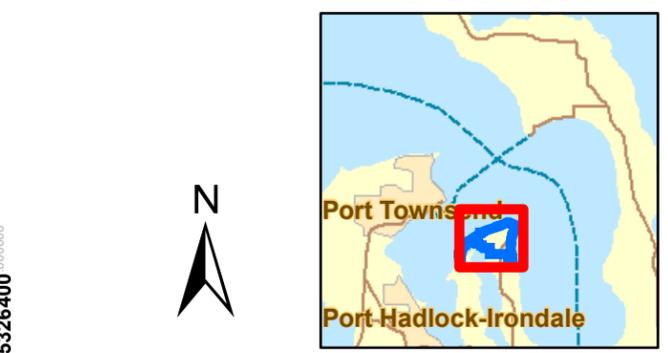


**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Ranges Identified in the MMRP Range Inventory**
- Range Complex No. 1
- Gas Chamber
- Rocket Range
- Transition Range 1
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area

**NOTES:**

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Topographic map (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 2-3**  
**CURRENT TOPOGRAPHIC MAP**  
FORT FLAGLER MILITARY RESERVATION



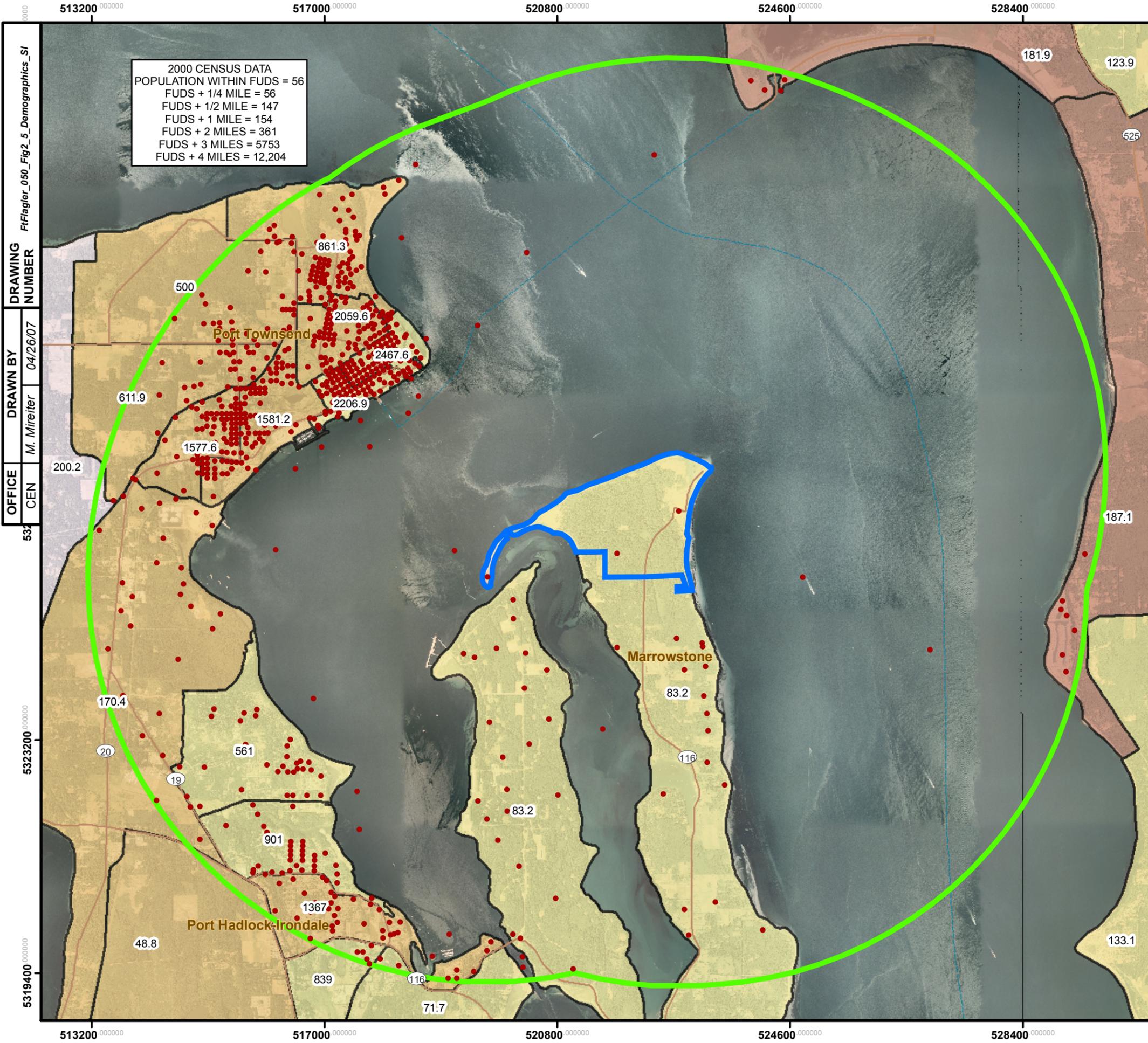
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DRAWN BY: K.Masterson  
OFFICE: MNRVL  
DATE: 05/09/07

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5326400  
5325600

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519850 520800 521750 522700 523650



2000 CENSUS DATA  
 POPULATION WITHIN FUDS = 56  
 FUDS + 1/4 MILE = 56  
 FUDS + 1/2 MILE = 147  
 FUDS + 1 MILE = 154  
 FUDS + 2 MILES = 361  
 FUDS + 3 MILES = 5753  
 FUDS + 4 MILES = 12,204

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- 4-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary

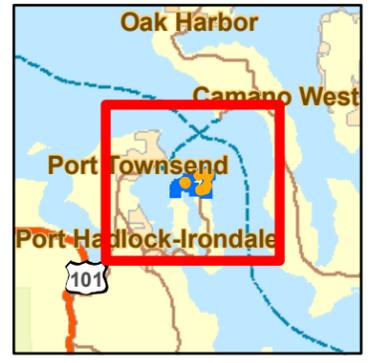
**2004 Census Block Group Population**

- 0 - 500
- 501 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2200

- Census Block Centroid Unit
- Number of People Per Square Mile

**NOTES:**

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Census data obtained from StreetMap, ESRI, 2005.
- 3) Aerial photos (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies; photos are from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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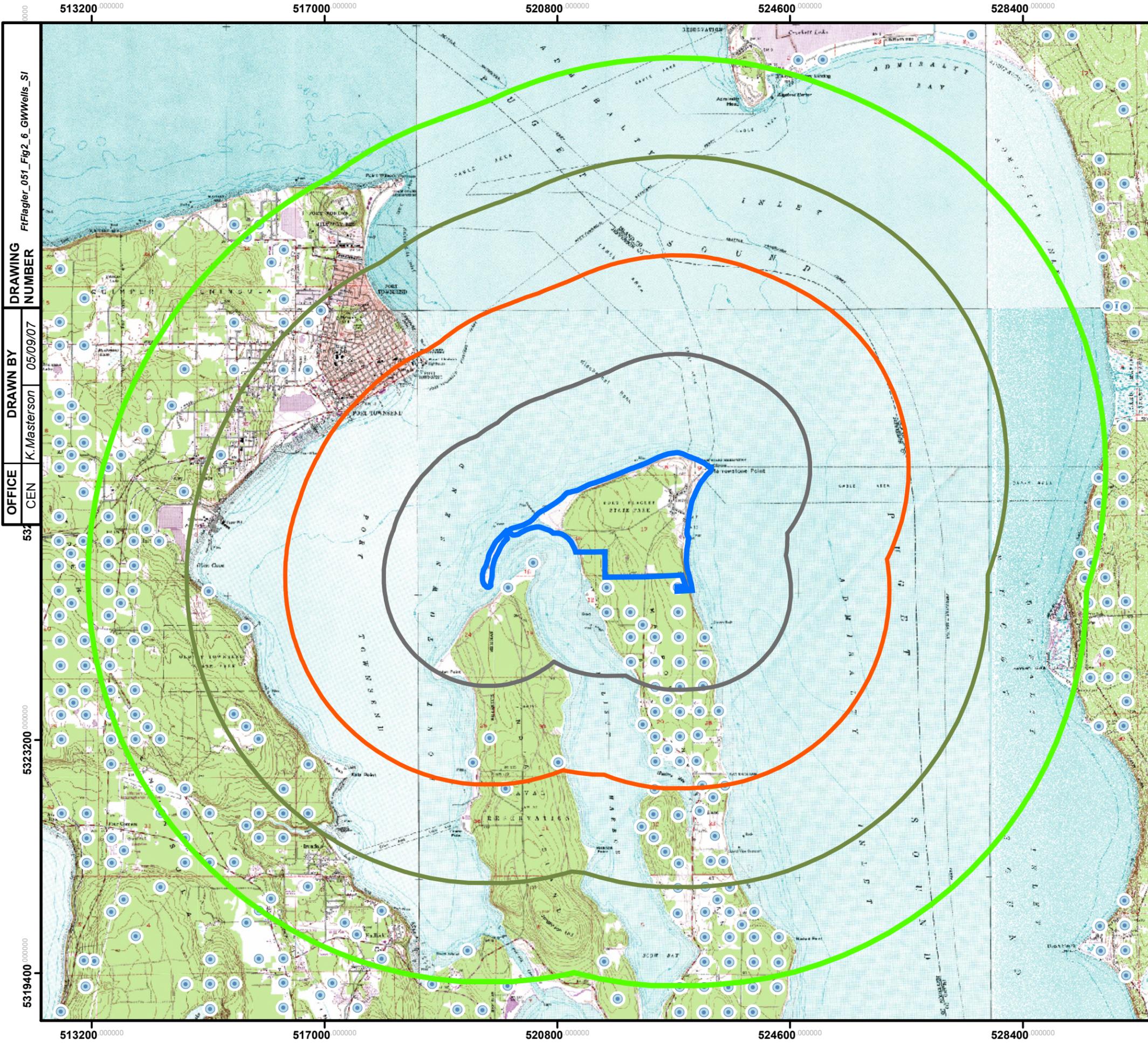
**FIGURE 2-4**  
**CENSUS DATA WITHIN 4-MILE RADIUS**  
 FORT FLAGLER MILITARY RESERVATION

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DRAWN BY: M. Mireiter

OFFICE: CEN

DATE: 04/26/07



DRAWING NUMBER: FIFlagler\_051\_Fig2\_6\_GWwells\_SI  
 DRAWN BY: K. Masterson  
 DATE: 05/09/07  
 OFFICE: CEN

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- 4-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 3-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 2-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 1-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- Groundwater Well

**NOTES:**

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Groundwater well data obtained from the State of Washington, Department of Ecology.
- 3) Topographic maps (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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**FIGURE 2-5**  
**GROUNDWATER WELL LOCATIONS**  
FORT FLAGLER MILITARY RESERVATION

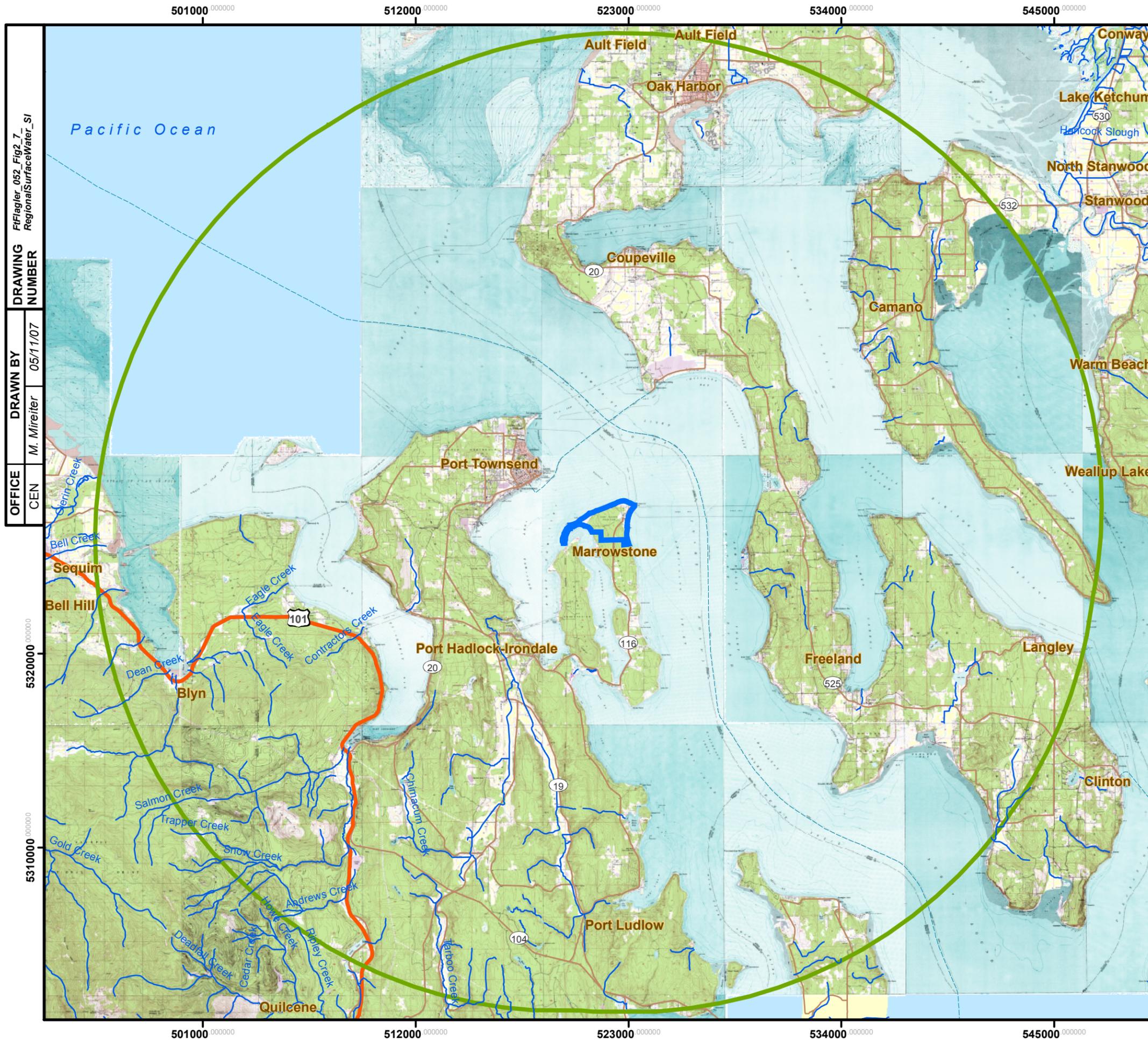


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513200 517000 520800 524600 528400

5319400 5323200 5330800 5334600

5319400 5323200 5330800 5334600



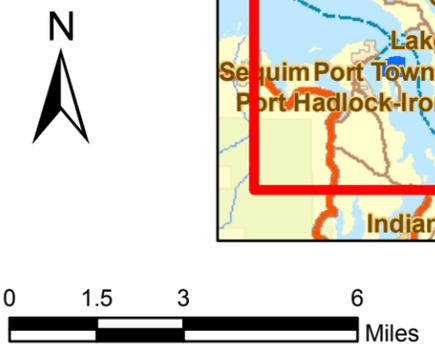
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**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- 15 Mile Radius from the FUDS Boundary

**NOTES:**

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Topographic maps (Jefferson, Island, Clallam, and Kitsap Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 2-6**  
**SURFACE WATER DRAINAGE**  
 FORT FLAGLER MILITARY RESERVATION



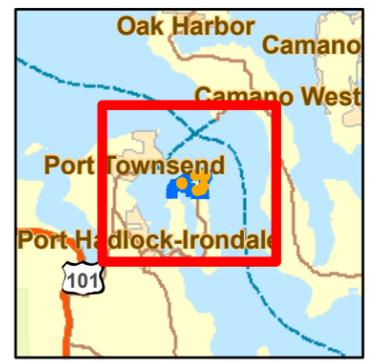
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 DRAWN BY: K.Masterson  
 DATE: 05/09/07  
 OFFICE: MNRVL

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- 4-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- 2-Mile Radius From Ft. Flagler Military Reservation FUDS Boundary
- Wetland Area
- Park
- Golf Course
- School
- Hospital

**NOTES:**

- 1) FUDS boundary was derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Wetlands data obtained from the U.S. Fish and Wildlife Service, 200605, NWIDBA.CONUS\_wet\_poly: Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31., U.S. Fish and Wildlife Service, Branch of Habitat Assessment, Washington, D.C.
- 3) Topographic maps (Jefferson and Island Counties) obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



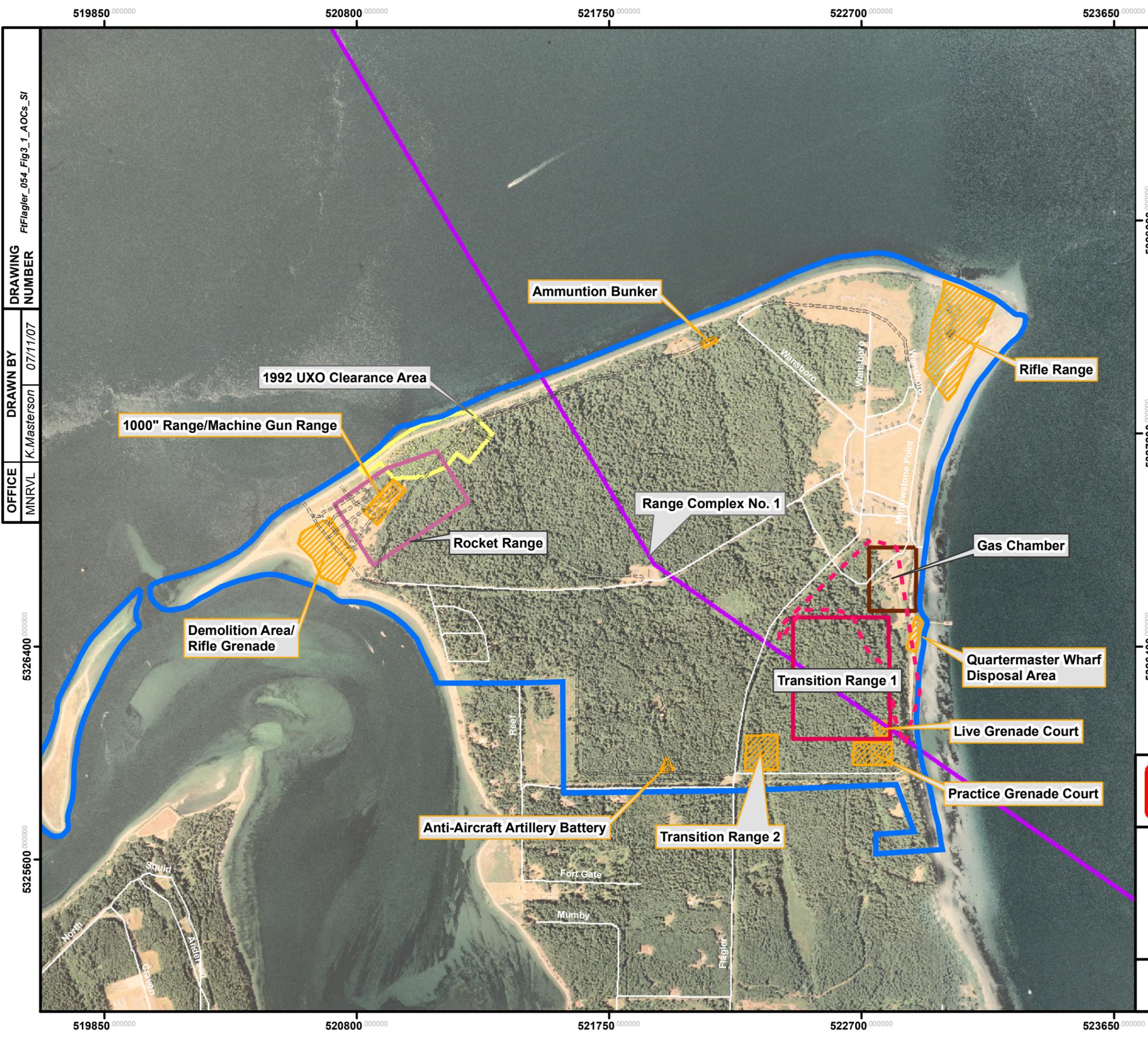
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 2-7**  
**SENSITIVE RECEPTOR LOCATIONS**  
 FORT FLAGLER MILITARY RESERVATION



513200.000000 517000.000000 520800.000000 524600.000000 528400.000000  
 5319400.000000 5323200.000000 5330800.000000 5334600.000000



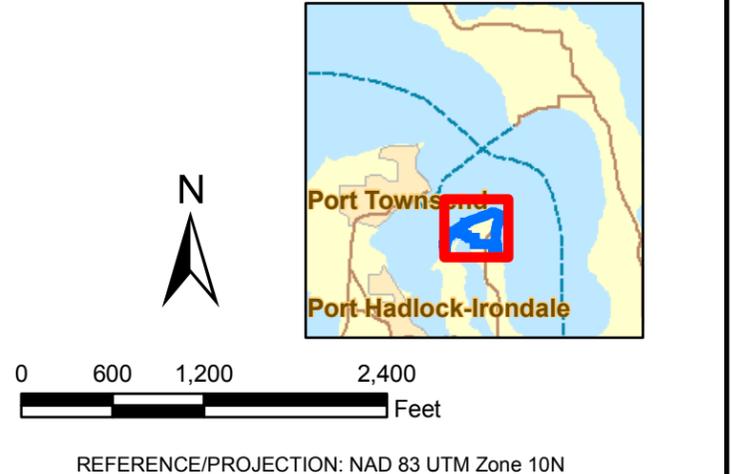
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 DRAWN BY: K.Masterson  
 DATE: 07/11/07  
 OFFICE: MNRVL

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Ranges Identified in the MMRP Range Inventory
- Range Complex No. 1
- Gas Chamber (Range Complex No. 1 Subrange)
- Transition Range 1 (Range Complex No. 1 Subrange)
- Rocket Range
- Range Boundary Identified in the ASR
- Transition Range 1 (Adjusted Location)
- Additional Areas
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Dashed lines indicate adjustments to INPR Supplement Locations
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



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**FIGURE 3-1**  
**SITE INSPECTION**  
**AREAS OF CONCERN**  
 FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



DRAWING NUMBER: FtFlagler\_055\_Fig3\_2\_BkgrndSampleLocs\_S1  
 DRAWN BY: K.Masterson  
 DATE: 07/11/07  
 OFFICE: MNRVL  
 NUMBER: 5325600

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Range Complex No. 1
- Gas Chamber
- Rocket Range (Adjusted Location)
- Transition Range 1 (Adjusted Location)
- Additional Areas of Interest Identified During the Technical Planning Process
- 1992 UXO Clearance Area
- Background Soil Sample Location
- ◆ Background Sediment Sample Location

**NOTES:**

- 1) FUDS boundary and range boundaries were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

N

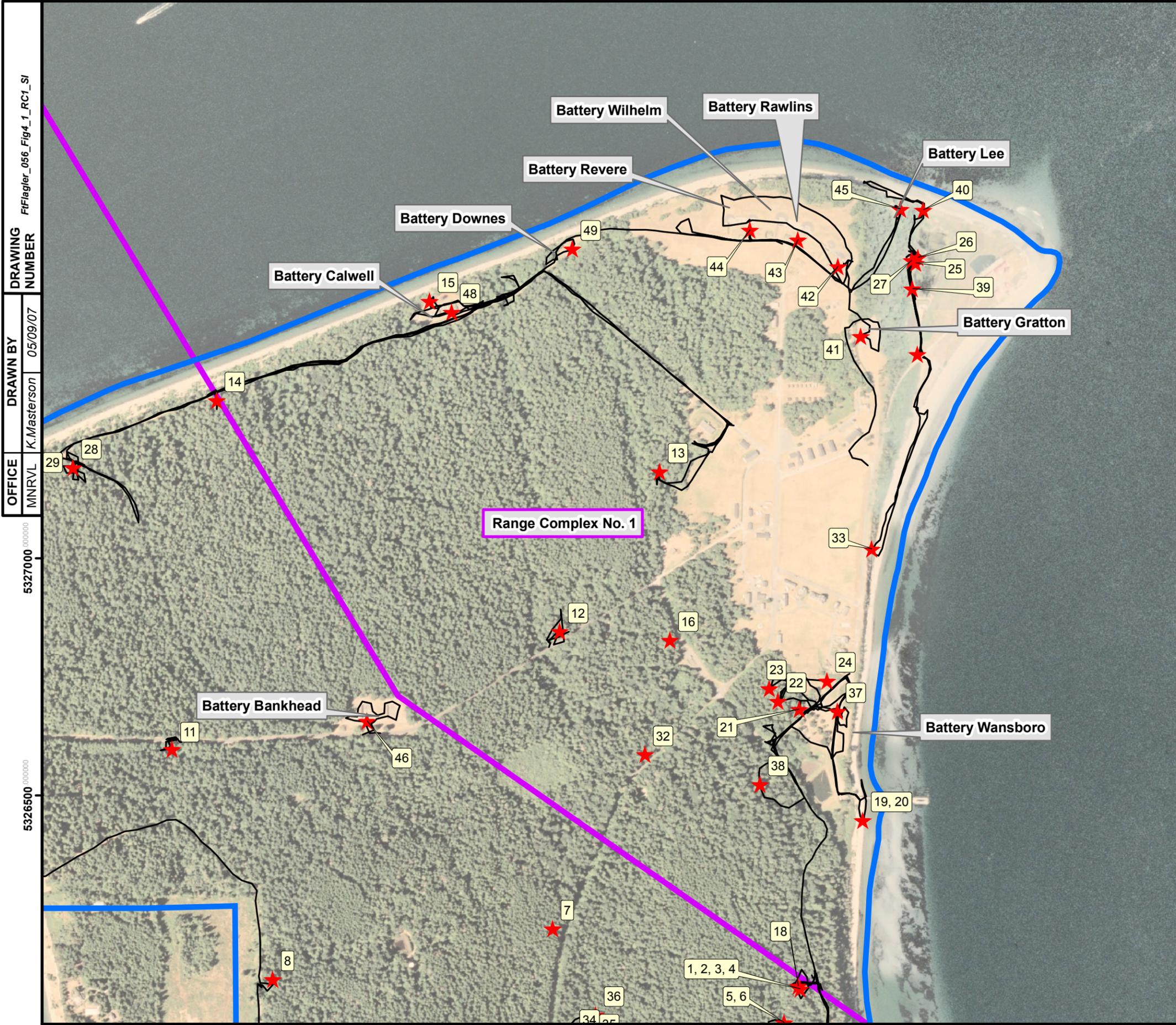
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Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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 OMAHA DESIGN CENTER

**FIGURE 3-2**  
**BACKGROUND SAMPLE LOCATIONS**  
 FORT FLAGLER MILITARY RESERVATION

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**Legend**

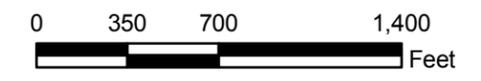
- Ft. Flagler Military Reservation FUDS Boundary
- Reconnaissance Tracks
- Photograph Location

NOTES:  
 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.  
 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

DRAWING NUMBER: FtFlagler\_056\_Fig4\_1\_RC1\_SI  
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 OFFICE: MNRVL

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REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

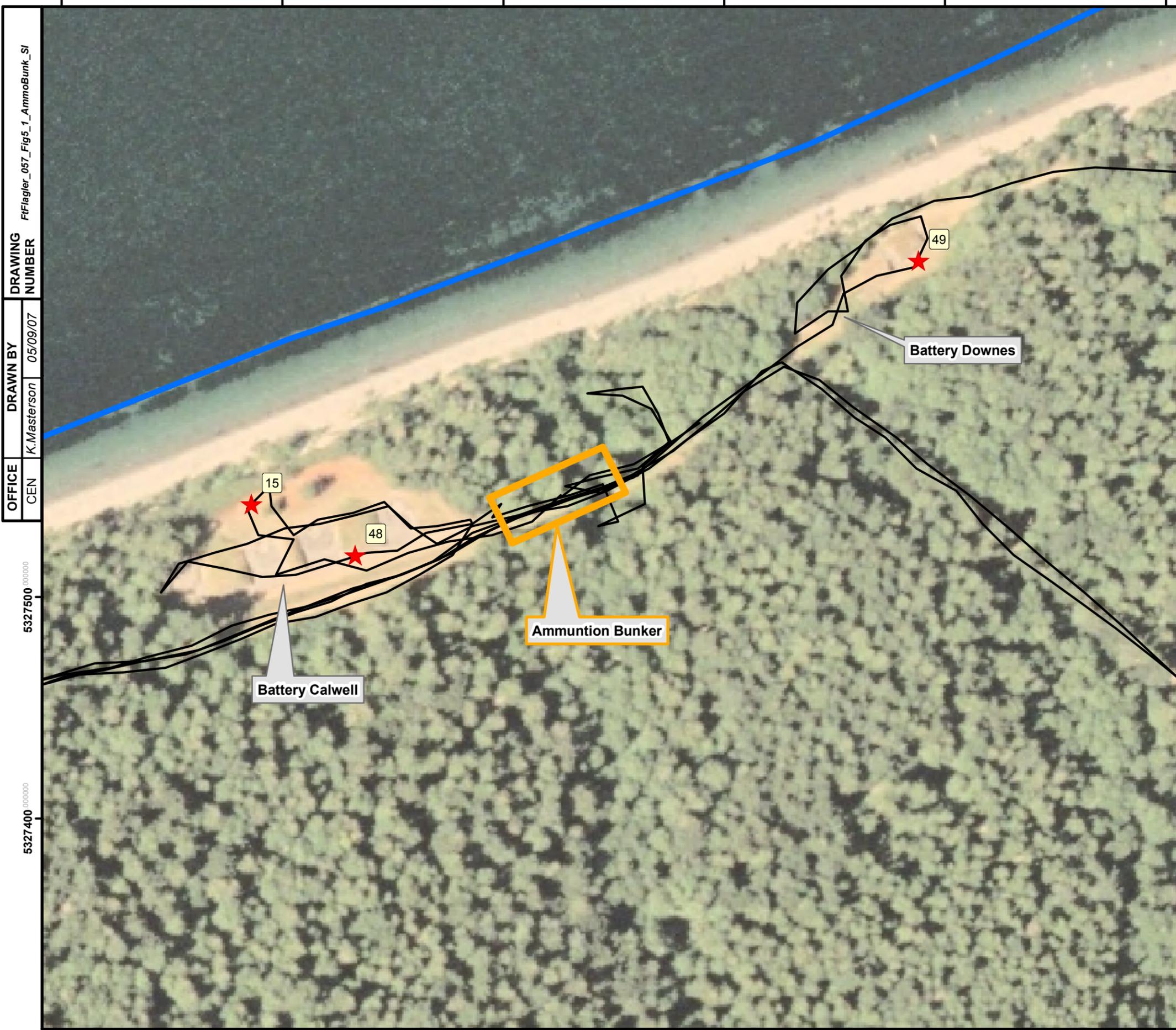
U.S. ARMY CORPS OF ENGINEERS  
 OMAHA DESIGN CENTER

**FIGURE 4-1**  
**RANGE COMPLEX NO. 1**  
**RECONNAISSANCE**  
 FORT FLAGLER MILITARY RESERVATION



521500 000000 522000 000000 522500 000000 523000 000000 523500 000000

521900 522000 522100 522200 522300 522400



F:\Flagler\_057\_Fig5\_1\_AmmoBunk\_SI  
 DRAWING NUMBER  
 DRAWN BY K.Masterson 05/09/07  
 OFFICE CEN

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Ammunition Bunker
- Reconnaissance Tracks
- Photograph Location

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

5327700  
5327600  
5327500  
5327400



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

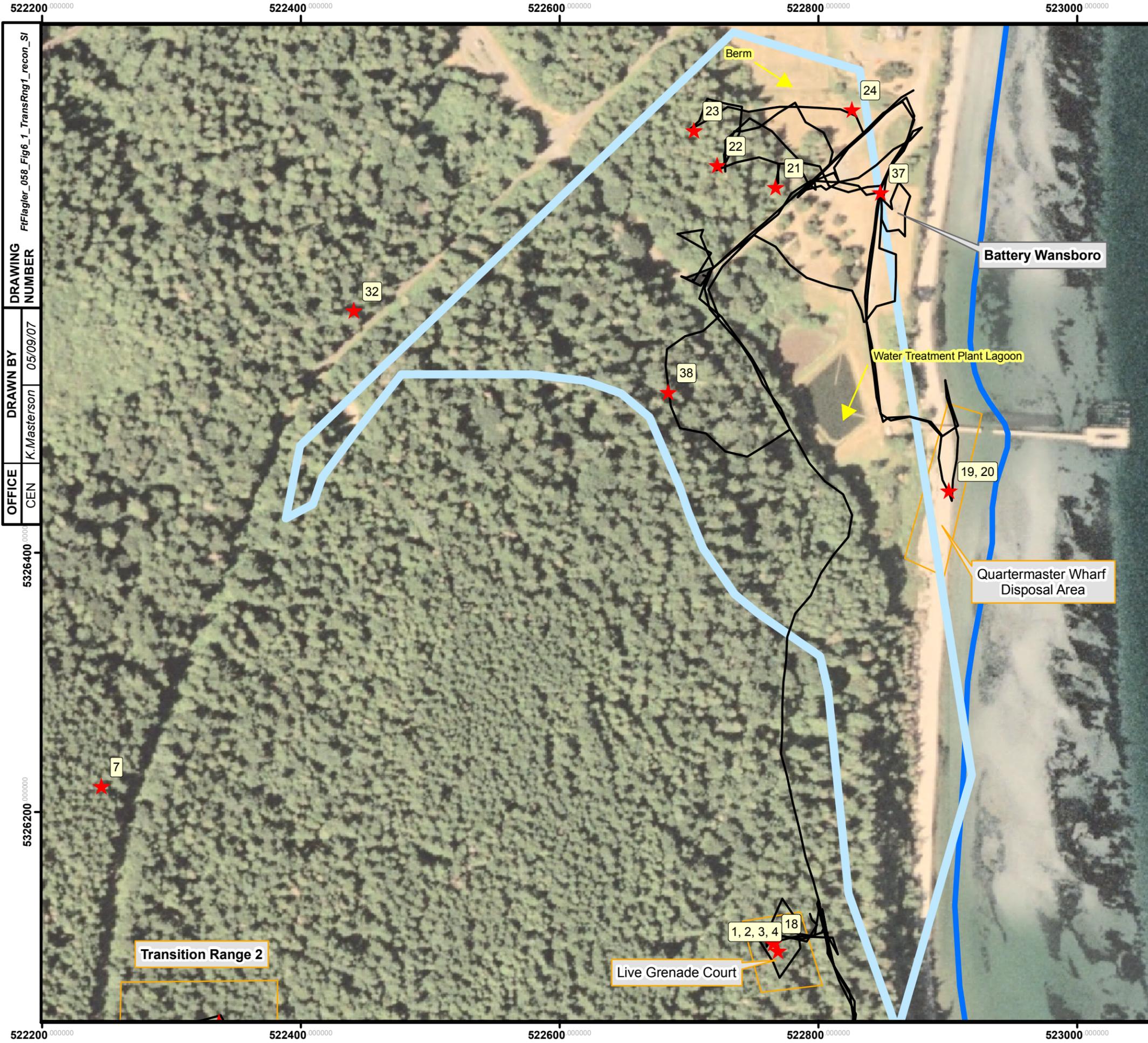


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OMAHA DESIGN CENTER

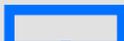
**FIGURE 5-1**  
**AMMUNITION BUNKER**  
**RECONNAISSANCE**  
 FORT FLAGLER MILITARY RESERVATION



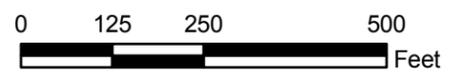
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**Legend**

-  Ft. Flagler Military Reservation FUDS Boundary
-  Transition Range 1
-  Reconnaissance Tracks
-  Photograph Location

**NOTES:**  
 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.  
 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

522200 000000 522400 000000 522600 000000 522800 000000 523000 000000

FtFlagler\_058\_Fig6\_1\_TransRng1\_recon\_SI

**DRAWING NUMBER**

**DRAWN BY**  
K.Masterson 05/09/07

**OFFICE**  
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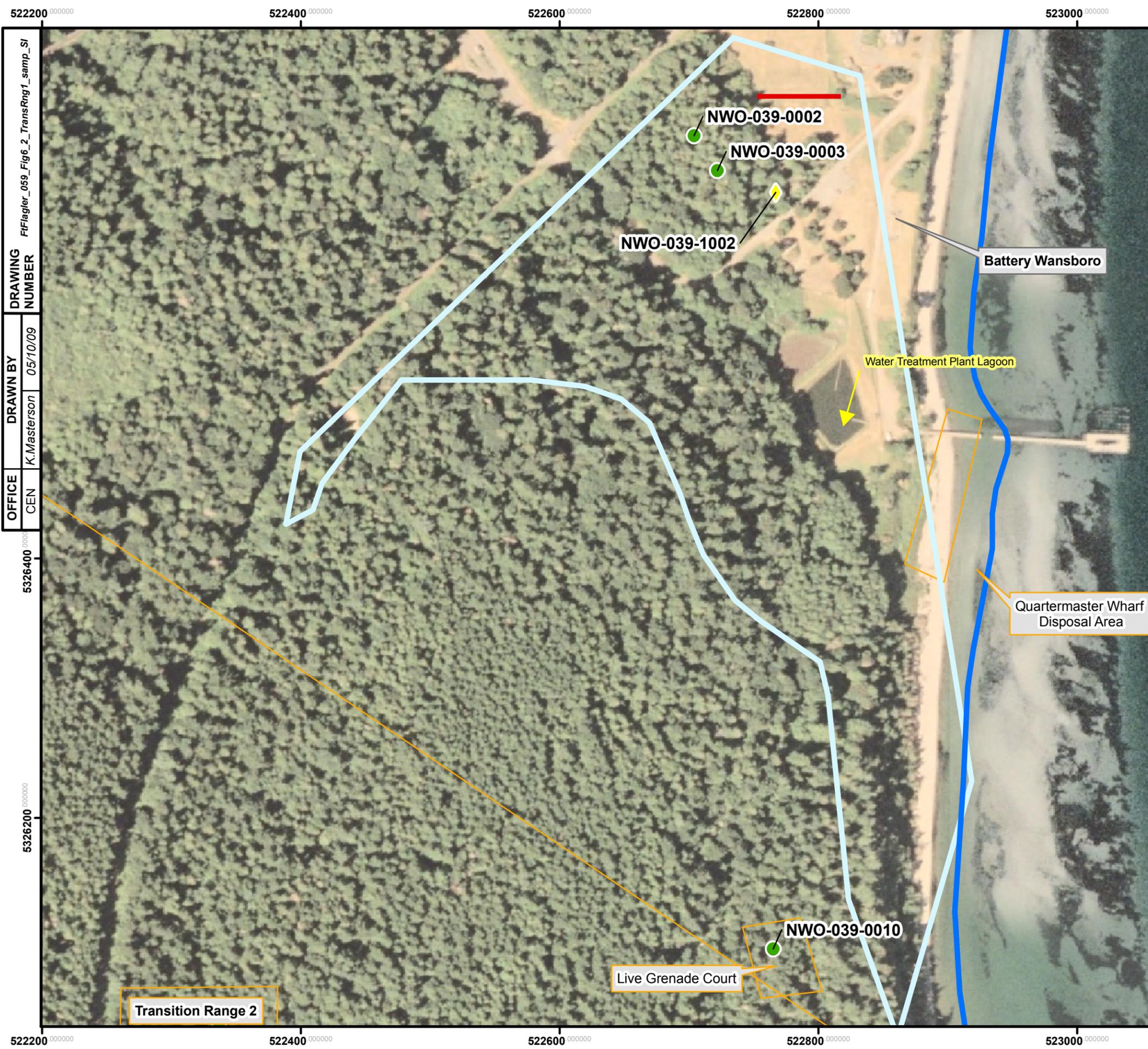


U.S. ARMY CORPS OF ENGINEERS  
OMAHA DESIGN CENTER

**FIGURE 6-1**  
**TRANSITION RANGE 1**  
**RECONNAISSANCE**  
 FORT FLAGLER MILITARY RESERVATION



Shaw Environmental, Inc.



522200 000000 522400 000000 522600 000000 522800 000000 523000 000000

5326800 5326600 5326400 5326200

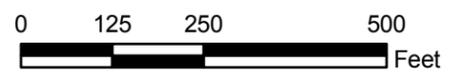
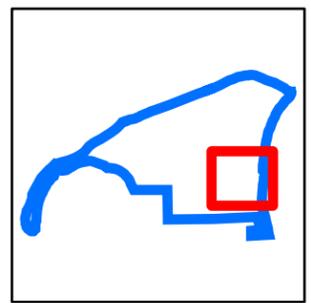
FtFlagler\_059\_Fig6\_2\_TransRng1\_samp\_SI  
 DRAWING NUMBER  
 DRAWN BY K.Masterson 05/10/09  
 OFFICE CEN

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Transition Range 1
- Target Berm
- Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values
- Sediment Sample Results Were Greater Than Background and Less than Eco and Human Health Screening Values

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 6-2**  
**TRANSITION RANGE 1**  
**SAMPLE LOCATIONS AND LEAD RESULTS**  
FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.

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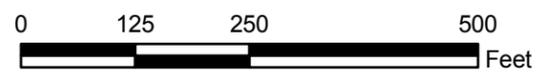
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 DRAWING NUMBER  
 DRAWN BY K.Masterson 07/10/09  
 OFFICE CEN  
 532600  
 532590  
 532580  
 532570

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Transition Range 2
- Reconnaissance Tracks

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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**FIGURE 7-1  
TRANSITION RANGE 2  
RECONNAISSANCE**

FORT FLAGLER MILITARY RESERVATION

**Shaw** Shaw Environmental, Inc.



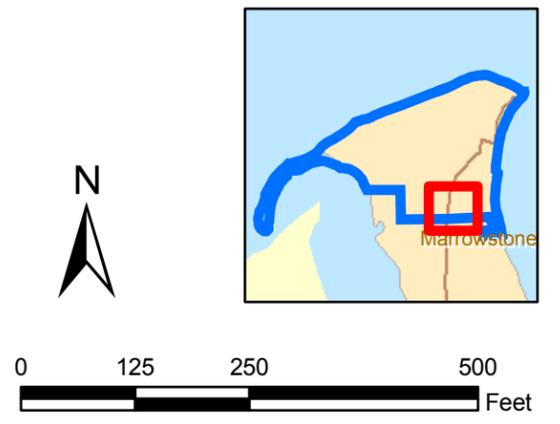
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 FtFlagler\_061\_Fig7\_2\_TransRng2\_samps\_SI  
 DRAWING NUMBER  
 DRAWN BY  
 OFFICE  
 CEN  
 K.Masterson  
 07/11/07

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Transition Range 2
- Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

**NOTES:**

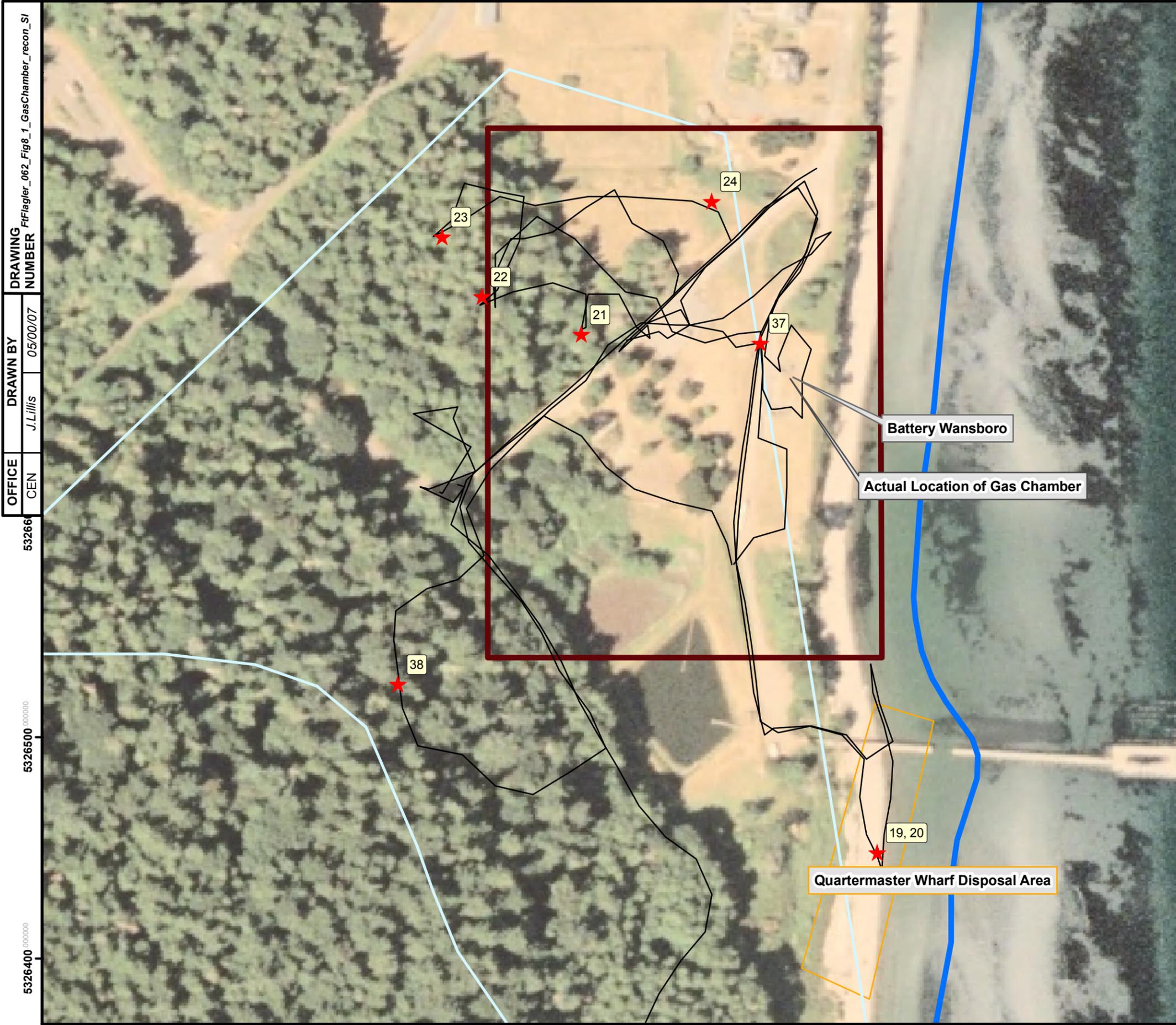
- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 7-2**  
**TRANSITION RANGE 2**  
**SAMPLE LOCATIONS AND LEAD RESULTS**  
 FORT FLAGLER MILITARY RESERVATION



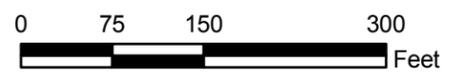
DRAWING NUMBER: FtFlagler\_062\_Fig8\_1\_GasChamber\_recon\_SI  
 DRAWN BY: J.Lillis  
 OFFICE: CEN  
 DATE: 05/00/07  
 532666  
 532650  
 532640

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Gas Chamber
- Transition Range 1
- Reconnaissance Tracks
- ★ Photograph Location

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

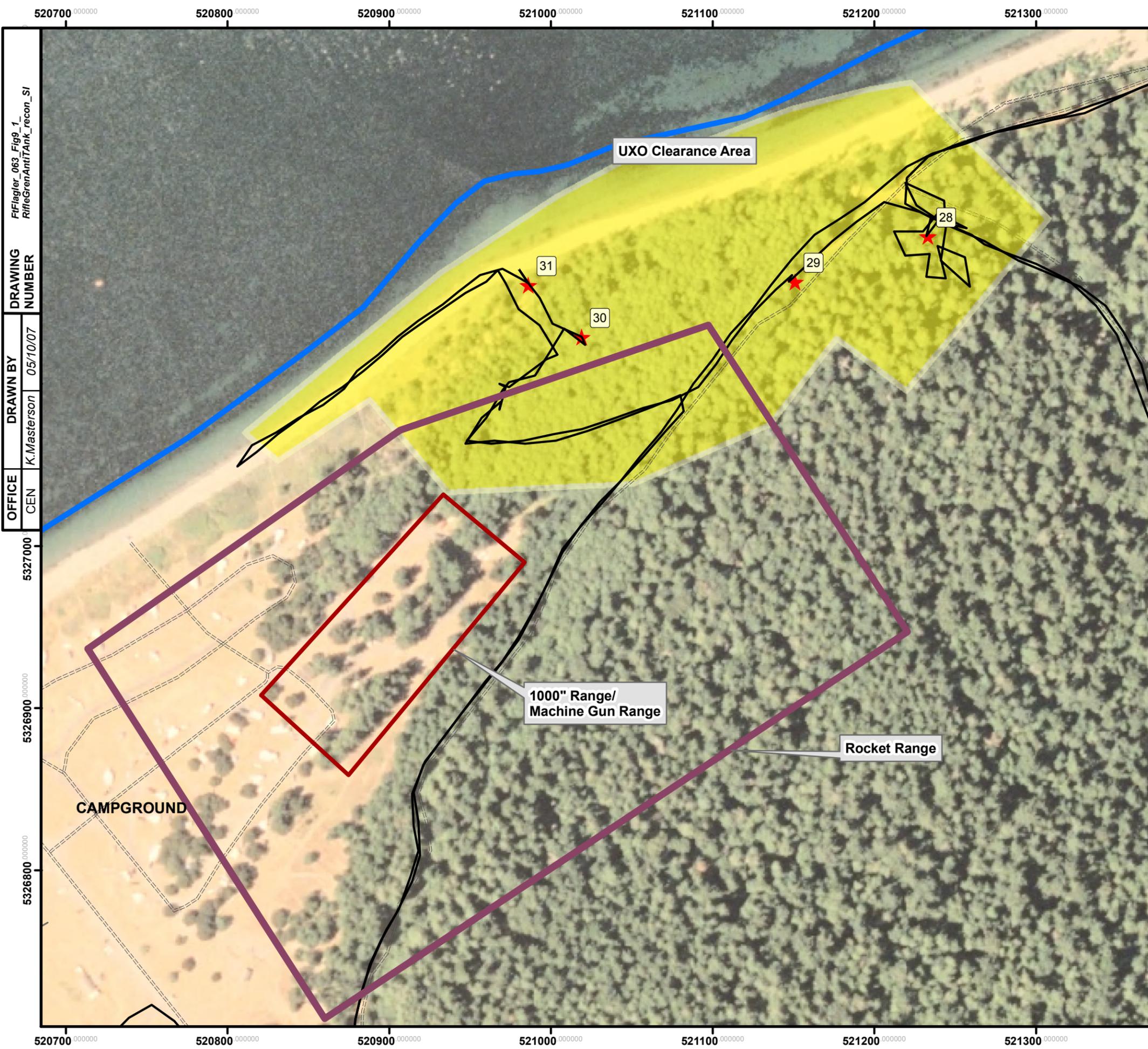


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 8-1**  
**GAS CHAMBER**  
**RECONNAISSANCE**  
 FORT FLAGLER MILITARY RESERVATION



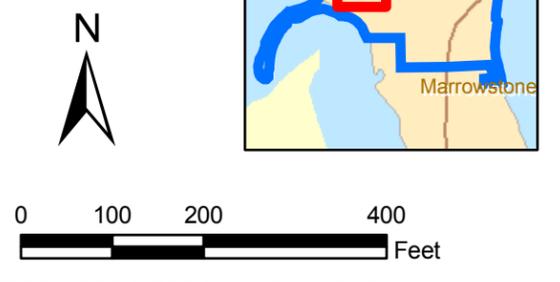


**Legend**

-  Ft. Flagler Military Reservation FUDS Boundary
-  Rocket Range
-  1992 UXO Clearance Area/TCRA Area
-  Reconnaissance Tracks
-  Photograph Location

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



0 100 200 400 Feet



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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FFlagler\_063\_Fig9\_1  
 RifleGrenAntiTank\_recon\_SI  
 DRAWING NUMBER  
 DRAWN BY K.Masterson 05/10/07  
 OFFICE CEN

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5326800.000000



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OMAHA DESIGN CENTER

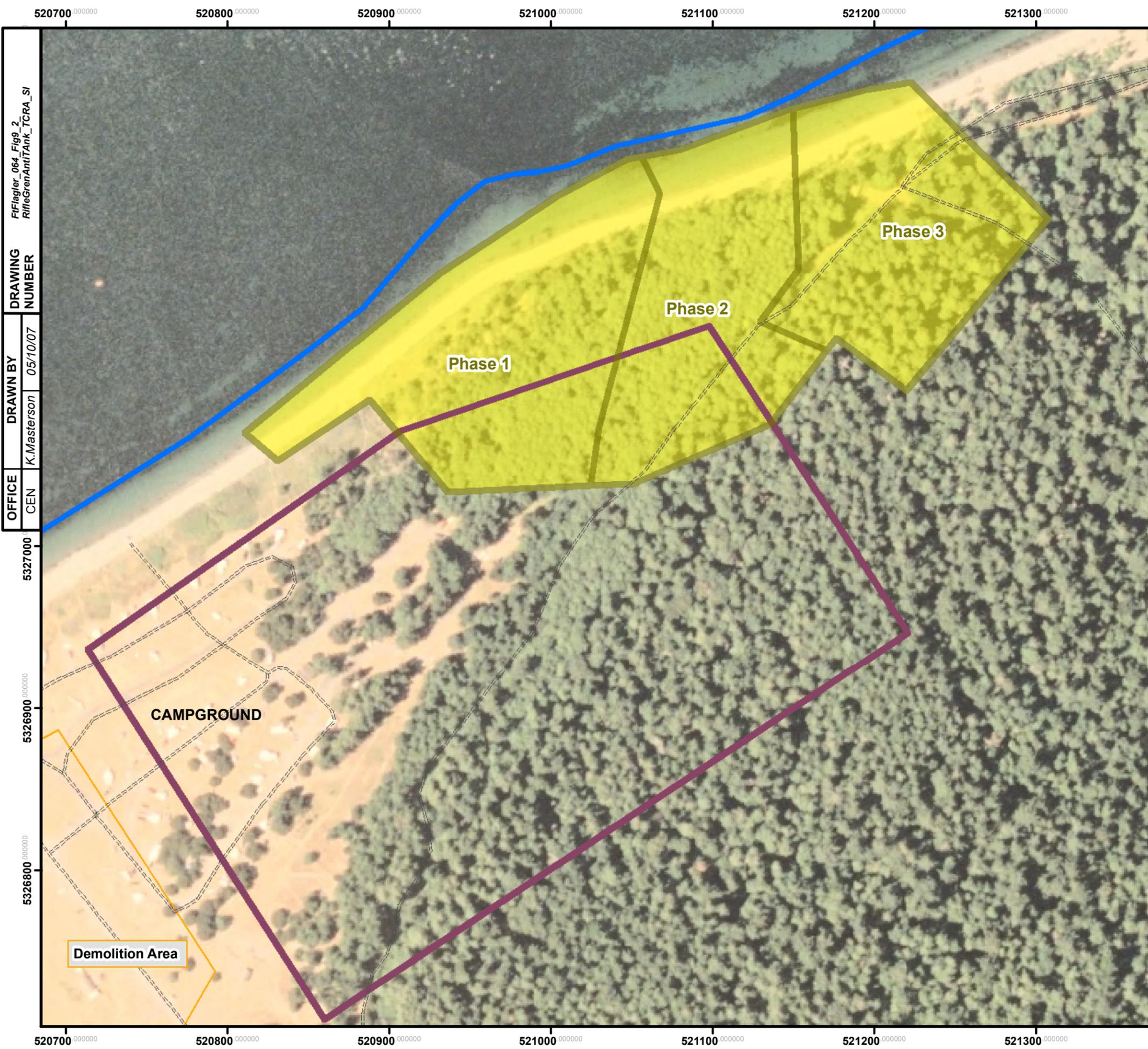
**FIGURE 9-1**  
**ROCKET RANGE**  
**RECONNAISSANCE**

FORT FLAGLER MILITARY RESERVATION



Shaw Environmental, Inc.

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FFlagler\_064\_Fig9\_2  
 RifleGrenAntiTank\_TCRA\_SI  
 DRAWING NUMBER  
 DRAWN BY  
 OFFICE  
 K.Masterson  
 05/10/07  
 CEN

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Rocket Range
- 1992 UXO Clearance Area/TCRA Area

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



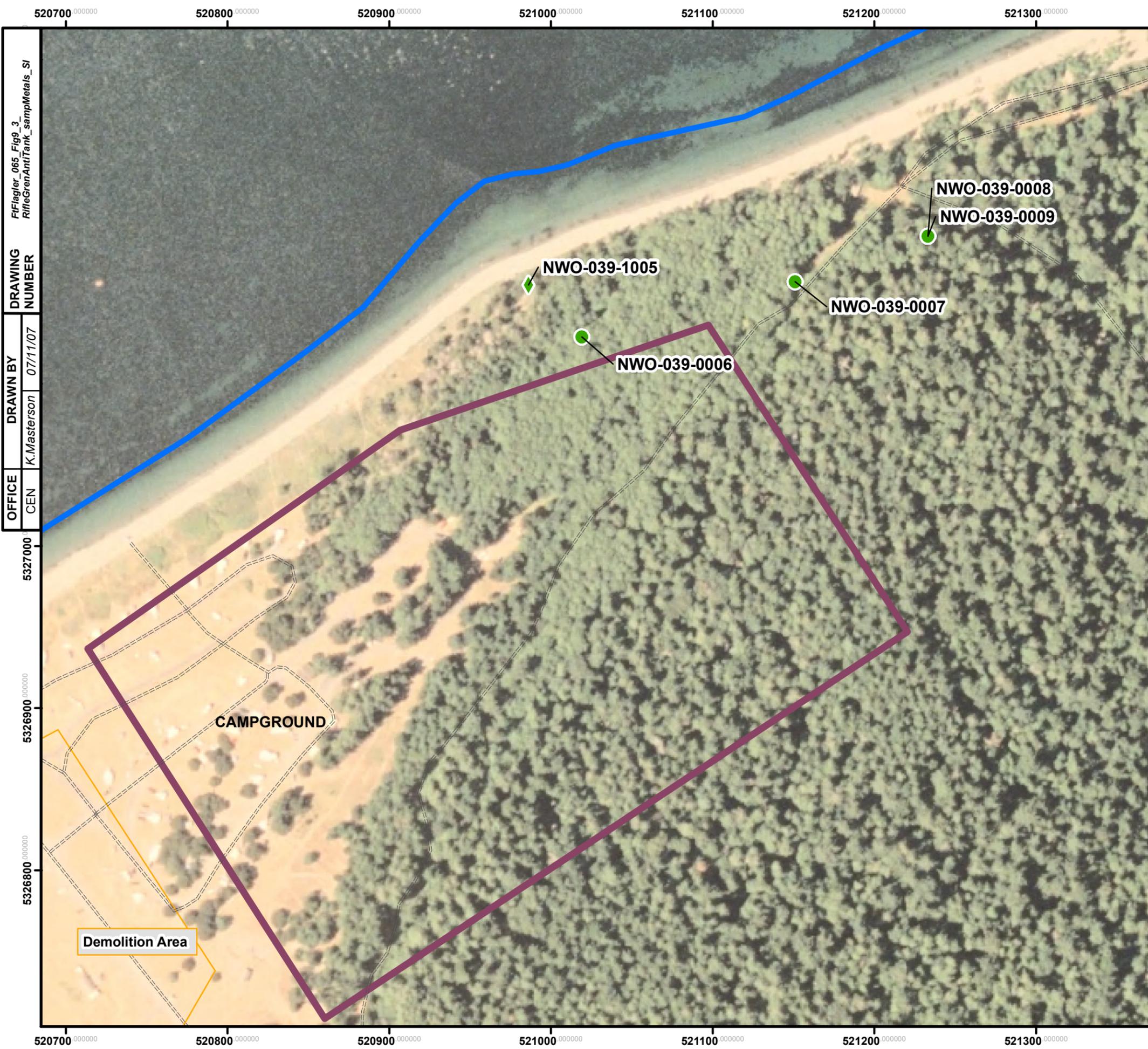
REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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 OMAHA DESIGN CENTER

**FIGURE 9-2**  
**ROCKET RANGE**  
**TCRA AREA**  
 FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



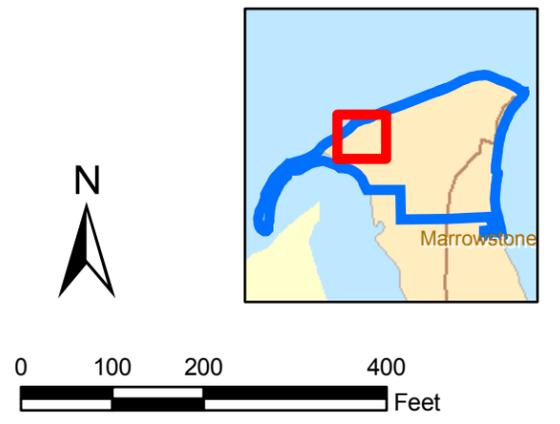
FFlagler\_065\_Fig9\_3  
 RifleGrenAntiTank\_sampMetals\_SI  
 DRAWING NUMBER  
 DRAWN BY  
 OFFICE  
 K.Masterson  
 07/11/07  
 CEN

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Rocket Range
- Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

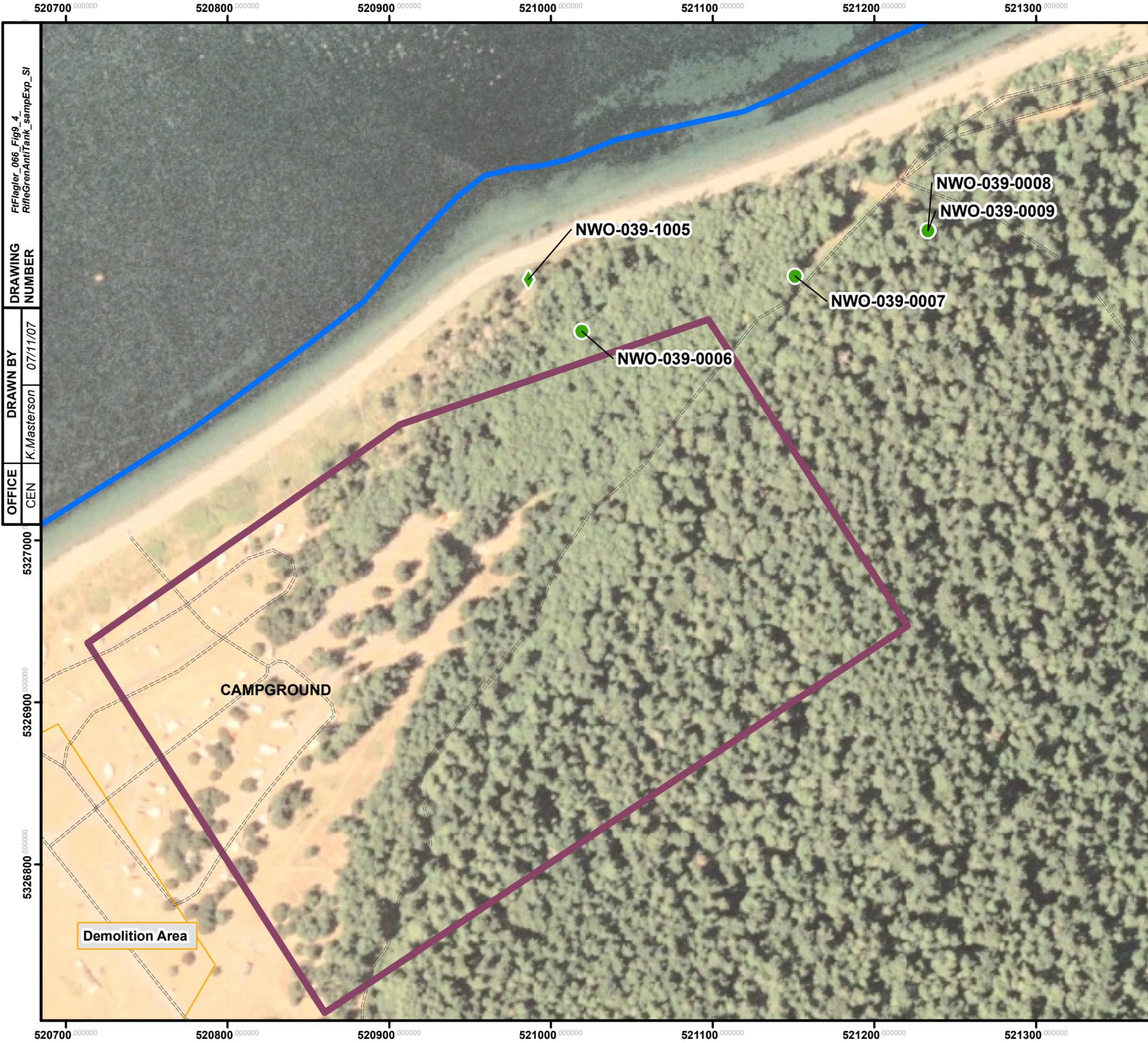


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 9-3**  
**ROCKET RANGE**  
**SAMPLE LOCATIONS AND METALS RESULTS**  
 FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



FFlagler\_066\_Fig9\_4  
 RifleGrenAntiTank\_sampExp\_SI  
 DRAWING NUMBER  
 DRAWN BY  
 OFFICE  
 K.Masterson  
 07/11/07  
 CEN

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Rocket Range
- Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values
- ◆ Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

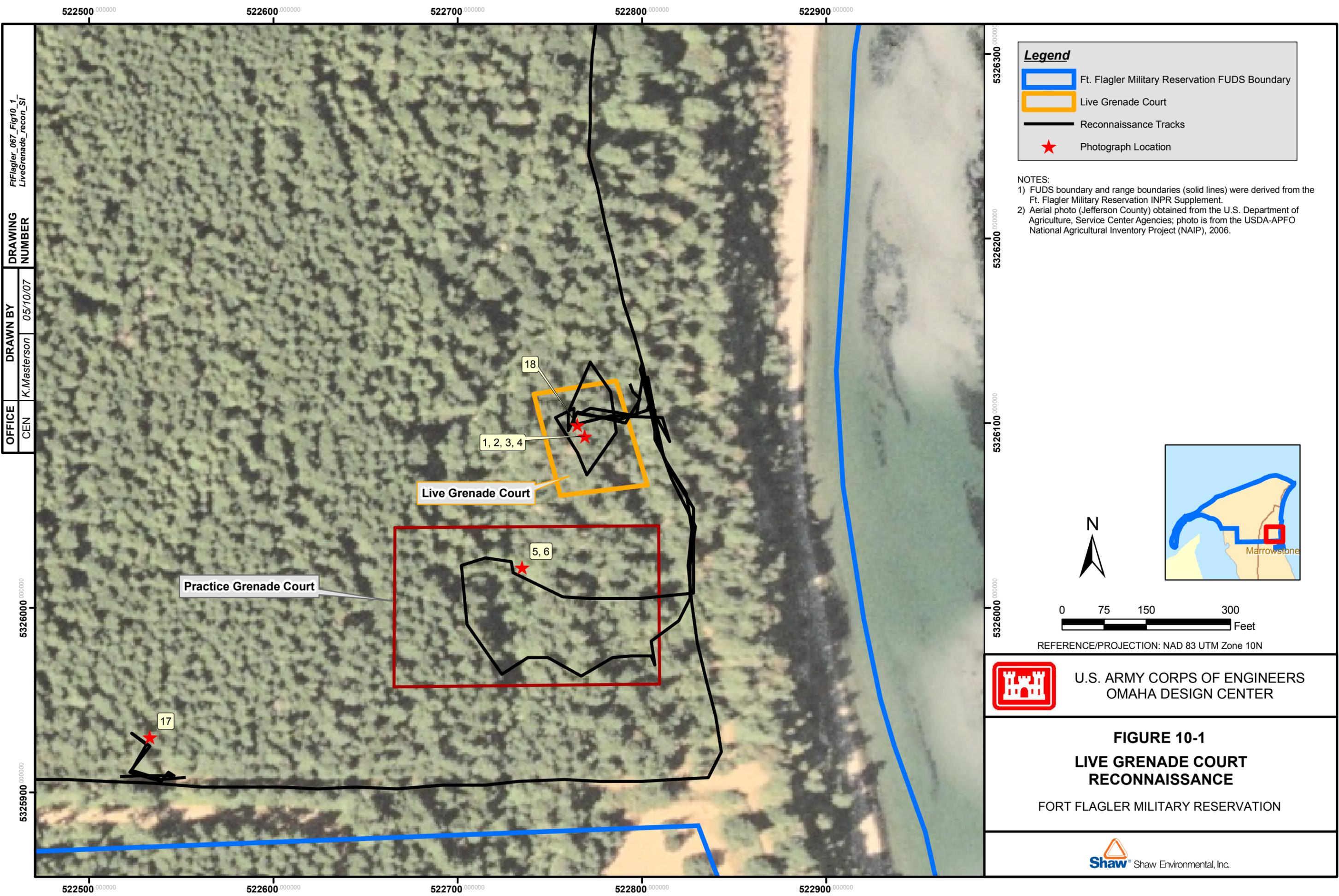


U.S. ARMY CORPS OF ENGINEERS  
 OMAHA DESIGN CENTER

**FIGURE 9-4**  
**ROCKET RANGE**  
**SAMPLE LOCATIONS AND**  
**EXPLOSIVE RESULTS**

FORT FLAGLER MILITARY RESERVATION





OFFICE: CEN  
 DRAWN BY: K. Masterson  
 DRAWING NUMBER: 05/10/07  
 Ft. Flagler 067 Fig10\_1  
 Live Grenade Recon\_S1

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Live Grenade Court
- Reconnaissance Tracks
- ★ Photograph Location

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

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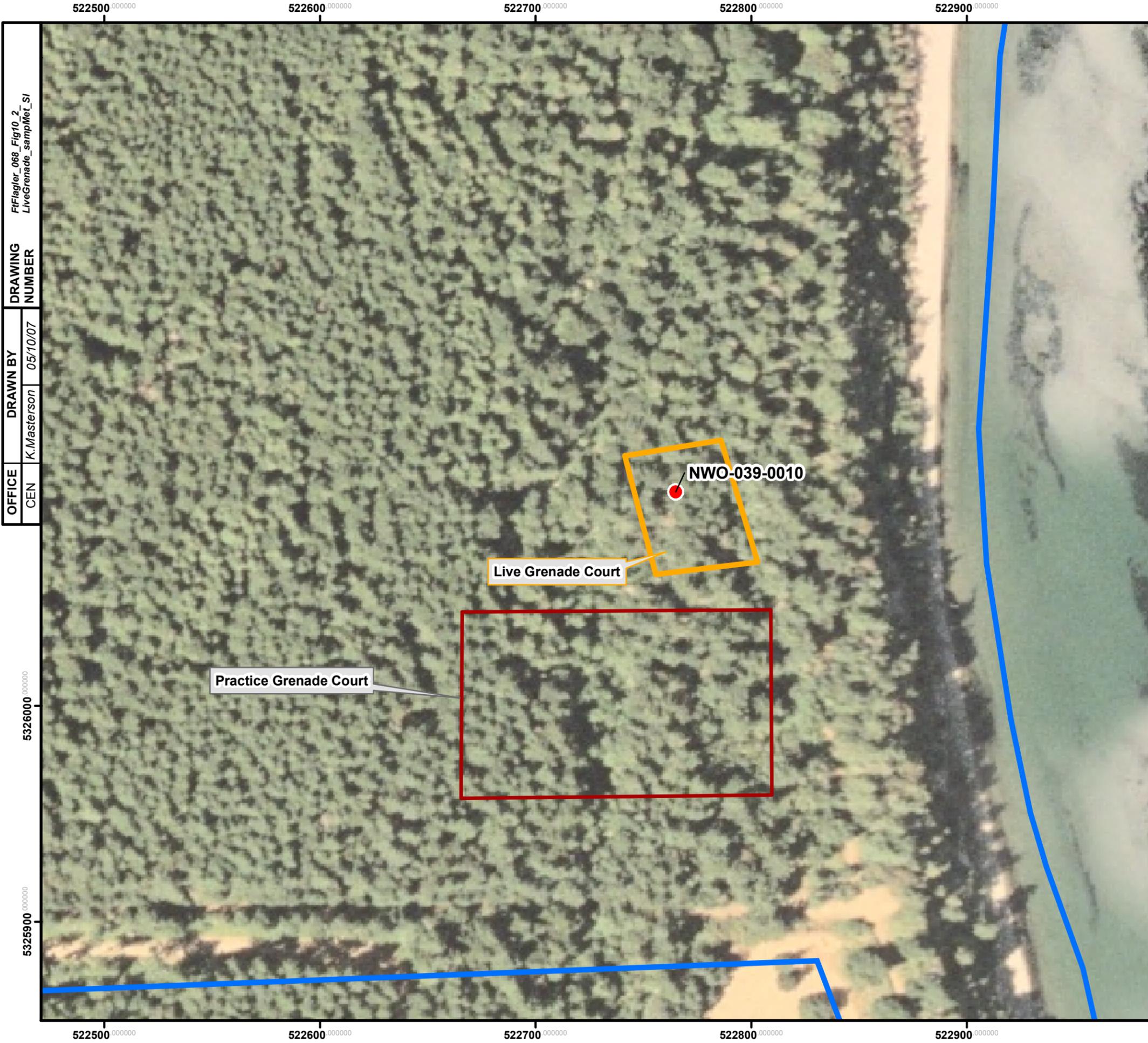


REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

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**FIGURE 10-1**  
**LIVE GRENADE COURT**  
**RECONNAISSANCE**  
 FORT FLAGLER MILITARY RESERVATION

Shaw Environmental, Inc.



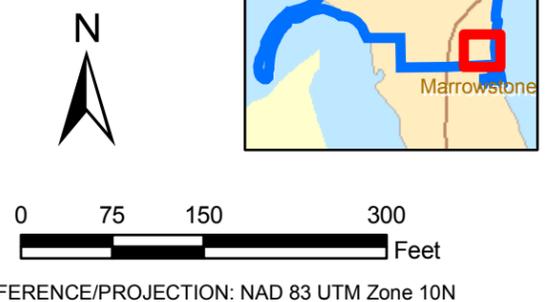
OFFICE: CEN  
 DRAWN BY: K. Masterson  
 DRAWING NUMBER: FFlagler\_068\_Fig10\_2\_LiveGrenade\_sampMet\_SI  
 DATE: 05/10/07

**Legend**

-  Ft. Flagler Military Reservation FUDS Boundary
-  Live Grenade Court
-  Soil Sample Results Were Greater Than Background and Greater Than Eco or Human Health Screening Values

**NOTES:**

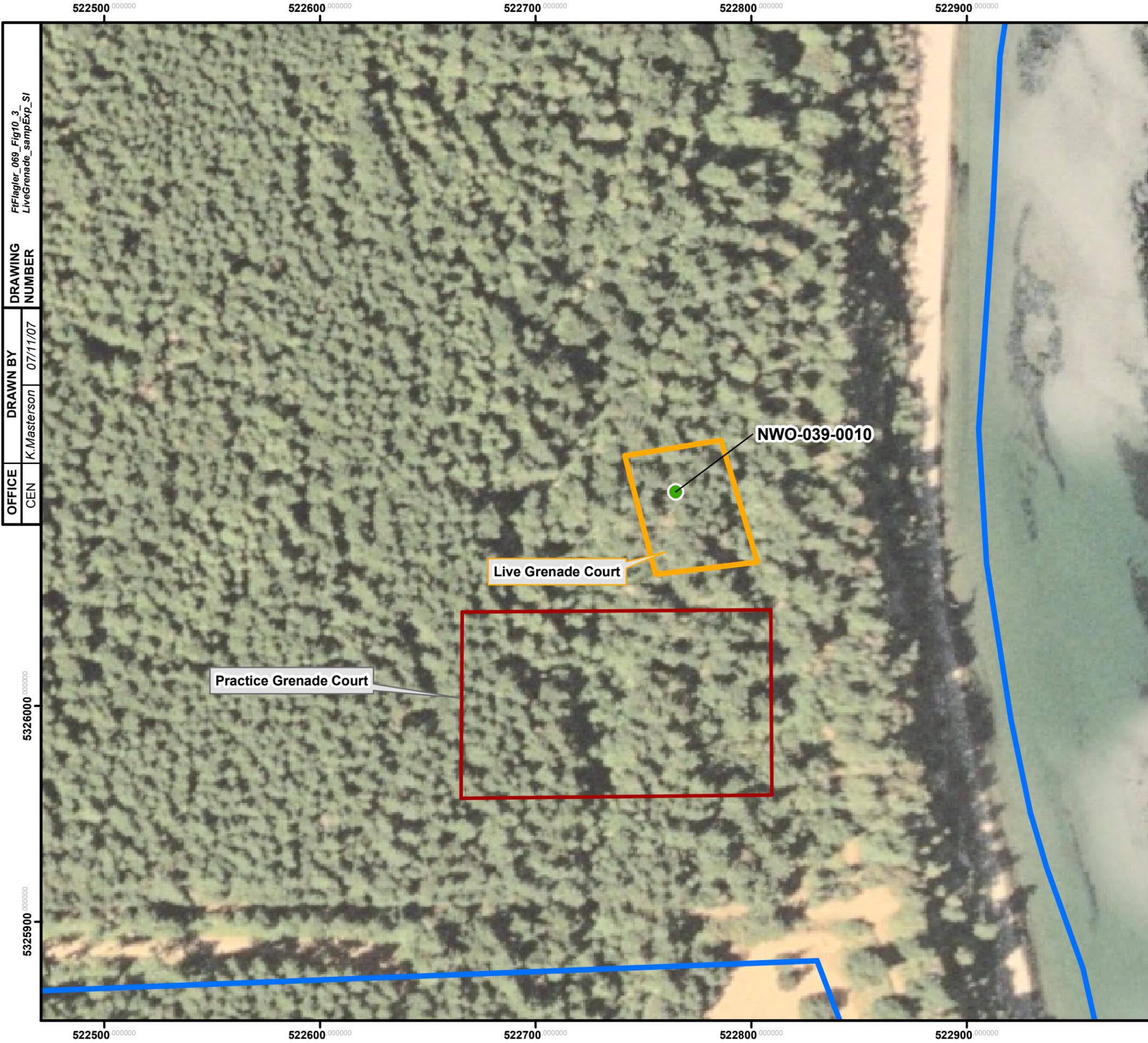
- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.




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**FIGURE 10-2**  
**LIVE GRENADE COURT**  
**SAMPLE LOCATIONS AND**  
**METALS RESULTS**  
 FORT FLAGLER MILITARY RESERVATION


 Shaw Environmental, Inc.



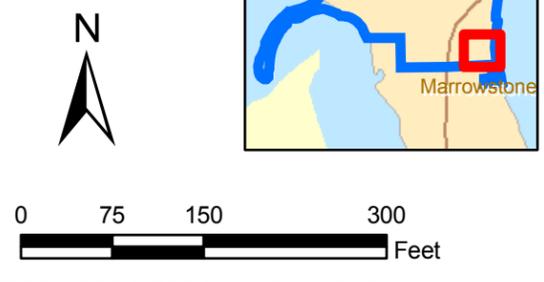
OFFICE: CEN  
 DRAWN BY: K. Masterson  
 DRAWING NUMBER: FFlagler\_069\_Fig10\_3\_LiveGrenade\_sampExp\_SI  
 DATE: 07/11/07

**Legend**

-  Ft. Flagler Military Reservation FUDS Boundary
-  Live Grenade Court
-  Soil Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

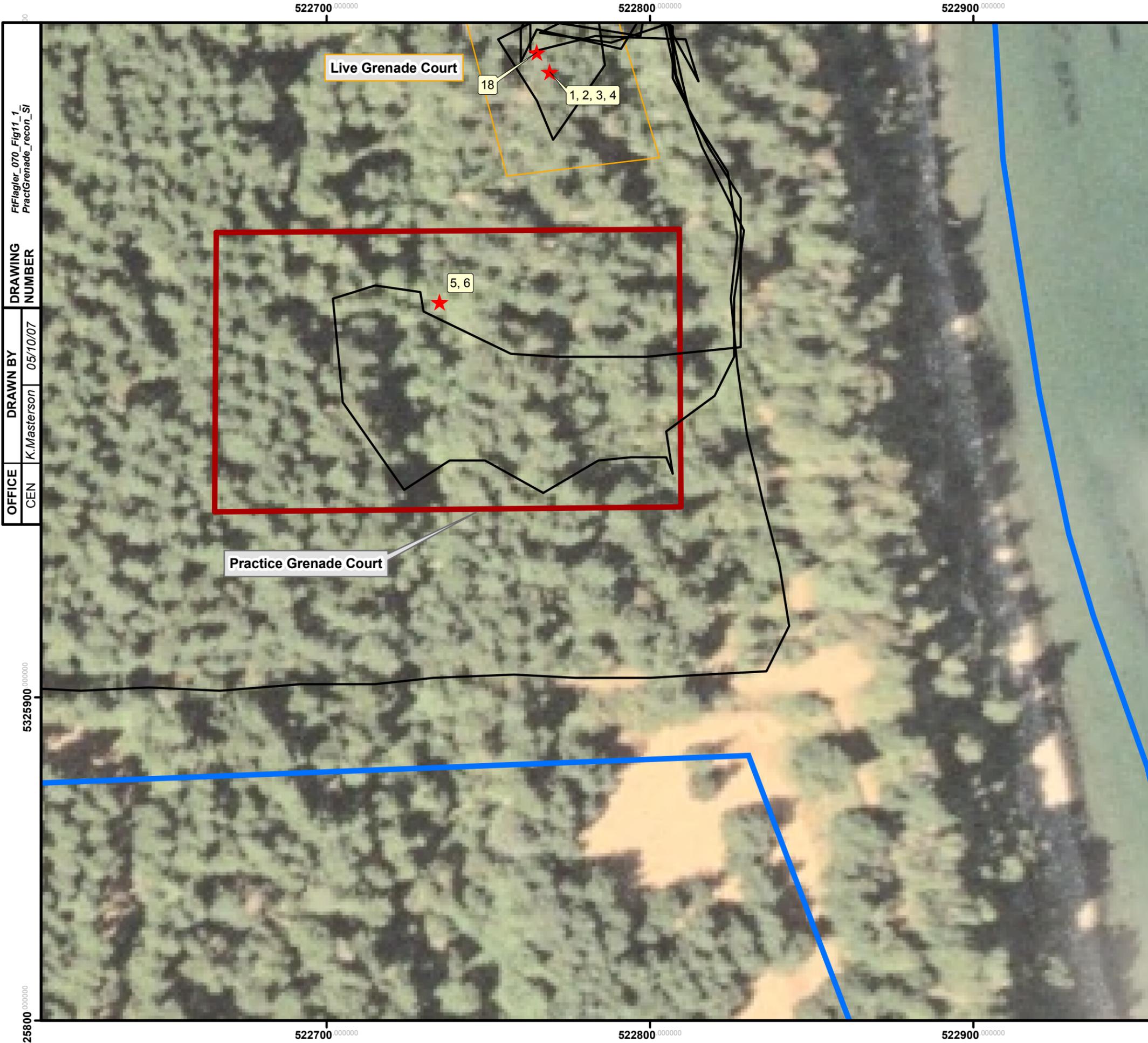



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**FIGURE 10-3**  
**LIVE GRENADE COURT**  
**SAMPLE LOCATIONS AND**  
**EXPLOSIVE RESULTS**  
 FORT FLAGLER MILITARY RESERVATION


 Shaw Environmental, Inc.

OFFICE: CEN  
 DRAWN BY: K. Masterson  
 DATE: 05/10/07  
 DRAWING NUMBER:  
 Ft. Flagler\_070\_Fig11\_1  
 PractGrenade\_recon\_Si



**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Practice Grenade Court
- Reconnaissance Tracks
- Photograph Location

**NOTES:**  
 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.  
 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



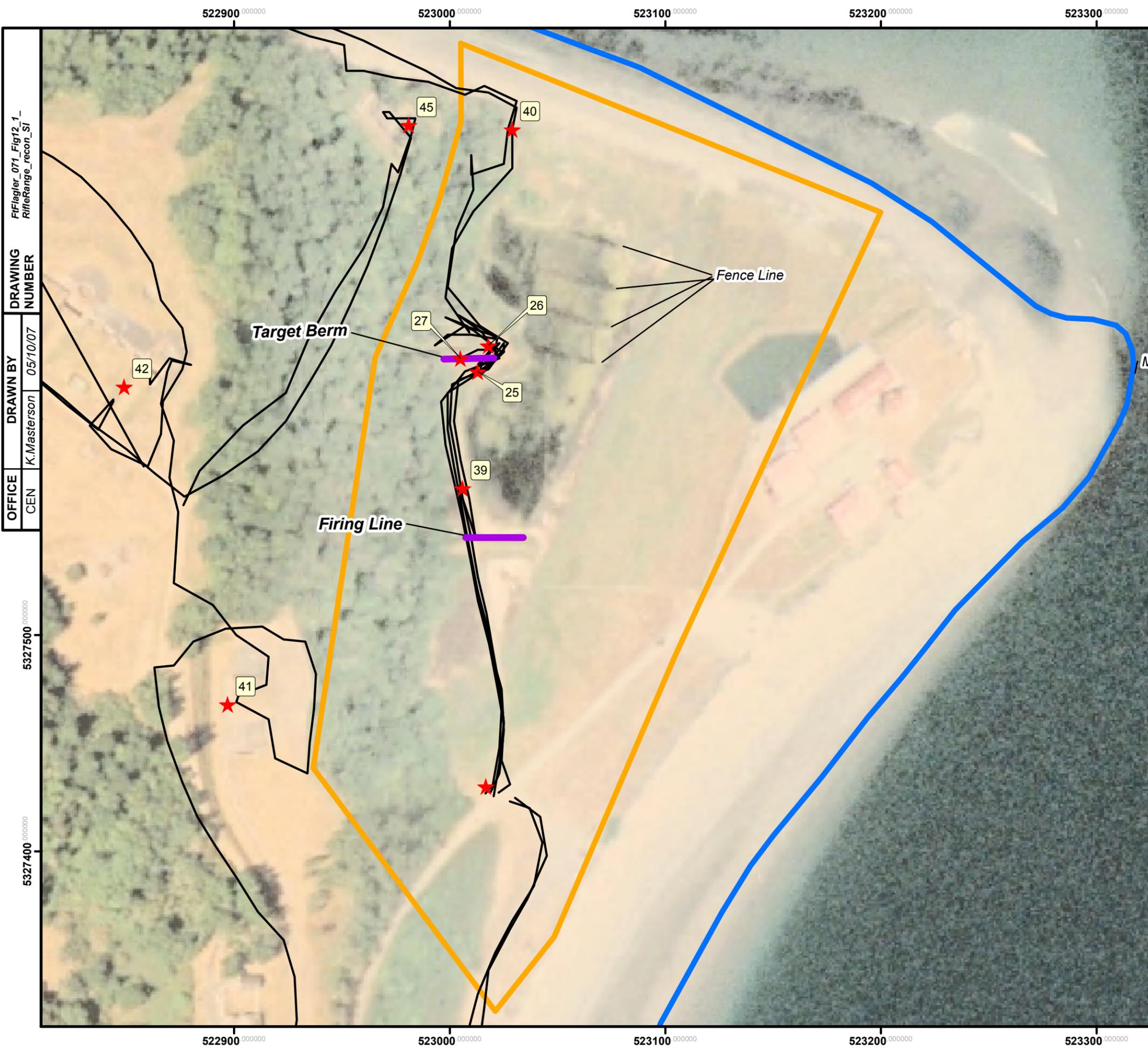
U.S. ARMY CORPS OF ENGINEERS  
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**FIGURE 11-1**  
**PRACTICE GRENADE COURT**  
**RECONNAISSANCE**  
 FORT FLAGLER MILITARY RESERVATION



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 5326100

522700  
 522800  
 522900



OFFICE: CEN  
 DRAWN BY: K. Masterson  
 DRAWING NUMBER: 05/10/07  
 Title: Ft. Flagler\_071\_Fig12\_1\_RifleRange\_recon\_S1

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Rifle Range
- Reconnaissance Tracks

**NOTES:**  
 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.  
 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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**FIGURE 12-1**  
**RIFLE RANGE**  
**RECONNAISSANCE**  
 FORT FLAGLER MILITARY RESERVATION

 Shaw Environmental, Inc.



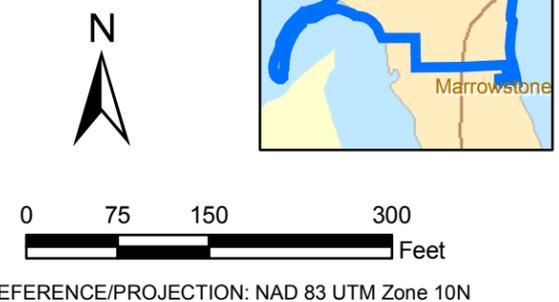
OFFICE: CEN  
 DRAWN BY: J.Lillis  
 DATE: 05/10/07  
 DRAWING NUMBER: FFlagler\_072\_Fig12\_2\_RifleRange\_sampLead\_SI

**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- Rifle Range
- Soil Sample Results Were Greater Than Background and Greater than Eco or Human Health Screening Values
- Sediment Sample Results Were Greater Than Background and Greater than Eco or Human Health Screening Values

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



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**FIGURE 12-2**  
**RIFLE RANGE**  
**SAMPLE LOCATIONS AND**  
**LEAD RESULTS**  
 FORT FLAGLER MILITARY RESERVATION

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520500 520600 520700 520800 520900



**Legend**

-  Ft. Flagler Military Reservation FUDS Boundary
-  Demolition Area
-  Rocket Range
-  Reconnaissance Tracks

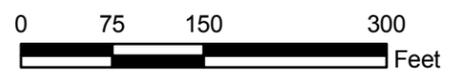
**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

OFFICE: CEN  
 DRAWN BY: K. Masterson  
 DRAWING NUMBER: 05/10/07  
 F:\Flagler\_073\_Fig13\_1\_DemoArea\_recon\_Si\_

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 5326700



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



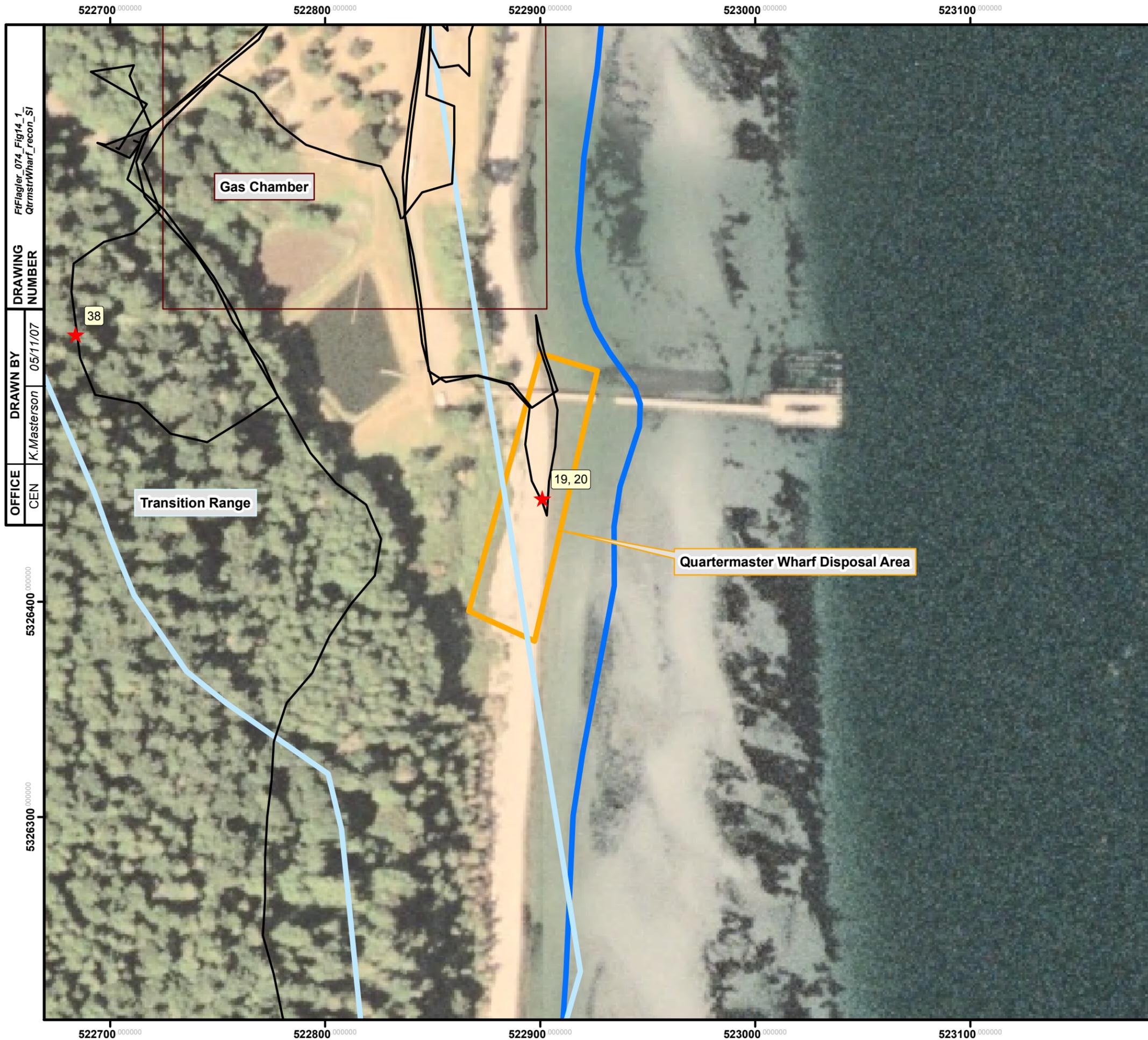
U.S. ARMY CORPS OF ENGINEERS  
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**FIGURE 13-1  
DEMOLITION AREA  
RECONNAISSANCE**

FORT FLAGLER MILITARY RESERVATION

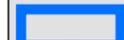
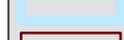
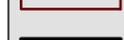


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FIFlagler\_074\_Fig14\_1  
 QtrmstrWharf\_recon\_Si  
**DRAWING NUMBER**  
**DRAWN BY** K.Masterson 05/11/07  
**OFFICE** CEN

**Legend**

-  Ft. Flagler Military Reservation FUDS Boundary
-  Quatermaster Wharf Disposal Area
-  Transition Range 1 Adjusted Location
-  Gas Chamber
-  Reconnaissance Tracks

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

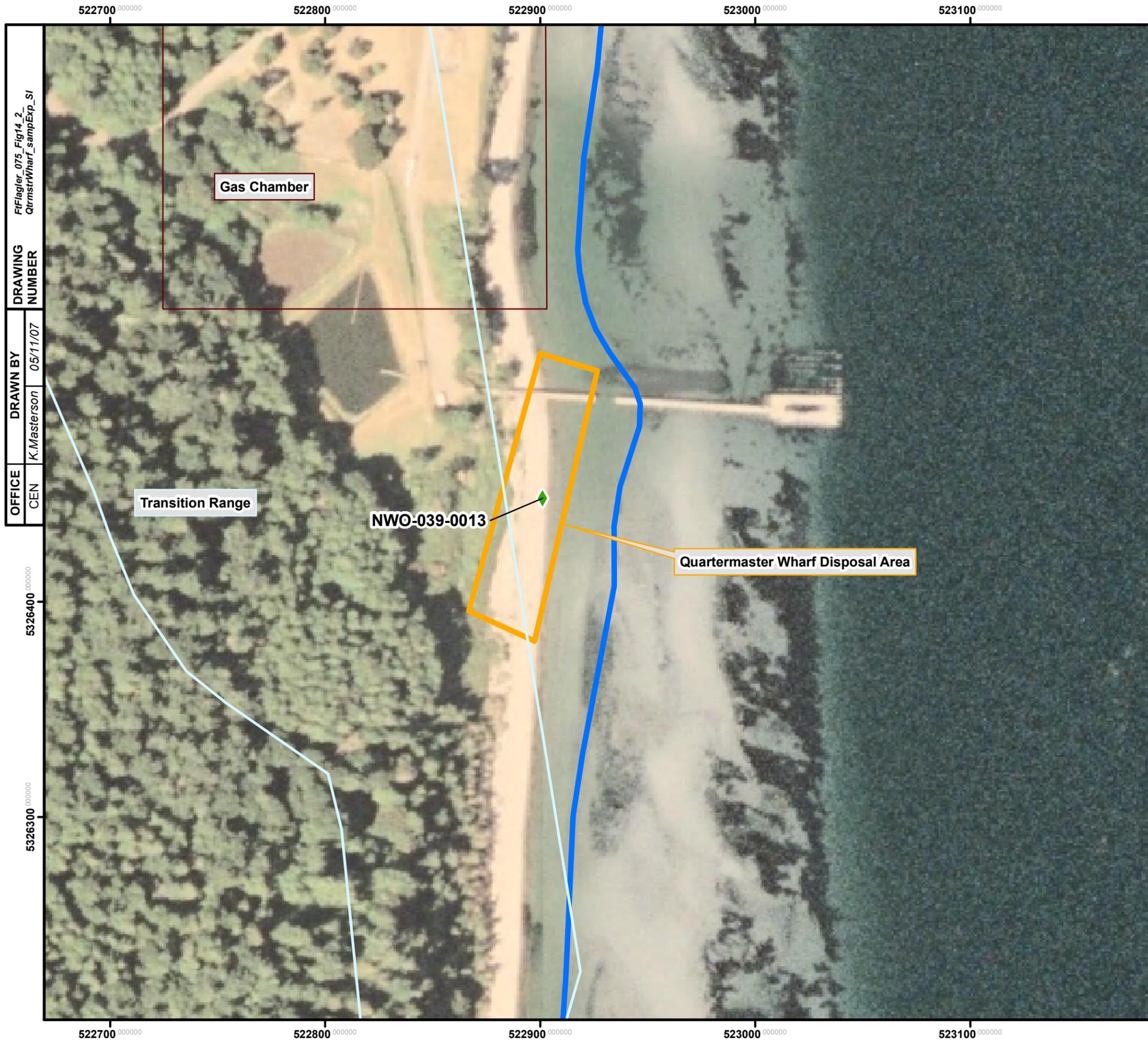


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OMAHA DESIGN CENTER

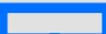
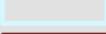
**FIGURE 14-1**  
**QUATERMASTER WHARF DISPOSAL AREA**  
**RECONNAISSANCE**

FORT FLAGLER MILITARY RESERVATION





**Legend**

-  Ft. Flagler Military Reservation FUDS Boundary
-  Quatermaster Wharf Disposal Area
-  Transition Range 1
-  Gas Chamber
-  Sediment Sample Results Were Less Than Background and Less Than Eco or Human Health Screening Values

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



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**FIGURE 14-2**  
**QUATERMASTER WHARF DISPOSAL AREA**  
**SAMPLE LOCATIONS AND EXPLOSIVE RESULTS**  
**FORT FLAGLER MILITARY RESERVATION**



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520800 000000

521750 000000

522700 000000

523650 000000



OFFICE: CEN  
 DRAWN BY: K. Masterson  
 DRAWING NUMBER: 5326400  
 DATE: 05/11/07  
 FILE: FtFlagler\_075\_Fig16\_1\_MRS\_SI

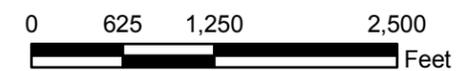
**Legend**

- Ft. Flagler Military Reservation FUDS Boundary
- MRS #1
- MRS #2
- MRS #3

**NOTES:**

- 1) FUDS boundary and range boundaries (solid lines) were derived from the Ft. Flagler Military Reservation INPR Supplement.
- 2) Aerial photo (Jefferson County) obtained from the U.S. Department of Agriculture, Service Center Agencies; photo is from the USDA-APFO National Agricultural Inventory Project (NAIP), 2006.

5328800 000000  
 5328000 000000  
 5327200 000000  
 5326400 000000  
 5325600 000000



REFERENCE/PROJECTION: NAD 83 UTM Zone 10N



U.S. ARMY CORPS OF ENGINEERS  
OMAHA DESIGN CENTER

**FIGURE 16-1**  
**MUNITIONS RESPONSE SITES**  
 FORT FLAGLER MILITARY RESERVATION



519850 000000

520800 000000

521750 000000

522700 000000

523650 000000

## *Tables*

**Table 2-1  
Munitions Information  
Fort Flagler Military Reservation**

<b>AOC</b>	<b>Subrange /Battery</b>	<b>Munitions</b>	<b>Munitions Constituents</b>
Range Complex	Battery Bankhead	12-inch Mortar, M1889 MI	Propellant – single-base (nitrocellulose) or triple-base (nitrocellulose, NG, and nitroguanidine); HE Projectile – Explosive D (ammonium picrate). Projectile cast iron or steel
	Battery Calwell	6-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) double-base (nitrocellulose and NG, or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – TNT. Projectile cast iron or steel
	Battery Downes	3-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); HE Projectile – TNT. Projectile cast iron or steel
	Battery Gratton	6-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – Explosive D (ammonium picrate). Projectile cast iron or steel
	Battery Lee	5-inch Rapid Fire, M1897	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Projectile explosive– unknown. Projectile cast iron or steel
	Battery Rawlins	10-inch Rifle, MII	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Projectile explosive – unknown. Projectile cast iron or steel
	Battery Revere	10-inch Rifle, MII	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Projectile explosive– unknown. Projectile cast iron or steel
	Battery Wansboro	3-inch Rapid Fire, M1903	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – TNT. Projectile cast iron or steel
	Battery Wilhelm	12-inch Rifle, M1888 MII	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); HE Projectile – Explosive D (ammonium picrate). Projectile cast iron or steel
	Anti-Torpedo Boat Battery	90-mm M1	Propellant – single-base (nitrocellulose), double-base (nitrocellulose and NG, or triple base (nitrocellulose, NG, and nitroguanidine) Projectile explosive - unknown Projectile cast iron or steel
Anti-Aircraft Artillery Battery	3-inch, M1917M1A2	Propellant – single-base (nitrocellulose) or triple base (nitrocellulose, NG, and nitroguanidine); Practice Projectile – spotting charge; HE Projectile – Explosive D (Ammonium picrate). Projectile cast iron or steel	

**Table 2-1 (Continued)**

AOC	Munitions	Munitions Constituents
Ammunition Bunker	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
	Riot Hand Grenade, ABC-M25A1	CN, steel
	Candle	CN
	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel
	Rocket, M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Practice Rocket, M7A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron
	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze.
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel
	Anti-Tank, Anti-Vehicle Mine	Inert, steel
Transition Range 1	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
Transition Range 2	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
Gas Chamber	Riot Hand Grenade, ABC-M25A1	CN, steel
	Candle	CN
Rifle Grenade/ Anti-Tank Rocket Range	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel.
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel.
	Rocket, M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Practice Rocket, M7A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Anti-Tank/Anti-Vehicle Mine.	Inert, steel

**Table 2-1 (Continued)**

AOC	Munitions	Munitions Constituents
Live Grenade Court	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron
	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
Practice Grenade Court	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel
Rifle Range	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
Demolition Area	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG).
	Riot Hand Grenade, ABC-M25A1	CN, steel
	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel
	Rocket, M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Practice Rocket, M7A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron.
	M21 Practice Hand grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel

**Table 2-1 (Continued)**

AOC	Munitions	Munitions Constituents
Quarter Master Wharf	Small Arms	Lead; Propellant – single-base (nitrocellulose) or double-base (nitrocellulose and NG)
	Riot Hand Grenade, ABC-M25A1	CN, steel
	Rocket, M28, 3.5-inch	NG, nitrocellulose, potassium perchlorate, RDX, TNT, steel
	Practice Rocket, M29, 3.5-inch	NG, nitrocellulose, potassium perchlorate, steel
	Rocket M6A1, 2.36-inch, Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine); Pentolite (TNT & PETN), steel
	Rocket Practice M7A1, 2.36-inch Anti-Tank	Ballistite (nitrocellulose, NG, diphenylamine), steel
	Mk II Fragment Hand Grenade	TNT, flaked or granular, older models used E.C. blank fire smokeless powder, perchlorate in fuze, cast iron
	M21 Practice Hand Grenade	Black powder (potassium nitrate, sulfur, charcoal), perchlorate in fuze, steel
	Mk 1A1 Practice Hand Grenade	Spotting charge, steel

Notes:

AOC – area of concern

CN – chloroacetophenone

HE – high explosive

mm – millimeter

NG – nitroglycerin

PETN – pentaerythritol tetranitrate

RDX – Hexahydro-1,3,5-trinitro-1,3,5-triazine

TNT – 2,4,6-Trinitrotoluene

**Table 2-2  
Army Checklist for Important Ecological Places <sup>a</sup>  
Fort Flagler, Washington**

		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 checked="" type="checkbox"/> / <input type="checkbox"/>	Site shoreline on Puget Sound and is in one of the 15 State counties identified under the CZMA.
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"/>	Occasional transient bald eagle Site use.
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"/>	
22	National river reach designated as Recreational	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

**Table 2-2 (Cont.)**

		<b>Yes / No</b>	<b>Comments</b>
23	Habitat known to be used by state designated endangered or threatened species	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Occasional transient bald eagle Site use.
24	Habitat known to be used by species under review as to its Federal endangered or threatened status	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
25	Coastal Barrier (partially developed)	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
26	Federally designated Scenic or Wild River	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
27	State land designated for wildlife or game management	<input checked="" type="checkbox"/> / <input type="checkbox"/>	Site is State Park, and Washington State Parks and Recreation Commission is assumed to manage state park lands for wildlife and/or game species.
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 checked="" type="checkbox"/> / <input type="checkbox"/>	Site is State Park, and Washington State Parks and Recreation Commission has statutory responsibility to conserve Washington's seashore.
32	Wetlands	<input type="checkbox"/> / <input checked="" type="checkbox"/>	
33	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	<input type="checkbox"/> / <input checked="" type="checkbox"/>	

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

Table 3-1

Summary of Samples Collected  
Fort Flagler Military Reservation

Location ID	Sample Number	Sample Purpose	Sample Type	Date Collected	Sample Depth (ft)	Laboratory SDG Number	Lead by SW-846 6020A	Select Metals* by SW-846 6020A	TAL Metals (including Molybdenum) by SW-846 6020A	Mercury by SW-846 7471A	Explosives by SW-846 8330A	Nitroglycerine and PETN by SW-846 8330A (Modified)
<b>Transition Range 1</b>												
039A003	NWO-039-0002	REG	SS	21-Feb-07	0 - 0.5	702114-001	X					
039A004	NWO-039-0003	REG	SS	21-Feb-07	0 - 0.5	702114-002	X					
039A005	NWO-039-1002	REG	SD	21-Feb-07	0 - 0.5	702114-003	X					
<b>Transition Range 2</b>												
039A006	NWO-039-0004	REG	SS	21-Feb-07	0 - 0.5	702114-004	X					
039A007	NWO-039-0005	REG	SS	21-Feb-07	0 - 0.5	702114-005	X					
039A008	NWO-039-1003	REG	SD	21-Feb-07	0 - 0.5	702114-006	X					
	NWO-039-1004	FD	SD	21-Feb-07	0 - 0.5	702114-007	X					
<b>Rifle Grenade / Anti-Tank Rocket Range</b>												
039A009	NWO-039-0006	REG	SS	21-Feb-07	0 - 0.5	702113-001		X			X	X
	NWO-039-0006-MS	MS	SS	21-Feb-07	0 - 0.5	702113-001MS		X			X	X
	NWO-039-0006-MSD	MSD	SS	21-Feb-07	0 - 0.5	702113-001MSD		X			X	X
039A010	NWO-039-0007	REG	SS	21-Feb-07	0 - 0.5	702113-002		X			X	X
039A011	NWO-039-0008	REG	SS	21-Feb-07	0 - 0.5	702113-003		X			X	X
	NWO-039-0009	FD	SS	21-Feb-07	0 - 0.5	702113-004		X			X	X
039A012	NWO-039-1005	REG	SD	21-Feb-07	0 - 0.5	702113-005		X			X	X
<b>Live Grenade Range</b>												
039A013	NWO-039-0010	REG	SS	21-Feb-07	0 - 0.5	702113-006		X			X	X
<b>Rifle Range</b>												
039A014	NWO-039-0011	REG	SS	21-Feb-07	0 - 0.5	702114-008		X				
039A015	NWO-039-0012	REG	SS	21-Feb-07	0 - 0.5	702114-009		X				
039A016	NWO-039-1006	REG	SD	21-Feb-07	0 - 0.5	702114-010		X				
<b>Quartermaster's Wharf</b>												
039A017	NWO-039-0013	REG	SD**	21-Feb-07	0 - 0.5	702113-007					X	X
<b>Background</b>												
039A018	NWO-039-5001	REG	SS	21-Feb-07	0 - 0.5	702112-001			X	X		
	NWO-039-5001-MS	MS	SS	21-Feb-07	0 - 0.5	702112-001MS			X	X		
	NWO-039-5001-MSD	MSD	SS	21-Feb-07	0 - 0.5	702112-001MSD			X	X		
039A019	NWO-039-5002	REG	SS	20-Feb-07	0 - 0.5	702112-002			X	X		
039A020	NWO-039-5003	REG	SS	20-Feb-07	0 - 0.5	702112-003			X	X		
039A021	NWO-039-5004	REG	SS	20-Feb-07	0 - 0.5	702112-004			X	X		
039A022	NWO-039-5005	REG	SS	20-Feb-07	0 - 0.5	702112-005			X	X		
039A023	NWO-039-5006	REG	SS	20-Feb-07	0 - 0.5	702112-006			X	X		
039A024	NWO-039-5007	REG	SS	20-Feb-07	0 - 0.5	702112-007			X	X		
039A025	NWO-039-5008	REG	SS	21-Feb-07	0 - 0.5	702112-008			X	X		
039A026	NWO-039-5009	REG	SS	20-Feb-07	0 - 0.5	702112-009			X	X		
039A027	NWO-039-5010	REG	SS	20-Feb-07	0 - 0.5	702112-010			X	X		
	NWO-039-5011	FD	SS	20-Feb-07	0 - 0.5	702112-011			X	X		
039A028	NWO-039-5012	REG	SD	20-Feb-07	0 - 0.5	702112-012			X	X		
039A029	NWO-039-5013	REG	SD**	21-Feb-07	0 - 0.5	702112-013			X	X		

**Notes:**

X - Indicates a sample was collected and analyzed for the given parameter

\* Select metals are aluminum, chromium, copper, iron, lead, manganese, molybdenum, and nickel.

\*\* Sediment - beach sand

ft - feet

SDG - sample delivery group

TAL - target analyte list

PETN - pentaerythritol tetranitrate

REG - regular field sample

FD - field duplicate

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MS - matrix spike

MSD - matrix spike duplicate

SS - surface soil (&lt; 0.5ft below ground surface)

SD - sediment

**Table 3-2  
Summary of Fort Flagler Military Reservation Background Values**

<b>Element</b>	<b>Soil Background Concentration 95th UTL/95th Percentile <sup>a</sup> (Based on 10 Samples) (mg/kg)</b>	<b>Sediment Background Concentration (Based on 1 Sample <sup>b</sup>) (mg/kg)</b>
Aluminum	12,300	10,800
Antimony	< 0.75	<0.13
Arsenic	11.5	3.9
Barium	426	131
Beryllium	0.25	0.19
Cadmium	0.35	0.19
Calcium	12,300	6,410
Chromium	35.2	28.5
Cobalt	10.4	8.4
Copper	13.2	11.1
Iron	17,800	15,600
Lead	32.6	12.8
Magnesium	5,830	5,660
Manganese	4,250	590
Mercury	0.23	0.082
Molybdenum	< 3.8	0.22
Nickel	80.2	46.9
Potassium	1,020	979
Selenium	< 3.8	0.73
Silver	< 0.23	0.11
Sodium	265	301
Thallium	< 1.5	0.13
Vanadium	42.6	33.9
Zinc	101	45.3

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

mg/kg - milligrams per kilogram

UTL - upper tolerance limit

<sup>a</sup> Supporting calculations for soil background values are provided in appendix L

<sup>b</sup> Background sample analytical results provided in Appendix G

**Table 3-3  
Human Health Soil and Sediment Screening Criteria  
Fort Flagler Military Reservation**

Analyte	USEPA Region 9 <sup>a</sup>		Washington Department of Ecology - Soil Cleanup Levels <sup>b</sup>					Final Screening Value <sup>b</sup> (mg/kg)
	Residential PRGs (mg/kg)	Industrial PRGs (mg/kg)	Method B Level - Unrestricted <sup>c</sup> (mg/kg)	Leaching - Phase 3 Model - Unrestricted <sup>d</sup> (mg/kg)	Method B Level - Industrial <sup>e</sup> (mg/kg)	Leaching - Phase 3 Model - Industrial <sup>f</sup> (mg/kg)	Natural Background Level <sup>g</sup> (mg/kg)	
<b>Explosives</b>								
Hexahydro-1,3,5-trinitro-1,3,5-triazine	4.4	16	NVA	NVA	NVA	NVA	NA	4.4
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	3,100	31,000	NVA	NVA	NVA	NVA	NA	3,100
2,4,6-Trinitrotoluene	16	57	NVA	NVA	NVA	NVA	NA	16
1,3,5-Trinitrobenzene	1,800	18,000	NVA	NVA	NVA	NVA	NA	1,800
1,3-Dinitrobenzene	6.1	62	NVA	NVA	NVA	NVA	NA	6.1
2,4-Dinitrotoluene <sup>1</sup>	0.72	2.5	NVA	NVA	NVA	NVA	NA	0.72
2,6-Dinitrotoluene <sup>1</sup>	0.72	2.5	NVA	NVA	NVA	NVA	NA	0.72
2-Amino-4,6-dinitrotoluene	12	120	NVA	NVA	NVA	NVA	NA	12
2-Nitrotoluene	0.88	2.2	NVA	NVA	NVA	NVA	NA	0.88
3-Nitrotoluene	730	1,000	NVA	NVA	NVA	NVA	NA	730
4-Amino-2,6-dinitrotoluene	12	120	NVA	NVA	NVA	NVA	NA	12
4-Nitrotoluene	12	30	NVA	NVA	NVA	NVA	NA	12
Nitrobenzene	20	100	NVA	NVA	NVA	NVA	NA	20
Nitroglycerin	35	120	NVA	NVA	NVA	NVA	NA	35
Methyl-2,4,6-trinitrophenylnitramine	610	6,200	NVA	NVA	NVA	NVA	NA	610
Pentaerythritol tetranitrate	NVA	NVA	NVA	NVA	NVA	NVA	NA	0.5 <sup>1</sup>
<b>Metals</b>								
Chromium (Total)	210	450	NVA	NVA	NVA	NVA	48	210
Copper	3,100	41,000	NVA	NVA	NVA	NVA	36	3,100
Iron	23,000	100,000	NVA	NVA	NVA	NVA	58,700	23,000
Lead	400	800	NVA	3,000	NVA	3,000	24	400
Molybdenum	390	5,100	NVA	NVA	NVA	NVA	NVA	390
Nickel	1,600	20,000	NVA	NVA	NVA	NVA	48	1,600

CLARC = Cleanup Level and Risk Calculation  
WAC = Washington Administrative Code  
NVA = no value available  
mg/kg = milligrams per kilogram.

C = Value for carcinogen  
N = Value for noncarcinogen  
NA = not applicable, compound considered not present in natural soils  
USEPA = U.S. Environmental Protection Agency

<sup>a</sup> Region 9 Preliminary Remediation Goals (PRG) table; October 2004. Values are based on residential and industrial exposure to single chemicals.

**Table 3-3**  
**Human Health Soil and Sediment Screening Criteria**  
**Fort Flagler Military Reservation**

<sup>b</sup> Cleanup levels are established under the Model Toxics Control Act (MCTA) Cleanup Regulation. Chapter 173-340 WAC.

<sup>c</sup> Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 740-1, Table 5: Method B Calculations for Carcinogens for Soil Ingestion Plus Dermal Contact and Table 6: Method B Calculation for Soil Ingestion Plus Dermal Contact. Based on Unrestricted land use. From CLARC Notes undated on November 23, 2004.

<sup>d</sup> Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 740-1, Table 7: 3-Phase Model Assumptions and Results. Based on protection of groundwater. From CLARC Notes updated on November 23, 2004.

<sup>e</sup> Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 745-1, Table 5: Method C Industrial Calculations for Carcinogens for Soil Injection Plus Dermal Contact and Table 6: Method C Industrial Calculations for Carcinogens for Soil Ingestion Plus Dermal Contact. Based on industrial land use. From CLARC Notes updated on November 23, 2004.

<sup>f</sup> Values from Notes on Method A Cleanup Levels WAC 173-340-720, 740, and 745, Table 745-1, Table 7: 3-Phase Model Assumptions and Results. Based on protection of groundwater. From CLARC Notes updated on November 23, 2004.

<sup>g</sup> Values from "Natural Background Soil Metals Concentrations in Washington State", Publication #94-115, October 1994. Based on data for Puget Sound.

<sup>h</sup> Final Screening Value selected based on the lowest value listed for chemical between USEPA Region 9 PRG and Washington Department of Ecology – Soil Cleanup Levels.

<sup>i</sup> Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

<sup>j</sup> Value is laboratory practical quantitation limit.

**Table 3-4  
Ecological Soil Screening Values  
Fort Flagler Military Reservation**

Analyte	Proposed Benchmarks										Potential Bioaccumulative Constituent? <sup>h</sup>	Final Proposed Ecological Screening Value Soil <sup>i</sup> (mg/kg)
	Washington Department of Ecology Lowest Value for Plants/ Soil Biota/Wildlife <sup>a</sup> (mg/kg)	USEPA Region 5 ESLs <sup>b</sup> (2003) (mg/kg)	USEPA Region 7 <sup>c</sup> (mg/kg)	USEPA Region 8 <sup>d</sup> (mg/kg)	USEPA Region 10 <sup>e</sup> (mg/kg)	Other Values: Talmage et al. (1999) <sup>f</sup> or LANL (2005) <sup>g</sup> (mg/kg)						
<b>Explosives</b>												
1,3,5-Trinitrobenzene	NVA	0.376	0.376	EPA-R4	NVA	0.376	EPA-R4	6.6	LANL			0.376
1,3-Dinitrobenzene	NVA	0.655	0.655	EPA-R4	NVA	0.655	EPA-R4	0.073	LANL			0.655
2,4,6-Trinitrotoluene	NVA	NVA	NVA		NVA	NVA		6.4	LANL			6.4
2,4-Dinitrotoluene	NVA	1.28	1.28	EPA-R4	NVA	1.28	EPA-R4	0.52	LANL			1.28
2,6-Dinitrotoluene	NVA	0.0328	0.0328	EPA-R4	NVA	0.0328	EPA-R4	0.37	LANL			0.0328
2-Amino-4,6-Dinitrotoluene	NVA	NVA	NVA		NVA	NVA		2.1	LANL			2.1
2-Nitrotoluene	NVA	NVA	NVA		NVA	NVA		2.0	LANL			2.0
3-Nitrotoluene	NVA	NVA	NVA		NVA	NVA		2.4	LANL			2.4
4-Amino-2,6-Dinitrotoluene	NVA	NVA	NVA		NVA	NVA		0.73	LANL			0.73
4-Nitrotoluene	NVA	NVA	NVA		NVA	NVA		4.4	LANL			4.4
HMX	NVA	NVA	NVA		NVA	NVA		27	LANL			27
Nitrobenzene	40	1.31	1.31	EPA-R4	NVA	1.31	EPA-R4	2.2	LANL			40
Nitroglycerin	NVA	NVA	NVA		NVA	NVA		71	LANL			71
PETN	NVA	NVA	NVA		NVA	NVA		8600	LANL			8600
RDX	NVA	NVA	NVA		NVA	NVA		7.5	LANL			7.5
Tetryl	NVA	NVA	NVA		NVA	NVA		0.99	LANL			0.99
<b>Metals/Inorganics</b>												
Chromium (total)	42	0.4	26	SSL	26	SSL	26	SSL	2.3	LANL	Yes	42
Copper	50	5.4	60	ORNL	190	Dutch	60	ORNL	10	LANL	Yes	50
Iron	NVA	NVA	200	EPA-R4	NVA		200	EPA-R4	NVA			200
Lead	50	0.0537	11	SSL	11	SSL	11	SSL	14	LANL	Yes	50
Molybdenum	2	NVA	2	ORNL	2	ORNL	2	ORNL	NVA			2
Nickel	30	13.6	30	ORNL	30	ORNL	30	ORNL	20	LANL	Yes	30

**Acronyms and Abbreviations:**

EPA-R4 = USEPA Region 4

Dutch = Dutch Intervention Values

HMX - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

LANL = Los Alamos National Laboratory

mg/kg = milligrams per kilogram

NVA: No value available

ORNL = Oak Ridge National Laboratory Ecological PRGs (Efroymsen et al.)

PETN - pentaerythritol tetranitrate

RDX - Hexahydro-1,3,5-trinitro-1,3,5-triazine

SSL = USEPA Eco Soil Screening Levels

USEPA = U. S. Environmental Protection Agency

**Notes:**

<sup>a</sup> Washington Department of Ecology, Toxics Cleanup Program, Table 749-3, Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals. Developed under WAC 173-340-7493 (2)(a)(i).

<sup>b</sup> Ecological Screening Levels (ESLs), USEPA Region V, August 2003.

<sup>c</sup> USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: USEPA EcoSSLs; ORNL Efroymsen values; USEPA Region 4 values; other published values.

<sup>d</sup> USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: USEPA SSLs; Dutch Intervention Values or ORNL Efroymsen values.

<sup>e</sup> USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.

<sup>f</sup> Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel, 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values, Rev. Environ. Contam. Toxicol.

**Table 3-4**  
**Ecological Soil Screening Values**  
**Fort Flagler Military Reservation**

<sup>g</sup> Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.

<sup>h</sup> Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation.

Potential bioaccumulative potential from: *Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs* (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).

<sup>i</sup> Final Screening Value selected using the following hierarchy:

1. State Value (Washington)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. (1999) or LANL (2005) values.

**Other References:**

U.S. Environmental Protection Agency, 2005, *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)* , Office of Solid Waste and Emergency Response, Website version last updated March 15, 2005: <http://www.epa.gov/ecotox/ecossl>.

U.S. Environmental Protection Agency, 2001, *Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment* . Originally published November 1995. Website version last updated November 30, 2001: <http://www.epa.gov/region4/waste/ots/ecolbul.htm>.

Efroymsen, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints. Lockheed Martin Energy Systems, Inc. (ORNL) ES/ER/TM-162/R2. Dutch Intervention Values:

Swartjes, F.A. 1999. *Risk-based Assessment of Soil and Groundwater Quality in the Netherlands: Standards and Remediation Urgency* . Risk Analysis 19(6): 1235-1249

The Netherlands Ministry of Housing, Spatial Planning and Environment's Circular on target values and intervention values for soil remediation [http://www2.minvrom.nl/Docs/internationaal/S\\_I2000.pdf](http://www2.minvrom.nl/Docs/internationaal/S_I2000.pdf) and Annex A:

Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination [http://www2.minvrom.nl/Docs/internationaal/annexS\\_I2000.pdf](http://www2.minvrom.nl/Docs/internationaal/annexS_I2000.pdf) were also consulted.

**Table 3-5  
Ecological Sediment Screening Values  
Fort Flagler Military Reservation**

Analyte	Proposed Benchmarks										Potential Bioaccumulative Constituent? <sup>g</sup>	Final Ecological Screening Value Sediment <sup>h</sup> (mg/kg)
	Washington Department of Ecology Screening Level Values Freshwater <sup>a</sup> (mg/kg)	USEPA Region 5 Ecological Screening Levels <sup>b</sup> (mg/kg)	USEPA Region 7 <sup>c</sup> (mg/kg)	USEPA Region 8 <sup>d</sup> (mg/kg)	USEPA Region 10 <sup>e</sup> (mg/kg)	Other Ecological Screening Levels <sup>f</sup> (mg/kg)						
<b>Explosives</b>												
1,3,5-Trinitrobenzene	NVA	NVA	NVA		NVA		NVA		2.40E-02	TAL		2.40E-02
1,3-Dinitrobenzene	NVA	8.61E-03	NVA		NVA		NVA		6.70E-02	TAL		6.70E-02
2,4,6-Trinitrotoluene	NVA	NVA	NVA		NVA		NVA		9.20E-01	TAL		9.20E-01
2,4-Dinitrotoluene	NVA	1.44E-03	NVA		NVA		NVA		2.90E-01	LANL		2.90E-01
2,6-Dinitrotoluene	NVA	3.98E-03	NVA		NVA		NVA		1.90E+00	LANL		1.90E+00
2-Amino-4,6,-Dintrotoluene	NVA	NVA	NVA		NVA		NVA		7.00E+00	LANL		7.00E+00
2-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		5.60E+00	LANL		5.60E+00
3-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		4.90E+00	LANL		4.90E+00
4-Amino-2,6,-Dintrotoluene	NVA	NVA	NVA		NVA		NVA		1.90E+00	LANL		1.90E+00
4-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		1.00E+01	LANL		1.00E+01
HMX	NVA	NVA	NVA		NVA		NVA		4.70E-02	TAL		4.70E-02
Nitrobenzene	NVA	1.45E-01	NVA		NVA		NVA		3.20E+01	LANL		3.20E+01
Nitroglycerin	NVA	NVA	NVA		NVA		NVA		1.70E+03	LANL		1.70E+03
PETN	NVA	NVA	NVA		NVA		NVA		1.20E+05	LANL		1.20E+05
RDX	NVA	NVA	NVA		NVA		NVA		1.30E-01	TAL		1.30E-01
Tetryl	NVA	NVA	NVA		NVA		NVA		1.00E+02	LANL		1.00E+02
<b>Metals/Inorganics</b>												
Chromium	2.60E+02	4.34E+01	4.34E+01	MAC	4.34E+01	MAC	4.34E+01	MAC	5.60E+01	LANL	Yes	2.60E+02
Copper	3.90E+02	3.16E+01	3.16E+01	MAC	3.16E+01	MAC	3.16E+01	MAC	1.70E+01	LANL	Yes	3.90E+02
Iron	NVA	NVA	NVA		NVA		NVA		2.00E+01	LANL		2.00E+01
Lead	2.60E+02	3.58E+01	3.58E+01	MAC	3.58E+01	MAC	3.58E+01	MAC	2.70E+01	LANL	Yes	2.60E+02
Molybdenum	NVA	NVA	NVA		NVA		NVA		NVA			NVA
Nickel	4.60E+02	2.27E+01	2.27E+01	MAC	2.27E+01	MAC	2.27E+01	MAC	3.90E+01	LANL	Yes	4.60E+02

**Acronyms and Abbreviations:**

EPRGs = Oak Ridge National Laboratory Ecological PRGs  
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine  
ISQGs = Canadian Interim Sediment Quality Guidelines  
LANL = Los Alamos National Laboratory  
MAC = MacDonal Consensus Values  
mg/kg = milligram per kilogram  
NVA = No Value Available  
PETN - pentaerythritol tetranitrate  
RDX - Hexahydro-1,3,5-trinitro-1,3,5-triazine  
TAL = Talmage et al (1999)  
USEPA = U. S. Environmental Protection Agency

**Table 3-5**  
**Ecological Sediment Screening Values**  
**Fort Flagler Military Reservation**

**Notes:**

<sup>a</sup> Washington Department of Ecology, Creation and Analysis of Freshwater Sediment Quality Values in Washington State, July, 1997, Pub. No. 97-323a (Table 11).

<sup>b</sup> Ecological Screening Levels (ESLs), USEPA Region V, August 2003.

<sup>c</sup> USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); ORNL Efroymsen values (ORNL, 1977).

<sup>d</sup> USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); Canadian ISQG values (CCME, 2003) or ORNL Efroymsen values (ORNL, 1977).

<sup>e</sup> USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.

<sup>f</sup> Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values*, Rev. Environ. Contam. Toxicol. or Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005; the Talmage [TAL] screening values assume 10% organic carbon in the sediment.

<sup>g</sup> Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation. Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).

<sup>h</sup> Final Screening Value selected using the following hierarchy:

1. State Value (Washington)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values.

**Other References:**

Efroymsen, R.A., et al., 1997, *Preliminary Remediation Goals* (EPRGs), ORNL, ES/ER/TM-162/R2,

Canadian Interim Sediment Quality Guidelines (ISQGs) Summary Table, CCME, December 2003.

MacDonald, D.D., C.G. Ingersoll and T.A. Berger, 2000, *Development and Evaluation of Consensus-Based Sediment Quality Criteria for Freshwater Ecosystems*, Archives of Environmental Contamination and Toxicology 39:20-31.

**Table 6-1  
Comparison of Transition Range 1 Surface Soil Detected Analytical Results to Site Background,  
Human Health and Ecological Screening Values  
Fort Flagler Military Reservation**

Location						039A003		039A004	
Sample Date						21-Feb-07		21-Feb-07	
Sample Number						NWO-039-0002		NWO-039-0003	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Lead	mg/kg	32.6	50	400	13.8		18.6	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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

**Table 6-2  
Comparison of Transition Range 1 Sediment Detected Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Fort Flagler Military Reservation**

<b>Location</b>							<b>039A005</b>	
<b>Sample Date</b>							<b>21-Feb-07</b>	
<b>Sample Number</b>							<b>NWO-039-1002</b>	
<b>Sample Depth (bgs) (ft)</b>							<b>0 to 0.5</b>	
<b>Sample Purpose</b>							<b>REG</b>	
<b>Fraction</b>	<b>Parameter</b>	<b>Units</b>	<b>Maximum Concentration from Media Background Sample</b>	<b>"3x" Maximum Concentration from Media Background Sample</b>	<b>Site Inspection Ecological Screening Level</b>	<b>USEPA Region 9 PRGs - Residential Soil</b>	<b>Result</b>	<b>VQ</b>
Metals	Lead	mg/kg	12.8	38.4	260	400	<b>40.4</b>	

Notes:

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

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

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

ft - feet

bgs - below ground surface

REG - regular sample

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

R - The reported sample results are rejected due to the following: 1. Severe deficiencies in the supporting quality control data, 2. Anomalies noted in the sampling and/or analysis process which could affect the validity of the reported data, 3. The presence or absence of the constituent cannot be

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

**Table 7-1  
Comparison of Transition Range 2 Surface Soil Detected Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Ft. Flagler Military Reservation**

Location						039A006		039A007	
Sample Date						21-Feb-07		21-Feb-07	
Sample Number						NWO-039-0004		NWO-039-0005	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Lead	mg/kg	32.6	50	400	6.7		8.5	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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

**Table 7-2  
Comparison of Transition Range 2 Sediment Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Fort Flagler Military Reservation**

Location							039A008	039A008			
Sample Date							21-Feb-07	21-Feb-07			
Sample Number							NWO-039-1003	NWO-039-1004			
Sample Depth (bgs) (ft)							0 to 0.5	0 to 0.5			
Sample Purpose							REG	FD			
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	
Metals	Lead	mg/kg	12.8	38.4	260	400	28.4		22		

Notes:

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

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

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

ft - feet

REG - regular sample

bgs - below ground surface

FD - field duplicate

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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

**Table 9-1  
Comparison of Rocket Range Surface Soil Detected Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Fort Flagler Military Reservation**

Location						039A009		039A010		039A011		039A011	
Sample Date						21-Feb-07		21-Feb-07		21-Feb-07		21-Feb-07	
Sample Number						NWO-039-0006		NWO-039-0007		NWO-039-0008		NWO-039-0009	
Sample Depth (bgs) (ft)						0 to 0.5		0 to 0.5		0 to 0.5		0 to 0.5	
Sample Purpose						REG		REG		REG		FD	
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ	Result	VQ	Result	VQ
Metals	Chromium	mg/kg	35.2	42	210	25.9		23.4		17.9		19.9	
Metals	Copper	mg/kg	13.2	50	3100	9.3		7.9		10.8		10.3	
Metals	Iron	mg/kg	17800	200	23000	<i>13200</i>		<i>13600</i>		<i>11500</i>		<i>11600</i>	
Metals	Lead	mg/kg	32.6	50	400	4.3		3		17.3		15.9	
Metals	Molybdenum	mg/kg	3.8	2	390	0.47	J	0.23	U	0.28	J	0.28	J
Metals	Nickel	mg/kg	80.2	30	1600	<i>38.3</i>		<i>42.2</i>		27.9		<i>27.2</i>	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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

**Table 9-2  
Comparison of Rocket Range Sediment Detected Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Fort Flagler Military Reservation**

Location							039A012	
Sample Date							21-Feb-07	
Sample Number							NWO-039-1005	
Sample Depth (bgs) (ft)							0 to 0.5	
Sample Purpose							REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Chromium	mg/kg	28.5	85.5	260	210	25.5	
Metals	Copper	mg/kg	11.1	33.3	390	3100	8	
Metals	Iron	mg/kg	15600	46800	20	23000	<i>13100</i>	
Metals	Lead	mg/kg	12.8	38.4	260	400	3.6	
Metals	Molybdenum	mg/kg	0.22	.66	No criteria	390	0.25	J
Metals	Nickel	mg/kg	46.9	140.7	460	1600	37.7	

Notes:

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

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

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

ft - feet

bgs - below ground surface

REG - regular sample

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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

**Table 10-1  
Comparison of the Live Grenade Court Surface Soil Detected Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Fort Flagler Military Reservation**

<b>Location</b>						<b>039A013</b>	
<b>Sample Date</b>						<b>21-Feb-07</b>	
<b>Sample Number</b>						<b>NWO-039-0010</b>	
<b>Sample Depth (bgs) (ft)</b>						<b>0 to 0.5</b>	
<b>Sample Purpose</b>						<b>REG</b>	
<b>Fraction</b>	<b>Parameter</b>	<b>Units</b>	<b>Site Inspection Background 95th UTL / 95th Percentile</b>	<b>Site Inspection Ecological Screening Level</b>	<b>USEPA Region 9 PRGs - Residential Soil</b>	<b>Result</b>	<b>VQ</b>
Metals	Chromium	mg/kg	35.2	42	210	<b>36.3</b>	
Metals	Copper	mg/kg	13.2	50	3100	7.6	
Metals	Iron	mg/kg	17800	200	23000	<i>16700</i>	
Metals	Lead	mg/kg	32.6	50	400	10	
Metals	Molybdenum	mg/kg	3.8	2	390	0.24	U
Metals	Nickel	mg/kg	80.2	30	1600	<b>85.8</b>	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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

**Table 12-1  
Comparison of the Rifle Range Surface Soil Detected Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Fort Flagler Military Reservation**

Location						039A014	039A015		
Sample Date						21-Feb-07	21-Feb-07		
Sample Number						NWO-039-0011	NWO-039-0012		
Sample Depth (bgs) (ft)						0 to 0.5	0 to 0.5		
Sample Purpose						REG	REG		
Fraction	Parameter	Units	Site Inspection Background 95th UTL / 95th Percentile	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ	Result	VQ
Metals	Lead	mg/kg	32.6	50	400	<b>235</b>		<b>587</b>	

Notes:

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

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

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

bgs - below ground surface

ft - feet

UTL - upper tolerance limit

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

REG - regular sample

FD - field duplicate

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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

**Table 12-2  
Comparison of the Rifle Range Sediment Detected Analytical Results to Site Background,  
Human Health, and Ecological Screening Values  
Fort Flagler Military Reservation**

Location							039A016	
Sample Date							21-Feb-07	
Sample Number							NWO-039-1006	
Sample Depth (bgs) (ft)							0 to 0.5	
Sample Purpose							REG	
Fraction	Parameter	Units	Maximum Concentration from Media Background Sample	"3x" Maximum Concentration from Media Background Sample	Site Inspection Ecological Screening Level	USEPA Region 9 PRGs - Residential Soil	Result	VQ
Metals	Lead	mg/kg	12.8	38.4	260	400	<b>219</b>	

Notes:

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

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

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

ft - feet

bgs - below ground surface

REG - regular sample

USEPA - United States Environmental Protection Agency

PRG - Preliminary Remediation Goal

mg/kg - milligram per kilogram

VQ - validation qualifier

Validation Qualifier Definitions

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

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

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

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