FORA ESCA REMEDIATION PROGRAM

FINAL

Interim Remedial Action Completion Report
Volume 2 – Habitat Restoration Field Activities and Results

Interim Action Ranges
Munitions Response Area
Phase II

Former Fort Ord
Monterey County, California

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FORT ORD REUSE AUTHORITY

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Interim Remedial Action Completion Report Volume 2
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Phase II
Former Fort Ord
Monterey County, California

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ACRONYMS AND ABBREVIATIONS

AR	Administrative Record
AOC	Administrative Order on Consent
Army	United States Department of the Army
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BMPs	best management practices
BO	biological opinion
C	Celsius
CDFW	California Department of Fish and Game
CDR	Covenant Deferral Request
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CTS	California Tiger Salamander
DGM	digital geophysical mapping
DMM	discarded military munitions
DOD	U.S. Department of Defense
EOD	Explosives Ordnance Disposal
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESCA	Environmental Services Cooperative Agreement
F	Fahrenheit
FORA	Fort Ord Reuse Authority
FS	Feasibility Study
ft	foot or feet
g	gram(s)
ha	hectare(s)
HAZWOPER	Hazardous Waste Operations and Emergency Response
HMP	Habitat Management Plan
HRP	Habitat Restoration Plan
IAR	Interim Action Ranges
IRACR	Interim Remedial Action Completion Report
kg	kilogram(s)
km	kilometers

l	liter(s)
lbs	pounds
m	meter
m^3	cubic meters
mag	magnetic
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mm	millimeter
MRA	Munitions Response Area
MRS	Munitions Response Site
NCA	Non-Completed Area
PVC	polyvinyl chloride
QC	quality control
RI	remedial investigation
ROD	Record of Decision
RP	Remediation Program
SCA	Special Case Area
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance

GLOSSARY

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980
CERCLA authorizes federal action to respond to the release or threatened release of hazardous substances into the environment or a release or threatened release of a pollutant or contaminant into the environment that may present an imminent or substantial danger to public health or welfare.

Environmental Services Cooperative Agreement Remediation Program (ESCA RP) Team
ARCADIS U.S., Inc., Weston Solutions, Inc., and Westcliffe Engineers, Inc.

Explosive
A substance or a mixture of substances that is capable by chemical reaction of producing gas at such temperature, pressure, and speed as to cause damage to the surroundings. The term "explosive" includes all substances variously known as high explosives and propellants, together with igniters, primers, initiators, and pyrotechnics (e.g., illuminant, smoke, delay, decoy, flare, and incendiary compositions).

Explosive Hazard
A condition where danger exists because explosives are present that may react (e.g., detonate, deflagrate) in a mishap with potential unacceptable effects (e.g., death, injury, damage) to people, property, operational capacity, or the environment.

Feasibility Study (FS)
A study conducted where the primary objective is "to ensure appropriate remedial alternatives are being developed and evaluated and an appropriate remedy selected" (NCP 40 CFR 300.430[e]).

Historical Impact Area
The historical impact area consists of approximately 8,000 acres in the southwestern portion of the former Fort Ord, bordered by Eucalyptus Road to the north, Barloy Canyon Road to the east, South Boundary Road to the south, and North-South Road General Jim Moore Blvd to the west.

Institutional Control (IC)
A legal or institutional mechanism that limits access to or use of property, or warns of a hazard. An IC can be imposed by the property owner, such as use restrictions contained in a deed, or by a government, such as a zoning restriction.

Magnetometer
An instrument used to detect ferromagnetic (iron-containing) objects by measuring the distortion the object imposes on the ambient field. This distortion is known as an anomaly. Total field magnetometers measure the strength of the earth's natural magnetic field at the magnetic sensor location. Gradient magnetometers, sensitive to smaller near-surface metal objects, use two sensors to measure the difference in magnetic field strength between the two sensor locations. Vertical or horizontal gradients can be measured.

Military Munitions
All 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 Coast Guard, the 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 ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. 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 U.S.C. 2011 et seq.) have been completed. (10 U.S.C. 101[e][4][A through C]).

Munitions Response
Response actions, including investigation, removal actions, and remedial actions, to address the explosives safety, human health, or environmental risks presented by unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC), or to support a determination that no removal or remedial action is required.

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

Munitions Constituents (MC)
Any materials originating from UXO, discarded military munitions (DMM), or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions (10 U.S.C. 2710).

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

Munitions Response Area (MRA)
Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites.

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

Ordnance and Explosives (OE)

See MEC.

Quality Assurance (QA)
The management system implemented by a United States Army Corps of Engineers (USACE) Safety Specialist or a Third Party Safety Specialist to ensure Quality Control (QC) is functioning and that project quality objectives are being met. QC components include planning, implementation, assessment, reporting, and quality improvement.

Quality Control (QC)
The system of inspections, typically performed by the munitions contractor performing the work, of operational activities, work in progress, and work completed to assess the attributes and performance of a process against defined standards that are used to fulfill requirements for quality.

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 U.S.C. 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 U.S.C. 101(e)(2)(A) and (B))

Record of Decision (ROD)
A document used to record the remedial action decision made at a National Priorities List property. The ROD will be maintained in the project Administrative Record and project file.

Remedial Actions
Those actions consistent with a permanent remedy taken instead of or in addition to remedial actions in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health, welfare, or the environment. The term includes but is not limited to such actions at the location of the release as storage; confinement; perimeter protection using dikes, trenches, or ditches; clay cover; neutralization; cleanup of released hazardous substances and associated contaminated materials; recycling or reuse; diversion; destruction; segregation of reactive wastes; dredging or excavations; repair or replacement of leaking containers; collection of leachate and runoff; on-site treatment or incineration; provision of alternative water supplies; and any monitoring reasonably required to assure that such actions protect the public health, welfare, and the environment. The term includes the costs of permanent relocation of residents and businesses and community facilities where the President of the United States determines that, alone or in combination with other measures, such relocation is more cost-effective and environmentally preferable to the transportation, storage, treatment, destruction, or secure disposition off site of hazardous substances, or may otherwise be necessary to protect the public health or

welfare. The term includes off-site transport and off-site storage, treatment, destruction, or secure disposition of hazardous substances and associated contaminated materials.

Remedial Investigation (RI)

An investigation intended to "adequately characterize the site for the purpose of developing and evaluating an effective remedial alternative" [NCP, 40 CFR 300.430(d)]. In addition, the RI provides information to assess the risks to human health, safety, and the environment that were identified during risk screening in the site investigation.

Special Case Areas (SCAs)

SCAs were identified by the Army for a variety of reasons, such as dense metallic clutter that prevented digital detection or interference due to nearby metal structure or features. SCAs include historical and current fencing; asphalt/concrete range pads, roads, and walkways; areas under existing structures (i.e., field latrines and range-related structures); berms and culverts; and areas requiring excavation by heavy equipment (i.e., scrape areas).

Surface Removal

Removal of MEC from the ground surface by UXO teams using visual identification sometimes aided by magnetometers.

Unexploded Ordnance (UXO)

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 whether by malfunction, design, or any other cause (10 U.S.C. 101[e][5][A] through [C]).

UXO-Qualified Personnel

Personnel who have performed successfully in military EOD positions, or are qualified to perform in the following Department of Labor, Service Contract Act, Directory of Occupations, contractor positions: UXO Technician II, UXO Technician III, UXO Safety Officer, UXO Quality Control Specialist, or Senior UXO Supervisor.

UXO Technicians

Personnel who are qualified for and filling Department of Labor, Service Contract Act, Directory of Occupations, contractor positions of UXO Technician I, UXO Technician II, and UXO Technician III.

EXECUTIVE SUMMARY

Introduction and Purpose

This Interim Remedial Action Completion Report (IRACR) describes the operations and results of field activities conducted by the Fort Ord Reuse Authority (FORA) to complete the munitions and explosives of concern (MEC) Design Study and Phase II Interim Action in the Interim Action Ranges (IAR) Munitions Response Area (MRA) at the former Fort Ord in Monterey County, California. A site vicinity map is provided on Figure 1. This report has been prepared in accordance with the Administrative Order on Consent (AOC) Task 9. The field activities, operations, and results described in this report are limited to work conducted within the IAR MRA Phase II areas. The areas discussed in this IRACR are shown on Figure 2.

The United States Department of the Army (Army) previously conducted munitions response actions within Munitions Response Site (MRS) Ranges 43-48, which encompasses the IAR MRA (Parsons 2002 and 2007). The Army determined that the MRS Ranges 43-48 warranted an interim action due to the proximity and increased accessibility to the public, the threat of trespassing, and the MEC on or near the surface of the ranges. An Interim Action Record of Decision (ROD) was produced by the Army in August 2002 for Interim Action Sites at the former Fort Ord, which included MRS Ranges 43-48 (Army 2002). The interim remedial action selected for the Interim Action Sites included surface and subsurface MEC remediation. The interim action in MRS Ranges 43-48, which was referred to as the Phase I Interim Action by FORA, encompassed the IAR MRA and began in 2002 with site preparation followed by a prescribed burn. Interim remedial actions were conducted from November 2003 to December 2005 (Parsons 2007). The Army designated approximately 235 acres within MRS Ranges 43-48 where the interim remedial action was not completed as Special Case Areas (SCAs) or Non Completed Areas (NCAs). Subsurface removal was not completed within the SCAs due to high concentrations of metallic debris or high density of anomalies (Parsons 2007). Approximately 35 acres of SCAs and approximately 9 acres of NCAs within MRS Ranges 43-48 are located within the boundaries of the IAR MRA. Range 44 SCA (approximately 18.9 acres), Range 47 SCA (approximately 15.2 acres), and Central Area NCAs (approximately 9.2 acres) are the subject of this IRACR. Two additional SCAs (Range 45 Trench SCA [approximately 1.15 acres] and a small portion of the Fenceline SCA [one partial 100-ft by 100-ft grid), are also located within the IAR MRA; however, these areas are not included in this IRACR. The data and recommendations for these areas will be included in the Feasibility Study (FS) for the IAR MRA to support a final remedial decision.

Investigation of the SCAs and NCAs comprise the Phase II activities for the IAR MRA. The Phase II activities and results reported in this IRACR complete the interim remedial action within the IAR MRA consistent with the objectives outlined in the Record of Decision (ROD), Interim Action for Ordnance and Explosives at Ranges 43-48, Range 30A, and Site OE-16, Former Fort Ord, California (“Interim Action ROD”; Army 2002) for the IAR MRA which includes a portion of the Army MRS for Ranges 43-48 (“MRS Range 43-48”).

As contractors to FORA under the Environmental Services Cooperative Agreement (ESCA) Remediation Program (RP), the work described in this report was conducted by ARCADIS

U.S., Inc., Weston Solutions, Inc., Westcliffe Engineers, Inc. (collectively, "the ESCA RP Team"), and their subcontractors.

The scope of work discussed in this IRACR generally included:

- Conducting digital geophysical mapping (DGM) surveys in selected areas, and investigation and removal of selected target anomalies to evaluate the presence of sensitively-fuzed MEC during the Design Study
- Conducting DGM surveys and investigation and removal of target anomalies that potentially represented MEC during the Phase II Interim Action
- Conducting analog geophysical surveys in areas that were not suitable for DGM surveys and investigation and removal of anomalies that potentially represented MEC during the Phase II Interim Action
- Conducting soil excavation, stockpiling and sifting operations in areas where site conditions (e.g., high concentration of metallic debris) interfered with digital detection instruments in establishing individual target anomalies
- Conducting habitat restoration activities, including monitoring, passive restoration (seeding), and active restoration (seeding and planting), in habitat parcels that were affected by the ESCA RP Team's activities

Report Organization

The IAR MRA IRACR is divided into two volumes. Volume 1 describes the MEC-related operations and presents results of field activities conducted by FORA to complete the Design Study and Phase II Interim Action. Volume 2 describes the habitat restoration field activities performed in the habitat parcels of the MRA and presents monitoring results.

Interim Remedial Action Field Activities and Results (Volume 1)

Volume 1 describes the technical approach employed to conduct MEC remedial action field activities associated with the Design Study and Phase II Interim Remedial Action in the IAR MRA and presents quality control and quality assurance activities, results, and conclusions.

The Design Study and Phase II Interim Remedial Action in the IAR MRA began in February 2011 and were completed in March 2013. In total, the Design Study and Phase II Interim Remedial Action conducted by FORA resulted in the recovery of the following:

- 3,655 MEC items
- Approximately 44,629 pounds (lbs) of munitions debris (MD)
- Approximately 11,144 lbs of other debris

The results of the Design Study and Phase II Interim Remedial Action activities presented in Volume 1 as well as results from historical actions conducted by the Army will be incorporated into the FS for the IAR MRA to support a final remedial decision.

Habitat Restoration Field Activities and Results (Volume 2)

Volume 2 summarizes the activities conducted by FORA during the implementation and monitoring of habitat restoration activities in the IAR MRA between 16 October 2012 and 31 December 2013. The habitat restoration activities conducted in the IAR MRA were performed in habitat parcels affected by the Design Study and Phase II Interim Action activities.

A Habitat Restoration Plan (HRP) for the IAR MRA was prepared to describe the activities to be undertaken to restore the natural resources in habitat parcels that were affected by the ESCA RP Team's MEC remedial activities. The HRP includes restoration requirements outlined in the Installation-Wide Multispecies Habitat Management Plan (HMP) for Former Fort Ord, California ("the HMP"; USACE 1997) and in Biological Opinions (BOs; USFWS 1999, 2002, 2005) issued to the Army.

The HRP identified the required restoration strategies to address the four types of vegetation disturbance activity that occurred in the habitat parcels. Restoration strategies including monitoring, passive restoration (seeding), and active restoration (seeding and planting), were implemented in the areas of vegetation disturbance. Implementation of the restoration strategies involved site preparation (erosion control and installation of an animal deterrent system and an irrigation system), seeding of HMP annuals and seed bank, targeted seeding of common species, salvaging and transplanting of shaggy-barked manzanita, and installation of container plantings. Results of monitoring for plant survival, species richness, and percentage vegetation cover from October 2012 through December 2013 are reported in Volume 2.

Construction and implementation of the restoration areas has been completed and restoration systems are in place, operational and functioning. Operation and maintenance to support the long-term success of restoration at the site is being implemented through a post-installation adaptive management process to evaluate and manage the restoration areas as described in the HRP (ESCA RP Team 2013b). Results of the 2013 habitat monitoring data are consistent with current year performance targets for all activity types (ingress/egress corridors, vegetation cutting, small-scale excavation, and large-scale excavation). The initiated restoration activities are currently on track to achieve the prescribed performance criteria in the IAR MRA restoration areas.

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1.0 INTRODUCTION

This Interim Remedial Action Completion Report (IRACR) Volume 2 describes the activities conducted by the Fort Ord Reuse Authority (FORA) during the planning, implementation, and monitoring of habitat restoration in the Interim Action Ranges (IAR) Munitions Response Area (MRA) on the former Fort Ord in Monterey County, California, between 16 October 2012 and 31 December 2013. Information included in this IRACR will be used to support a Feasibility Study (FS) and a final remedial action decision for the IAR MRA.

The munitions and explosives of concern (MEC) Design Study and Phase II Interim Action have been completed in the Range 44 Special Case Area (SCA), Range 47 SCA, and Central Area Non-Completed Areas (NCAs) of the IAR MRA by the Environmental Services Cooperative Agreement (ESCA) Remediation Program (RP) Team ("ESCA RP Team"; consisting of ARCADIS U.S., Inc., Weston Solutions, Inc., and Westcliffe Engineers, Inc.). The objective of the Design Study and Phase II Interim Action was to complete the interim remedial action within the IAR MRA consistent with the objectives outlined in the Record of Decision (ROD), Interim Action for Ordnance and Explosives at Ranges 43-48, Range 30A, and Site OE-16, Former Fort Ord, California ("Interim Action ROD"; Army 2002) because the IAR MRA is located within a portion of the United States Department of the Army (Army) Munitions Response Site (MRS) for Ranges 43-48 ("MRS Range 43-48"). The interim remedial action objectives in the Interim Action ROD were to reduce risks to human health and the environment and comply with federal and state Applicable or Relevant and Appropriate Requirements (ARARs). The interim remedial action in the remaining portion of the IAR MRA, outside of the SCAs and NCAs, was completed by the Army in accordance with the objectives outlined in the Interim Action ROD and is referred to as the Phase I Interim Action by FORA.

To meet the remedial action objectives and complete the selected remedy for the Interim Action ROD in the SCAs and NCAs, a design study was conducted followed by a remedial action in the Range 47 SCA.

The activities completed during the Design Study and Phase II Interim Action began in February 2011 and were completed in March 2013. Activities were conducted in accordance with the Final Phase II Interim Action Work Plan, IAR MRA ("Interim Action Work Plan"; ESCA RP Team 2011) and associated field variance forms. Activities completed during the Design Study and Phase II Interim Action are discussed in Volume 1 of this IRACR.

In accordance with the Interim Action Work Plan, a Habitat Restoration Plan (HRP) for the IAR MRA was prepared to describe the activities to be undertaken to restore the natural resources in habitat parcels that were affected by the ESCA RP Team's MEC remedial activities (Figures 2 and 3). The HRP includes requirements outlined in the Installation-Wide Multispecies Habitat Management Plan (HMP) for Former Fort Ord, California ("the HMP"; USACE 1997) and in Biological Opinions (BOs; USFWS 1999, 2002, 2005) issued to the Army. The HRP includes mitigation measures to avoid and minimize impacts to rare, threatened, and endangered species and their habitats during pre-disposal activities such as munitions response activities (ESCA RP Team 2013b). The plan was reviewed and approved by the Army and United States Fish and Wildlife Service (USFWS) and was provided as an

addendum to the Interim Action Work Plan. The activities outlined in the HRP were designed to establish native vegetation at the site that is progressing on a trajectory toward a self-sustaining native plant community equitable with the species richness and relative cover of species included in the HMP that were present on the site prior to the ESCA RP Team remedial efforts. This report summarizes the implementation and monitoring activities performed by the ESCA RP Team, and its subcontractors, pursuant to requirements outlined in the HRP. Activities were performed for FORA in coordination with the Army.

1.1 Regulatory History

On March 31, 2007, the Army and FORA entered into an Environmental Services Cooperative Agreement (ESCA) governing the remaining MEC removal activities required for approximately 3,300 acres of the former Fort Ord property. In accordance with the ESCA and an Administrative Order on Consent (AOC), FORA is responsible for munitions response actions as defined in the ESCA and related documents, except for those retained by the Army, and demonstrating means of securing regulatory clearance for future uses on former military lands. The AOC was entered into voluntarily by FORA, the United States Environmental Protection Agency (EPA) Region 9, the California Department of Toxic Substances Control, and the United States Department of Justice Environment and Natural Resources Division on December 20, 2006 (EPA Region 9 Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. R9-2007-03). The AOC was issued under the authority vested in the President of the United States by Sections 104, 106, and 122 of CERCLA, as amended, 42 United States Code §§ 9604, 9606, and 9622.

This IRACR was prepared in accordance with AOC Task 9. ARCADIS U.S., Inc. has prepared this document on behalf of FORA in accordance with industry standards and consistent with the requirements of the Remediation Services Agreement dated March 30, 2007 by and between ARCADIS U.S., Inc. and FORA including any applicable governing documents and applicable laws and regulations. As contractors to FORA under the ESCA Remediation Program (RP), the field activities described in this IRACR were conducted by the ESCA RP Team, and their subcontractors.

1.2 Purpose and Scope

The purpose of Volume 2 of this IRACR is to summarize the activities conducted by FORA during the planning, implementation, and monitoring of habitat restoration activities in the IAR MRA between 16 October 2012 and 31 December 2013. The information included in Sections 2 through 8 and 10 is presented in the Habitat Restoration Implementation and Monitoring Report, an appendix to the 2013 Annual Natural Resources Monitoring, Mitigation, and Management Report ("Annual Natural Resources Report"; ESCA RP Team 2014). While the discussion in Section 9 is similar to that presented in the Annual Natural Resources Report, some additional information and figures are presented in this IRACR Volume 2. The Habitat Restoration Implementation and Monitoring Report is the first mitigation monitoring report documenting restoration activities in the IAR MRA. The fifteen-month reporting period covers restoration implementation activities as well as the first year of maintenance and monitoring. Subsequent reporting on restoration monitoring will follow the

calendar year (01 January – 31 December) and will be included in future Annual Natural Resources Reports.

The information presented in this IRACR Volume 2 supports the completion of the Phase II Interim Action under the Interim Action ROD (Army 2002). Information included in this IRACR will be used to support a FS and a final remedial action decision for the IAR MRA.

1.3 IAR MRA and Phase II Area Location

The IAR MRA is located in the north-central portion of the former Fort Ord, within the boundary of the historical impact area and is bordered by the Parker Flats MRA to the north, the Seaside MRA to the northwest, and the historical impact area to the southeast, south, and southwest (Figure 1). The IAR MRA is contained within the jurisdictional boundaries of the City of Seaside and Monterey County. The IAR MRA encompasses approximately 227 acres and contains five United States Army Corp of Engineer (USACE) property transfer parcels, E38, E39, E40, E41, and E42.

The proposed future land use for the IAR MRA Phase II areas is habitat reserve (Figure 3). The future land use presented in this report is primarily based upon the 1997 Fort Ord Base Reuse Plan (FORA 1997). Other sources of future land use information include public benefit conveyance, negotiated sale requests, transfer documents, the HMP (USACE 1997), and the Assessment East Garrison – Parker Flats Land Use Modifications (Zander 2002). The Fort Ord Base Reuse Plan identified approximately 20 land-use categories at the former Fort Ord (FORA 1997) including habitat management, open space/recreation, institutional/public facilities, commercial, industrial/business park, residential, tourism, mixed use, and others.

1.4 Site Description and Background

The following sections discuss the physical description and background of the IAR MRA. The history and previous munitions response actions conducted for the IAR MRA are discussed in Section 1.5; however, field activities described in this IRACR were only required to be conducted in the SCAs and NCAs of the IAR MRA.

1.4.1 Topography and Geology

The terrain of the IAR MRA is relatively flat. The elevation ranges from approximately 370 to approximately 530 feet (ft) mean sea level with 2 to 15 percent slopes. The surface soils are characterized as eolian (sand dune) and terrace (river deposits), which consist of unconsolidated materials of the Aromas and Old Dune Sand formations. The primary soil type present in the IAR MRA area is Arnold-Santa Ynez Complex with Baywood Sand in the northwestern portion. Soil conditions at the MRA consist predominantly of weathered dune sand.

1.4.2 Vegetation

Vegetation in the IAR MRA consists primarily of maritime chaparral (USACE/Jones & Stokes 1992; Figure 2). Prior to 2003 much of the IAR MRA was inhabited by dense maritime chaparral with stands of varying maturity (or seral stage) ranging from very young to mature, the latter with shrub canopy up to 15 ft tall. The MRA was subjected to a prescribed burn in 2003. In early 2008, prior to initiation of ESCA RP vegetation monitoring activities in the MRA, the majority of vegetation was less than 4 ft tall and much less dense than it was prior to the 2003 prescribed burn. Patches of annual grassland habitats existed in 2008 along the western and southern boundaries of the MRA. Currently, there are areas within the MRA where poison oak occurs in dense stands.

1.4.3 Surface Water and Groundwater

Groundwater investigations associated with the Basewide Remedial Investigation/Feasibility Study have resulted in the installation of a number of groundwater monitoring wells on former Fort Ord property near the IAR MRA. The IAR MRA overlies the Seaside groundwater basin, which is structurally complex and divided into several sub-basins. The depth to groundwater is estimated to be greater than 100 ft below ground surface (bgs). No wells are located within the IAR MRA. The occurrence of groundwater beneath the MRA was not expected to influence geophysical surveys conducted for the Design Study or Phase II Interim Action.

There are no surface-water features or delineated wetlands present on the IAR MRA; however, an aquatic feature is present approximately 4,500 ft to the east-southeast of the MRA.

1.4.4 Ecological Profile

In 2004, the California Tiger Salamander (CTS) was identified as a threatened species. CTS may be found as far as 2 kilometers (km) from aquatic breeding habitats. There is a possibility that CTS may be found in the IAR MRA as the MRA is within 2 km of aquatic features (i.e., vernal pools, ponds) that may provide habitat for the CTS (USFWS 2005).

As identified in the HMP, threatened and endangered species could be found on the IAR MRA (USACE 1997). Threatened or endangered plant species identified as having possible occurrence in the IAR MRA include Monterey gilia (endangered; formerly referred to as sand gilia) and Monterey spineflower (threatened). A portion of the IAR MRA has been designated as critical habitat for the Monterey spineflower by the USFWS (USFWS 2002).

1.5 Site History and Previous Munitions Response Actions

The former Fort Ord was used to train Army infantry, cavalry, and field artillery units until official closure in 1994. In support of the training of soldiers, military munitions were used at the ranges throughout the former Fort Ord. As a result of the training activities, a wide variety of conventional MEC have been encountered in areas throughout the former Fort Ord. The

MEC encountered at the former Fort Ord have been either unexploded ordnance (UXO) or discarded military munitions (DMM).

The IAR MRA is located in the area designated by the Army as MRS Ranges 43-48. The Army previously conducted munitions response actions within MRS Ranges 43-48, which encompasses the IAR MRA (Parsons 2002 and Parsons 2007). The Army determined that the MRS Ranges 43-48 warranted an interim action due to the proximity and increased accessibility to the public, the threat of trespassing, and the MEC on or near the surface of the ranges. An Interim Action ROD was produced by the Army in August 2002 for Interim Action Sites at the former Fort Ord, which included MRS Ranges 43-48 (Army 2002). The interim remedial action selected for the Interim Action Sites included surface and subsurface MEC remediation. The interim action in MRS Ranges 43-48, which was referred to as the Phase I Interim Action by FORA, encompassed the IAR MRA and began in 2002 with site preparation followed by a prescribed burn. Interim remedial actions were conducted from November 2003 to December 2005 (Parsons 2007). The Army designated approximately 235 acres within MRS Ranges 43-48 where the interim remedial action was not completed as SCAs or NCAs. Subsurface removal was not completed within the SCAs due to high concentrations of metallic debris or high density of anomalies (Parsons 2007). Approximately 35 acres of SCAs and approximately 9 acres of NCAs within MRS Ranges 43-48 are located within the boundaries of the IAR MRA. Range 44 SCA (approximately 18.9 acres), Range 47 SCA (approximately 15.2 acres), and Central Area NCAs (approximately 9.2 acres) are the subject of this IRACR. Two additional SCAs (Range 45 Trench SCA [approximately 1.15 acres] and a small portion of the Fenceline SCA [one partial 100-ft by 100-ft grid]) are also located within the IAR MRA; however, these areas are not included in this IRACR. The data and recommendations for these areas will be included in the FS for the IAR MRA to support a final remedial decision.

Investigation of the SCAs and NCAs comprise the Phase II activities for the IAR MRA. The Phase II activities and results reported in this IRACR complete the interim remedial action within the IAR MRA consistent with the objectives outlined in the Record of Decision (ROD), Interim Action for Ordnance and Explosives at Ranges 43-48, Range 30A, and Site OE-16, Former Fort Ord, California (“Interim Action ROD”; Army 2002) for the IAR MRA which includes a portion of the Army MRS for Ranges 43-48 (“MRS Range 43-48”). The Phase II activities and results have been the focus of the ESCA RP Team’s remedial efforts as described in Volume 1.

1.6 Report Organization

Volume 2 of this IRACR is presented in numbered sections, tables, and figures and a lettered appendix. Tables are numbered to correspond with the section in which they are first referenced. Figures and photographs are numbered sequentially. Introductory information for the project, including site description and background information, is presented in Section 1.0. Section 2.0 presents the requirements for restoration associated with the ESCA RP Design Study and Phase II Interim Action activities. The goals, restoration strategies, and success criteria identified in the HRP are summarized in Section 3.0. Section 4.0 provides the methods for restoration plant material collection (seed, cutting, and seedbank collection) and plant propagation. Soil excavation, processing of excavated soil, soil replacement, and soil

de-compaction that occurred in the restoration areas are presented in Section 5.0. Section 6.0 describes implementation of the restoration strategies including site preparation, seeding and seedbank placement, and installation of container plants. Routine restoration maintenance including weed abatement, irrigation system monitoring, erosion control monitoring, and animal deterrent fence monitoring are described in Section 7.0. Sections 8.0 and 9.0 present the quantitative monitoring methods used to document native plant establishment and monitoring results, respectively. Conclusions and recommendations are presented in Section 10.0. References are provided in Section 11.0.

2.0 REGULATORY RESTORATION REQUIREMENTS

Primary requirements for restoration associated with ESCA RP munitions response actions are described in the HMP (USACE 1997) and the BOs (USFWS 1999, 2002, 2005) issued to the Army. These regulatory documents ensure compliance with the Federal Endangered Species Act (ESA) and provide guidance on avoiding and minimizing, to the extent feasible, take of listed species, as well as protection of other species of concern during remedial activities. Moreover, these documents provide specific objectives and goals for the restoration and monitoring of habitat areas reserved in perpetuity that are impacted by remedial activities.

2.1 Habitat Management Plan

The HMP (USACE 1997) and modifications to the HMP provided in the "Assessment, East Garrison—Parker Flats Land Use Modifications, Fort Ord, California" (Zander 2002) present the boundaries of habitat reserve and development areas and describe land use, conservation, management, and habitat monitoring requirements for target species within the former Fort Ord.

The HMP and BOs establish guidelines for the conservation and management of wildlife and plant species and habitats that largely depend on former Fort Ord land for survival (USACE 1997). Threatened and endangered plant and animal species as well as designated critical habitat occur at the former Fort Ord. Each reuse area has been screened for potential impacts or disturbances to any threatened and endangered species identified in the HMP (USACE 1997). Implementation of the provisions of the HMP and referenced additional measures satisfy the requirements of the ESA. The HMP specifically addresses protection of habitats and certain wildlife and plant species ("HMP species") within the former Fort Ord. HMP species were chosen based on their state and federal ESA listing status and the relative importance of existing populations and habitats at the former Fort Ord to the continued survival of the species. The HMP species list also incorporates those plant taxa included on rare plant list (now called rare plant ranks) 1B by the California Native Plant Society (CNPS) in 1997 with more than 10 percent of their known range at former Fort Ord.

Restoration objectives and goals required by the HMP and mitigation requirements relevant to the IAR MRA restoration effort are described in the HRP (ESCA RP Team 2013b) and are listed below:

- Survey sites before disturbance to estimate restoration potential and establish success criteria (including information on species presence, soil composition, presence of non-native species, slope, aspect, and microhabitats)
- Develop a restoration plan
- Develop feedback mechanisms that allow restoration results to guide the Army's restoration program
- Collect seed and cuttings from within 0.6 mile (1 km) of the restoration site

- Recontour excavation sites to recreate a natural landscape that grades smoothly into existing topography
- Implement erosion control
- Establish native vegetation and HMP species populations that are equitable with those that were removed
- Monitor re-establishment of vegetation in accordance with the Army's protocol for vegetation monitoring
- Conduct monitoring to evaluate the success of restoration efforts
- Meet success criteria established to evaluate healthy central maritime chaparral using baseline data from undisturbed central maritime chaparral communities
- Meet success criteria related to vegetative cover and species diversity
- Meet success criteria for Monterey gilia, also known as sand gilia (*Gilia tenuiflora* subsp. *arenaria*), Monterey spineflower (*Chorizanthe pungens* var. *pungens*), and seaside bird's-beak (*Cordylanthus rigidus* subsp. *littoralis*) including restoration results after five years consistent with self-sustaining populations (in different age stands) of central maritime chaparral, occupying the same amount of habitat and with population sizes comparable to those recorded during the Army's vegetation survey of the former Fort Ord conducted in 1992 (USACE 1992)
- Prepare annual monitoring reports
- Implement corrective measures if monitoring indicates that success criteria for vegetation or HMP species are not being met, including recontouring, weeding, replanting, reseeding, and improvement of habitat for Monterey gilia and Monterey spineflower

2.2 Biological Opinions

To ensure compliance with the Federal ESA requirements, the Army consulted with the USFWS on the Army's predisposal actions, including cleanup of MEC. These consultations resulted in three BOs that include incidental take coverage for specific numbers of (or habitat acres for) the following wildlife species: Smith's blue butterfly (*Euphilotes enoptes smithi*), black legless lizard (*Anniella pulchra nigra*), western snowy plover (*Charadrius alexandrines nivosus*), and California tiger salamander (*Ambystoma californiense*). The incidental take statements allow impacts to and incidental take of these listed species during project activities and specify minimization and avoidance measures to be implemented during the project for the protection of special status species and their habitats (USFWS 1999, 2005). In addressing listed plant species, these BOs state that "Sections 7(b)(4) and 7(o)(2) of the Act do not apply to the incidental take of listed plant species. However, protection of listed plants is provided to the extent that the Act requires a Federal permit for the removal or reduction to possession of endangered plants from areas under Federal jurisdiction."

Three BOs include requirements for habitat restoration related to ESCA RP Team's remedial activities. The BO on closure and reuse of Fort Ord (USFWS 1999, p. 21) states that "The Army shall implement all portions of the April 1997 HMP for all predisposal activities

undertaken." The BO on critical habitat of Monterey spineflower (USFWS 2002) contains restoration-related measures for excavation of soils. The BO on California tiger salamander and critical habitat for Contra Costa goldfields (*Lasthenia conjugens*; USFWS 2005, pp. 11-12) describes restoration requirements proposed by the Army. It should be noted that Contra Costa goldfields have not been reported to occur within the IAR MRA and there is no designated critical habitat for Contra Costa goldfields within the former Fort Ord site.

The following list summarizes USFWS restoration requirements identified in the relevant BOs (USFWS 1999, 2002, 2005).

- Determine a baseline condition during pre-activity assessment
- Biological surveys for HMP plant species will be conducted using the protocol for conducting vegetation sampling at Fort Ord
- Allow sites to recover naturally or restore sites by planting species consistent with the baseline condition of chaparral plant species present prior to remediation. If recolonization does not appear likely; erosion and weed control will be implemented
- Conduct monitoring of disturbed populations in accordance with HMP protocols
- Identify plant species and population densities to be re-established at each site, including a monitoring plan and corrective measures if goals are not met
- Create goals to establish native vegetation at each site and to establish populations of any HMP species affected to levels equitable to those observed before the disturbance
- Develop a restoration plan with success criteria and a monitoring plan
- Develop measures to enhance natural regeneration and recolonization of the [excavated] site
- After excavation, fill will be added to the excavated areas or they will be recontoured into the natural landscape and smooth transition to surrounding topography
- Provide soil stabilization measures to prevent erosion
- Conduct invasive weed and erosion control
- Monitor, evaluate, and implement corrective actions annually for five years to determine if success criteria are met
- Report monitoring results to the USFWS annually

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3.0 HABITAT RESTORATION PLAN

In accordance with goals, objectives and requirements outlined above from the HMP and BOs, the HRP was developed to describe the restoration activities in habitat parcels affected by the ESCA RP Team munition response actions. The following goals established in the HRP reflect those outlined in the HMP:

- Preserve, protect, and enhance populations and habitats of federally listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of federal proposed and candidate wildlife and plant species to levels that may result in one or more of these species becoming listed as threatened or endangered.
- Preserve and protect populations and habitat of state-listed threatened and endangered wildlife and plant species.
- Avoid reducing populations or habitat of species listed as rare, threatened, and endangered by the CNPS (Rare Plant Rank 1B), or with large portions of their range at former Fort Ord, to levels that may result in one or more of these species becoming listed as threatened or endangered.

All activities outlined in the HRP are designed to establish native vegetation in the IAR MRA restoration areas that are progressing on a trajectory toward a self-sustaining native plant community equitable with the species richness and relative cover of HMP species documented on the site prior to the ESCA RP Team's remedial efforts.

Restoration implementation, maintenance, and monitoring in the restoration areas are overseen by FORA and its contractors. The following sections summarize the restoration strategies and success criteria for specific activities and locations within the IAR MRA.

3.1 Designated Ground Disturbance Categories Associated with MEC Remedial Activities

The areas within the IAR MRA that are the focus of restoration efforts have been given the following names for the purposes of this report, as identified in the HRP (ESCA RP Team 2013b):

- North Range 44: Includes North Range 44 SCA (referred to as "Range 44 SCA [North]" in IAR MRA IRACR Volume 1; Figure 3)
- South Range 44: Includes South Range 44 SCAs and Central Area NCAs (referred to as "Range 44 SCA [South] and Central Area NCAs" in IAR MRA IRACR Volume 1; Figure 3)
- Range 47 Subarea A; Includes a portion of the Range 47 SCA that was subject to large-scale excavation in which the vegetative cover has historically been low, 10% or less (Figure 5; ESCA RP Team 2013b). Non-native pampas grass was abundant in places. Historical aerial imagery indicates that the vegetation of the area has changed

little since the 1970s, despite an apparent lack of recent disturbance, except for fire that has affected the whole range.

- Range 47 Subarea B: Includes the majority of Range 47, which was subject to large-scale excavation prior to restoration activities (Figure 5). It should be noted that the boundary of Range 47 Subarea B defined in the HRP has been adjusted slightly in this IRACR and is consistent with the boundary presented in the 2013 Annual Natural Resources Report (ESCA RP Team 2014).
- Range 47 Subarea C: Includes the portion of Range 47 surrounding the large-scale excavation area in which vegetation cutting took place in 2012 (Figure 5). Subarea C also includes an escarpment where small-scale excavation was conducted. It should be noted that the boundary of Range 47 Subarea C defined in the HRP has been adjusted slightly in this IRACR and is consistent with the boundary presented in the 2013 Annual Natural Resources Report (ESCA RP Team 2014).

Four designated categories of MEC remedial activities correlated with ground-disturbing actions are addressed in the HRP (Table 3-1). These designated activity categories include:

- Activity A – Ingress/egress pathways and roads: includes light and heavy traffic ingress/egress pathways on existing roads within the boundaries of the IAR MRA and some limited vegetation clearing. Approximate total area affected: 0.4 acres (0.2 hectares [ha]).
- Activity B – Above-ground vegetation cutting only, prior to target-specific excavation: vegetation is cut at ground level, and removed material is chipped and left in place. Approximate total area affected: 13.8 acres (5.6 ha).

  Target-specific excavations (i.e., highly localized typically small excavations involving typically hand tools, but occasionally backhoe operation) are conducted in SCA and NCA areas that were not excavated, as described below for Activities C and D.
- Activity C – Small-scale soil excavation: includes above- and below-ground vegetation removal, root removal, and soil excavation in limited areas (less than 1 acre [0.4 ha] or less than 100 feet [30 meters (m)] wide). Removed vegetation is stockpiled separately, along with the top 6 to 12 inches (15 to 30 centimeters [cm]) of soil, to preserve the existing seedbank. Stockpiled soils are used to backfill excavated areas within the IAR MRA. Approximate total area affected: 1.2 acres (0.4 ha).
- Activity D – Large-scale soil excavation: includes above-and below-ground vegetation removal, root material removal, and soil excavation in a larger area (more than 1 acre [0.4 ha]). Removed vegetation is stockpiled separately, along with the top 6 to 12 inches (15 to 30 cm) of soil to preserve the existing seedbank. Stockpiled soils are used to backfill excavated areas within the IAR MRA. Approximate total area affected: 13.4 acres (5.4 ha).

Restoration strategies were developed for each activity type, as detailed in the HRP (ESCA RP Team 2013b), and are summarized in the following sections.

3.2 Restoration Strategies

The restoration requirements of the BOs and HMP focus on facilitating re-establishment of native vegetation at the site as well as their associated ecological functions. To address the range of disturbance to native habitats anticipated as a result of the MEC remedial action work, three strategies focused on plant community recovery were identified within the HRP. This multi-strategy approach was based on the assumption that sites experiencing lesser disturbance will be more easily restored via natural processes, whereas sites experiencing greater disturbance (especially those of larger extent) require more active restoration interventions that facilitate natural recovery processes.

Two principles follow from this assumption:

- The level of restoration effort should be commensurate with the level and/or extent of site disturbance.
- Allocation of restoration resources should be biased toward more disturbed and/or larger sites where prevention of site deterioration and facilitation of natural recovery processes are most needed.

One of the three restoration strategies listed below was applied to each affected site, depending on the type and extent of disturbances.

- Monitoring only
- Passive restoration (seeding only)
- Active restoration (seeding and planting)

Restored sites are also monitored for erosion and invasion by exotic plant species. Each strategy and the associated field activities are discussed in the following sections. Restoration activities in the IAR MRA are shown in Figure 4. Subareas in Range 47 are shown in Figure 5.

3.2.1 Monitoring Only

The monitoring-only strategy involves the least restoration effort, with the primary post-disturbance activity being the monitoring of vegetation regrowth and implementation of weed eradication and/or erosion best management practices (BMPs), as needed. It relies upon vegetation re-establishment from existing root biomass, soil seedbank, and dispersal of plant propagules from adjoining habitat into the sites to re-establish the plant community.

"Monitoring only" was implemented where above-ground vegetation was cut or disturbed, but root systems remain intact; where target-specific excavations that were typically small in size and performed primarily with manual tools; and along ingress/egress pathways that were minimally disturbed during munitions investigation activities (Activities A and B).

The monitoring-only strategy was implemented at ingress/egress routes, North Range 44 SCAs, South Range 44 SCAs and Central Area NCAs, and Range 47 SCA Subarea C. The escarpment portion (0.5 acres) of Range 47 SCA within Subarea C was subject to small-scale excavation (Activity C). The escarpment was categorized as an Activity B area and the monitoring-only strategy was implemented in this historically low-recruitment area. The long-term pre-existing condition and baseline vegetation cover of the escarpment was documented in the HRP as being an area of low recruitment with only 10% shrub cover (ESCA RP Team 2013b).

The primary post-disturbance activity associated with the monitoring-only strategy is monitoring regrowth of vegetation and monitoring for weed infestations and/or erosion issues, as needed.

3.2.2 Passive Restoration: Seeding Only

The passive restoration strategy involves an intermediate level of effort and includes topsoil seedbank replacement (i.e., back-filled topsoil), seeding by restoration personnel, and natural dispersal of plant propagules from adjoining high quality habitat into the sites to re-establish the plant community. Topsoil contains native plant seedbank, nutrients, organic material, microorganisms, beneficial fungi, and other elements that promote ecosystem function. Passive restoration is applied to sites where disturbance activities include small-scale soil excavation or soil disturbance in areas of limited extent (i.e., less than 100 feet [30 m] wide [regardless of acreage] or less than 1 acre [0.4 ha] and in both types), surrounded by undisturbed habitat (Activity C).

The passive restoration strategy was implemented at the North Range 44 SCAs, South Range 44 SCAs and Central Area NCAs, and Range 47 SCA Subarea C along one linear scrape (Figure 4).

Restoration activities in IAR MRA North and South Range 44 involved backfilling excavated soil, recontouring as needed to match original topography, and seeding of the site by restoration personnel. A small portion of vegetation-cut areas in Range 47 Subarea C was also seeded. The seed palette is described in Section 6. Seeded areas in passive restoration sites are not irrigated, so seed was sown at the beginning of the rainy season on 09 November and 10 and 11 December 2013.

Monitoring of seed germination and seedling establishment will be conducted in the coming months, and no further restoration activity is anticipated unless corrective measures are subsequently determined to be needed through the adaptive management process. Monitoring methods and results of this activity for the first year are described in Sections 8 and 9, respectively.

3.2.3 Active Restoration: Seeding and Planting

The active restoration strategy involves the greatest level of effort and a wide range of restoration procedures and materials. This strategy has been implemented only in Range 47, where disturbances included large-scale soil excavation (i.e., greater than 100 feet [30 m] wide and more than 1 acre [0.4 ha], Activity D).

Site preparation involved backfilling excavated soil in the correct sequence, recontouring as needed to match original topography, erosion control prior to installation of an irrigation system, and restoration planting and seeding. Active restoration sites are a primary focus of the adaptive management process, which determines when corrective measures are needed to maintain restoration progress (for more details see Section 6).

Monitoring methods and results of this activity for the first year are described in Sections 8 and 9, respectively.

3.3 Success Criteria and Performance Targets

Quantitative success criteria for the first seven years following site restoration are shown in Tables 3-2 and 3-3 and first-year monitoring results are compared with these success criteria in Section 9 of this report.

Evaluation of and reporting against performance standards is required to support compliance with Applicable or Relevant and Appropriate Requirements (ARARs; ESA Federal requirements) in completion of the Phase II Interim Action under the Interim Action ROD (Army 2002). Habitat restoration and monitoring activities are documented consistent with the Phase II Interim Action Work Plan. These results will be the basis for annual meetings with the Army and the USFWS. These meetings are tentatively planned to occur in the first quarter of each year. Site restoration performance will be evaluated and approved by the USFWS based on compliance with the requirements of the BOs and HMP in accordance with the Federal ESA.

Demonstration that the restoration requirements of the BOs (USFWS 1999, 2002, 2005) and the HMP (USACE 1997) have been met will be accomplished by documenting two categories of outcomes as stated below:

- Successful soil and topography remediation in targeted areas (Table 3-2)
- Species and vegetation establishment that meet success criteria (Table 3-3)

Habitat restoration in the IAR MRA is being conducted at the site in a manner consistent with the land use requirements, engineering and institutional controls, and site management restrictions outlined in the HMP (USACE 1997) and HRP (ESCA RP Team 2013b). Quantitative success criteria for plant survival, species richness, and percentage cover have been established for the first seven years following site restoration. Metrics for most criteria are based on the pre-existing baseline values, and progress toward those values is determined on anticipated restoration trajectories. Upon determination that success criteria have been met at each site, monitoring efforts will be considered complete.

Restoration success is evaluated based on the following guidelines as stated in the HRP (ESCA RP Team 2013b):

- The health of the restored community will be determined by successful establishment of the community's component species, most importantly the HMP species (USACE 1997, p. 3-20).

- The self-sustainability of the restored community will be determined by vegetative development (i.e., community species richness and percentage cover) over a minimum of three to five years that is consistent with the generally accepted trajectory of chaparral vegetation development.
- The equity of the restored community will be determined by its consistency with the baseline (i.e., pre-disturbance) community. The baseline community represents the community that was removed (USACE 1997, p. 3-6).
- The equity of the restored populations of the HMP species will be determined by their consistency with the baseline (i.e., pre-disturbance) HMP populations. The baseline HMP populations represent the populations that were removed (USACE 1997, p. 3-6).
- The self-sustainability of restored populations of HMP species will be determined by their initial establishment and subsequent colonization of seeded and/or planted areas (i.e., HMP species richness and population estimates) over a minimum of three to five years that is consistent with the HMP baseline populations.
- The establishment of a restored habitat that is devoid of or minimally affected by exotic invasive plant populations will be determined by eliminating populations of the target exotic species and/or documenting that their populations are below the quantitative target levels (i.e., total community percentage cover) for a minimum of three to five years.

Achievement of these restoration objectives are evaluated via the following parameters and their associated quantitative metrics as stated in the HRP (ESCA RP Team 2013b). Results of first-year monitoring for each objective are presented in tables as noted.

- Community equity will be assessed by comparing the total number of plant species present in the site with the number present prior to disturbance (i.e., the plant palette or baseline, including HMP species; Tables 9-1, 9-2, 9-3, and 9-4)
- Restored community health and HMP equity will be assessed by comparing the total number of HMP species present in the site with the number present prior to disturbance (Tables 9-3 to 9-13)
- Self-sustainability of the community will be assessed by: a) achievement of community equity and b) vegetative development as exhibited by the total percentage live plant cover at the site and in a pattern that is consistent with the anticipated trajectory of chaparral regeneration (Tables 9-16 to 9-29)
- Minimization of habitat degradation via exotic invasion will be assessed by preventing the total area of the site occupied collectively by populations of pampas grass (*Cortaderia jubata*), iceplant (*Carpobrotus edulis*) and French broom (*Genista monspessulana*) from exceeding a target value (Tables 9-16 to 9-29 and summarized in Section 9.7)

The values of most of the metrics are not static but reflect the increases associated with growth and maturation of the community to be expected as it progresses along the anticipated

trajectory. The following assumptions were made in selecting quantitative success criteria (Table 3-3).

- Vegetation cover will start at a low of 0% in most areas in Year 1 and increase through time.
- The trajectory for vegetation cover to be equitable with pre-disturbance baseline conditions for each location will generally take 10 years.
- Species diversity will increase with time and achievement of equitable diversity to pre-disturbance baseline conditions for each location will take 15 years. This process is assumed to be slower than vegetative growth since long-distance seed dispersal and ideal germination conditions are required for seedling establishment and growth for each new species at a given site.
- HMP shrub species presence will increase through time.
- Monterey spineflower and Monterey gilia cover and frequency will decrease through time as the chaparral shrub canopy fills in and microsites are occupied by other species.
- Seaside bird's-beak is restricted to one location and requires a host plant for long-term presence. This species will recover more quickly in areas with above-ground vegetation removal where host plants are present but will take time to become established in excavated areas.
- Plant establishment in Range 47 Subarea A will be slow initially but will increase slowly to at least a minimum of pre-disturbance conditions within 7 years.
- Container plant survival will vary by species and individuals may gradually die, but these may be replaced by recruits of the same species.

In order to evaluate progress towards achieving success criteria and performance targets, monitoring results are tabulated at least annually, and the result for each parameter are compared with its expected outcome for Year 7 post-installation (Table 3-3). Results that meet or exceed the target criterion for the monitoring period are considered to have demonstrated a successful outcome and achievement of the restoration objective. Results that are below the expected outcome for Year 7 post-installation are examined by the adaptive management process to determine an appropriate course of action, if any. Review and potential reconsideration of past or proposed adaptive management actions will be conducted jointly with USFWS during annual review meetings.

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4.0 RESTORATION PLANT MATERIAL COLLECTION AND PROPAGATION

The methods for seed, cutting, and seedbank collection are described below, along with a summary of nursery activities and plant propagation.

4.1 Seed Collection

Seeds were collected on site for direct broadcast seeding in restoration areas as well as for use in propagation by selected native plant nurseries for production of container-grown nursery stock for later planting.

A total of 36.6 pounds (16,502 grams [g]) of native seeds were collected by ESCA RP biologists between 2010 and 2012 from five HMP species and fourteen non-HMP species. Table 6-1 lists the species collected for sowing in restoration areas and the dates of collection by year. All HMP species were collected within 0.6 miles (1 km) radius of the restoration areas in the IAR MRA (Range 44 and Range 47). Non-HMP species were collected within 0.5 to 4 miles (0.8 to 6.5 km) of the restoration areas.

Each species was monitored frequently during its bloom period to determine when plants would begin to set seed and fruits would begin to ripen. Seeds were harvested from healthy and robust adult plants. To reduce impacts to the seed source population, no more than 25% of the seeds were removed from each plant. Collection methods varied depending on fruit structure; however, fruits were generally pulled off individual plants by hand and placed in paper bags. For species with dry dehiscing fruits (e.g., rush-rose [*Helianthemum scoparium*] and coast horkelia [*Horkelia cuneata* var. *cuneata*]), some seeds were collected from the ground around the plants and sifted out of the substrate. Seeds were processed immediately after collection.

Because the seeds required storage prior to propagation, some processing was required to avoid mildew or other seed diseases and pests. For the majority of the species collected, seeds were dried on a ventilated drying rack in a heat-controlled room. The drying rack was vented at the top with drier ducting leading out a window. Drying time depended on the moisture of the fruits, which is affected by weather conditions (e.g., fog) during collection or fruit anatomy.

Once fruits were dry, seeds were separated from enclosing seed capsules and/or other surrounding structures. Once the capsules and other fruiting structures were removed, seeds were saved in separate, air-tight containers and stored with desiccant. All containers were treated with mothballs (naphthalene or paradichlorobenzene) to protect the seeds against mold and insects potentially acquired during collection or processing. Seeds were then refrigerated or stored indoors in a climate controlled, ventilated building. A portion of collected Monterey gilia seed was provided to a nursery for propagation of plants for container planting and additional seed. Seeds and cuttings of other species were also provided to nurseries for container plant propagation, as described below.

4.2 Stem Cuttings

Shrub species that are known or proved to be problematic to propagate from seed were also grown from stem cuttings. ESCA RP biologist collected cuttings from healthy, robust, adult plants, bundled them in damp burlap, and delivered to the propagating nursery within two hours of collection.

Nurseries were provided with cuttings for the following species: sandmat manzanita (*Arctostaphylos pumila*), shaggy-barked manzanita (*Arctostaphylos tomentosa* subsp. *tomentosa*), black sage (*Salvia mellifera*), and golden yarrow (*Eriophyllum confertiflorum*).

4.3 Soil Seedbank Salvaging

Soil in the vicinity of colonies of HMP annual species was collected by ESCA RP biologists in order to salvage seedbank for later placement in Range 47 Subareas A and B ("Range 47 Restoration Area"). Seedbank salvaging took place between 2010 and 2012. Soil seedbank salvaging focused on areas hosting colonies of Monterey gilia and Monterey spineflower. In addition, limited quantities of soil containing seed of rush-rose, dwarf ceanothus (*Ceanothus dentatus*), and Monterey ceanothus (*Ceanothus rigidus*) were also collected.

Seedbank salvaging for HMP species occurred within 0.6 miles (1 km) of restoration areas. Seedbank was collected using a flat shovel to scrape the top 2 inches (5 cm) of soil. Seedbank was stored in plastic buckets with tight fitting lids to prevent rodent entry. Buckets were ventilated to allow for evaporation of residual moisture and were stored in a cool enclosed place.

The following species were collected and stored:

- 130 buckets of Monterey gilia soil seedbank
- 108 buckets of Monterey spineflower soil seedbank
- 14 gallons of rush-rose soil seedbank
- 4 gallons of combined dwarf ceanothus and Monterey ceanothus seedbank

4.4 Nursery Propagation of Container-grown Plants

Four nurseries propagated plants for subsequent planting in the Range 47 Restoration Area.

- Central Coast Wilds – Santa Cruz, California; approximately 39 miles (62.7 km) from the site
- Rana Creek – Carmel, California; approximately 29 miles (46.7 km) from the site
- California State University at Monterey Bay Watershed Institute, Seaside, California; approximately 3 miles (4.8 km) from the site

- Elkhorn Nursery, Moss Landing, California; approximately 17 miles (27.3 km) from the site.

Nurseries propagated all container stock from seeds and/or cuttings delivered by ESCA RP biologists between November 2011 and November 2012. Each nursery utilized individual methods for planting, watering, and weeding propagated plants. Prior to propagation, some seeds required pre-treatment to ensure germination. Pre-treatment methods included: refrigeration/cold stratification, heat treatments (soaking in hot to boiling water), and heat treatments coupled with liquid smoke.

The following species were propagated for planting in the Range 47 Restoration Area:

- Deerweed (*Acmispon glaber*)
- Chamise (*Adenostoma fasciculatum*)
- Sandmat manzanita (*Arctostaphylos pumila*)
- Shaggy-barked manzanita (*Arctostaphylos tomentosa* subsp. *tomentosa*)
- Monterey ceanothus (*Ceanothus rigidus*)
- Dwarf ceanothus (*Ceanothus dentatus*)
- Golden yarrow (*Eriophyllum confertiflorum*)
- California coffeeberry (*Frangula californica*)
- Rush-rose (*Helianthemum scoparium*)
- Silver bush lupine (*Lupinus chamissonis*)

ESCA RP biologists monitored seed pre-treatments. Monthly monitoring of all nurseries was conducted by ESCA RP biologists from January 2012 until plants were ready to be delivered in January 2013.

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5.0 SOIL EXCAVATION AND SALVAGING DURING MEC REMEDIAL ACTION

5.1 Soil Excavation and Sifting in Range 44 and Range 47

Large-scale soil excavation and sifting operations were conducted during the Design Study and Phase II Interim Action at Range 47 between June 2011 and September 2012 in support of the Interim Action ROD (Army 2002). Prior to soil excavation, the above-ground vegetation was cut at ground level with mechanical heavy equipment. Root material remaining in the soil was removed by "root raking," in which a bulldozer equipped with heavy tines pulled out roots and burls, while retaining most of the soil. The above-ground and below-ground plant material was inspected for MEC and non-MEC items by a UXO Technician, stockpiled, and later processed using size-reduction equipment to reduce the size of the material to 1 inch (2.5 cm) or smaller. Although there were initial plans to use the wood chip material in the Range 47 Restoration Area and for producing charate, the quantity of weeds and residual materials in the wood chip pile made that approach infeasible. Following size reduction, the material was transported and placed within the IAR MRA.

Approximately 39,815, cubic yards (30,440.8 cubic meters [m^3]) of soil was excavated from Range 47 during this effort. A bulldozer and excavator removed the top six to twelve inches (15.2 to 30.5 cm) of topsoil. Approximately 12,308 cubic yards (9,410.1 m^3) of topsoil were excavated, screened, and stock-piled separately from subsoils to preserve the native seedbank and soil micro-organisms. Subsoils were then excavated to a depth of two to six feet (0.6 to 1.8 m) bgs. Approximately 27,507 cubic yards (21,030.6 m^3) of subsoil was excavated, screened, and stockpiled separately from topsoil. Excavated soils were processed by UXO Teams at an onsite mechanical sift plant and potential MEC was removed from the soil. Grading stakes were used throughout the work area during soil excavation to provide a visual reference on the depths of topsoil and subsoils in the work area.

Soil excavation also took place in Range 44. Approximately 1,472 cubic yards (1,125.4 m^3) of subsoil was removed from excavated and sifted transects and polygons. In these areas, the topsoil was not replaced because the equipment required to replace topsoil would significantly disturb existing and newly regrown vegetation, especially HMP annual species. As a result, topsoil from Range 44 and Range 47 Subarea C was mixed with the topsoil from Range 47, resulting in a larger volume of topsoil than originally anticipated. Similarly, subsoil from Range 44 and the Range 47 berm were mixed with the subsoil from Range 47, resulting in a larger final volume of subsoil than originally anticipated.

A total of approximately 41,300 cubic yards (31,566.2 m^3) was excavated and sifted from both Range 47 and Range 44 during ESCA RP remedial activities in 2011 and 2012. Soil piles were inspected on a periodic basis for weed infestation. Live pampas grass and iceplant that could be safely handled were removed and treated.

5.2 Soil Replacement in Range 47 Subareas A and B

Soil replacement activities for Range 47 started 12 November 2012 and were completed on 20 December 2012. A 1964 aerial image of the area was used for referencing the pre-existing

topography and site conditions. The grading plan provided soil volume calculations, pre-disturbance site topography in the location of a former berm, details for matching pre-existing topography of the area, and information on topsoil replacement in Subareas A and B.

Grading stakes were used during soil backfilling operations to provide a visual reference on the depths of subsoil and topsoil to be replaced. Ground-level photopoints were also used before and after soil replacement to document the process. Screened stockpiled subsoil was loaded into dump trucks and transported via designated ingress and egress routes to specified locations of Range 47. Approximately 18 to 24-inches (45.7 to 70 cm) of subsoil was backfilled and contoured. Topsoil was replaced and contoured in the same manner as subsoil to a depth of 6 to 12 inches (15 -30 cm). These methods adhered to the soil and topography remediation success criteria out lined in the HRP (Table 3-2; ESCA RP Team 2013b).

5.3 Soil De-compaction of Temporary Access Roads in Range 47

Access to the Range 47 Restoration Area was confined primarily to existing roads in order to avoid damage to surrounding native vegetation. Staging and stockpiling took place in the nearby development parcel.

To minimize vehicular soil compaction of newly placed soils in the Range 47 Restoration Area during restoration implementation, designated temporary access roads were clearly established with visible flagged field stakes. Upon completion of animal deterrent fencing construction, irrigation system installation, and seeding and container planting of the majority of the Range 47 Restoration Area (Section 6.0) roads were de-compacted using a mini-excavator. After de-compaction, vehicles were no longer allowed in the Range 47 Restoration Area. The de-compacted temporary access roads were planted with container plants, as described in Section 6.4. Deerweed and coyote bush were used in this area because they are tolerant of disturbed and compacted soil, along with other species such as bush monkeyflower.

6.0 RESTORATION IMPLEMENTATION

The following sections describe implementation of the active and passive restoration, as described in Section 3.2, of Range 44 and Range 47 subsequent to replacement of subsoil and topsoil.

Restoration implementation in the Range 47 Restoration Area began immediately following replacement and recontouring of salvaged soil. Once soil was replaced, preparation for planting and seeding commenced, including erosion control materials installation, fence installation of the planting area, and installation of an irrigation system. After site preparation, seeding and planting tasks were implemented. Figure 6 shows the locations of the fence, irrigation system, and irrigation zones.

Seeding areas in Range 47 are presented in Figure 7 and seeding areas in Range 44 area shown in Figure 8. Tables 6-1, 6-2, 6-3, and 6-4 provide details on the seed mixes, container plantings, and the HMP annual seed, seedbank, and container plantings installed in Range 47. Photo-documentation of the site prior to the soil replacement through completed container planting is provided in Photographs 1 through 32.

6.1 Site Preparation

Erosion control materials and methods, installation of the above- and below-ground animal deterrent system, and irrigation design and installation are described in this section.

6.1.1 Erosion Control

After the completion of soil replacement, the ESCA RP Team instituted best management practices to prevent and/or control erosion and the potential loss of newly replaced, lightly compacted topsoil (Figure 4).

The newly placed topsoil in the Range 47 Restoration Area gently slopes to the north-northeast. An escarpment, a steep mostly unvegetated slope approximately 25 feet (7.6 m) high, is located in the southwest corner of the Range 47 Restoration Area. A bulldozer was track-walked on the slopes throughout the Range 47 Restoration Area during final recontouring in December 2012 to establish tracks oriented perpendicular to the slopes, thereby reducing the potential for rill formation. Additional erosion control measures were installed from 04 January 2013 through 18 January 2013.

In order to address potential erosion on the escarpment in the Range 47 Restoration Area, a 100% biodegradable coconut fiber erosion control blanket (American Excelsior BioNet® 8-foot x 112.5-foot Straw Coco Blanket) was installed and secured with 100% biodegradable stakes (4-inch GreenStakes®).

Wattles were installed across the Range 47 Restoration Area in areas judged most at risk from erosion to slow water movement and trap sediments moving downslope. Approximately 2,500 feet (762 m) of wattles were installed parallel to elevation contours in three to four

rows spaced approximately 10 vertical feet (3 m) apart. Wattles are filled with certified weed-free California rice straw inside a 100% biodegradable burlap sheath (Kristar 9-inch Bio Wattle). Each wattle was placed in a shallow trench and fastened with 18-inch (46 cm) wooden stakes. The ends of wattles were overlapped by at least 12 inches (30 cm).

Approximately 800 feet (244 m) of fine-mesh silt fencing were installed along the northern perimeter of the Range 47 Restoration Area to reduce the potential for soil transport into down-gradient habitat. Where the fence line was not parallel to contour, there was a potential for the fence to funnel runoff into down-gradient habitat. In these areas straw bales were placed along the silt fence area to slow water flow and prevent erosion.

Hydromulch was also applied to the Range 47 Restoration Area (Subareas A and B) between 17 and 23 January 2013 in order to further stabilize the exposed soil. The hydromulch mixture consisted of 2,000 pounds (907 kg) per acre of paper matrix and 4 gallons (15 liters [l]) per acre of EarthGuard® tackifier. No seed was added to the hydromulch mixture.

Potential wind erosion and sand transport from the windward (western) side of the Range 47 Restoration Area was addressed by the addition of wind-blocking mesh to the animal deterrent fencing.

6.1.2 Animal Deterrent System Installation

An above-ground and below-ground animal deterrent fence system, consisting of a deer fence and subterranean barrier, was installed around the perimeter of the Range 47 Restoration Area in January 2013. The fence was generally located five feet (1.5 m) from the edge of the backfilled soil in at least 30 inches (76 cm) of sifted soil.

The eight-foot (2.4 m) high deer fence was installed along the perimeter of the Range 47 Restoration Area, for a total of 4,200 linear feet (1,280 m). The deer fence is constructed of heavy-duty UV-stabilized black polypropylene mesh mounted on steel posts; fence posts were installed every five feet (1.5 m) on the windward side of the fence to ensure stabilization for the windscreen and every ten feet (3 m) throughout the rest of the fence perimeter. A portion of the planted restoration area near the escarpment in the southwest corner was not fenced due to inaccessibility and slope stabilization concerns.

The subterranean fence barrier consists of galvanized hardware cloth with half-inch (1.2-cm) mesh buried two feet (0.6 m) bgs and attached to the deer fencing two feet (0.6 m) above ground. A trench digger was used to excavate for the subterranean fence barrier around the perimeter of the Range 47 Restoration Area, and a post-hole digger was used to place the sleeves for the fence posts. All subterranean work was approved by UXO-qualified personnel.

The fence is equipped with three gates. A15-foot-wide (4.6-m-wide) gate was installed on the northeast corner to allow vehicles to enter and exit. Two four-foot-wide (1.2-m-wide) ‘personnel’ gates were installed on the far west side of the Range 47 SCA and on the south side to allow personnel access to planted areas outside of the fencing. Hardware cloth was wrapped around the gates such that the gates would not create breaks in the animal deterrent

fencing above-ground or below-ground. After container planting was completed, the largest gate was modified so that only one side opens and additional hardware cloth was installed to ensure fence integrity.

The animal deterrent fence was completely installed by 15 January 2013. Installation of the wind-screen was complete on 15 February 2013.

6.1.3 Irrigation System Installation

An irrigation system was installed concurrently with the animal deterrent fencing and container planting to support plant growth by augmenting natural rainfall during the first months after container plants were installed. The irrigation system was completed and operational as of 14 February 2013.

The original scope of work included the installation of a hydrant connected to the Marina Coast Water District (MCWD) waterline near the Range 47 Restoration Area; however, access to the waterline was not practicable. Instead, a water line was run from the MCWD water tank located northwest of the intersection of Parker Flats Cut-off Road and Eucalyptus Road.

Water from the MCWD tank flows into an irrigation head tank. From the head tank, water flows through approximately 0.93 miles (1.5 km) of 4-inch (10.2 cm) high-density polyethylene (HDPE) pipe to a pump house located approximately 125 feet (38 m) east of the Range 47 Restoration Area entrance. The pump house is a 7 foot by 7 foot (2 m by 2 m) enclosure of expanded steel mesh. The pump house protects shutoff valves, pressure gauges and a high-pressure gasoline engine driven pump (Gorman-Rupp Model #2P5XA).

From the pump, a 4-inch (10.2-cm) polyvinyl chloride (PVC) line serves as the main line to the Range 47 Restoration Area. From the main line a series of lateral lines connect the overhead multi-stream rotor sprinklers to the main line. The irrigated area is subdivided into 14 zones. The irrigation system is constructed from PVC piping, connection tubing (Blu-Loc®), four-foot (1.2-m) risers, and overhead multi-stream rotor sprinklers (Hunter MP-Rotator®) on 40-foot (12 m) centers.

6.2 Broadcast Seeding and Salvaged Soil Seedbank Placement

Seeds collected between 2010 and 2012 were sown in the IAR MRA in 2013. Collected seed species and quantities are summarized in Table 6-1 (see Section 4). In addition, salvaged soil seedbank was also collected, stored, and spread in Range 47 and Range 44 restoration areas (see Section 4.3). Quantities of seed and soil seedbank as well as details of their distribution in Range 47 and Range 44 are provided in Table 6-2.

Approximately 36.6 pounds (16.5 kilograms [kg]) of seeds and 122 cubic feet (37.2 cubic meters [m^3]) of salvaged soil seedbank were sown in the Range 47 and Range 44 restoration areas. Broadcast seeding and salvage soil seedbank placement was conducted in January 2013 in Range 47 Restoration Area and in December 2013 in the Range 44 seeding area.

Staked polygons were established to restore Monterey spineflower and Monterey gilia to the Range 47 Restoration Area. A combination of seeded polygons, salvaged soil seedbank polygons, and Monterey gilia container plant polygons were placed across the Range 47 Restoration Area in order to establish sustainable colonies in areas where these rare plants had previously grown (see Figure 7).

In Range 47 Subarea A, a portion of Range 47 with decades of low vegetation cover, a Ceanothus Seed Mix was hand broadcast to boost native plant establishment, in addition to topsoil replacement. No container plantings were installed in Subarea A; however, 13 salvaged shaggy-barked manzanita shrubs were transplanted into Subarea A, as described in Section 6.3. A few small polygons were also established for herbaceous perennials and shrub seeding in Range 47 Subarea B among the container plantings.

Seed and salvaged soil seedbank polygons established in the Range 47 Restoration Area are shown in Figure 7. Broadcast seeding and salvage soil seedbank placement for each HMP annuals and shrub and herbaceous perennial species in the Range 47 Restoration Area are described in the following sections.

6.2.1 HMP Annuals Seeding and Seedbank

Three methods were employed in 2013 in order to establish colonies of HMP annuals (Monterey spineflower and Monterey gilia) in restoration areas: seeded polygons, salvaged soil seedbank polygons, and Monterey gilia container plants polygons. Only Monterey gilia was propagated in containers.

Thirty HMP annual species polygons have been established within Range 47 Subareas A and B: 20 polygons with HMP annual seeded or salvaged soil seedbank and 10 polygons with Monterey gilia container plantings (see Section 6.4.4). Polygons range in size from 75.2 to 257.1 square feet (23.9 to 57.9 square meters [m^2]) and the majority of polygons are located in Subarea B. Polygon sizes and species seeded and/or planted in each polygon are provided in Table 6-3.

Each seeded or soil seedbank polygon contains either Monterey gilia or Monterey spineflower seed or seedbank (Table 6-3). HMP annual polygons are demarcated with labeled stakes to delineate seeding/seedbank polygons. A buffer area ranging from 3.3 to 6.6 feet (1-2 m) in width surrounds each polygon. Within the buffer, only species that remain small at maturity were installed during container planting, such as coast horkelia, golden yarrow, rush-rose, and deerweed; buffers were created to maintain open areas among the container plantings. Global Positioning System (GPS) data were collected for all polygon areas with a hand-held GPS unit (Trimble GeoHX).

6.2.1.1 Range 47 HMP Annual Seeded Polygons

Two Monterey gilia and five Monterey spineflower seeded polygons were established within Range 47 (Figure 7). Collected seeds, seed capsules, and/or other surrounding fruit structures were divided equally between the seeded polygons. Two Monterey gilia seeded polygons are located in the northwest corner and in the center of the Range 47 restoration site in Subarea

B. Monterey gilia seeds were mixed with the existing polygon topsoil, then hand broadcast or sifted and lightly raked into the topsoil of each polygon.

Monterey spineflower seeded polygons are located Subarea A (one) and in the northeast, south, and central portions of Subarea B (four). Monterey spineflower was hand broadcast, and then raked into the existing topsoil.

6.2.1.2 Range 47 HMP Annual Soil Seedbank Polygons

Seven Monterey gilia and six Monterey spineflower soil seedbank polygons were established within Range 47 (Figure 7). Each polygon received approximately 5.5 cubic feet (0.16 m^3) of soil seedbank at approximately one inch (2.5 cm) thick. Monterey gilia seedbank polygons are located in Subarea A (one) and the northwest, northeast, southeast, south, and central portions of Subarea B (six). Monterey gilia seedbank was not raked into the topsoil.

Monterey spineflower seedbank polygons are located in Subarea A (one) and the northwest, northeast, south and central portions of Subarea B (five). Monterey spineflower soil seedbank was raked out over the existing topsoil within each polygon.

6.2.1.3 Range 47 Broadcast Seeding of HMP Annuals

Approximately 10.9 ounces (310 g) of HMP annual seeds were sown in the Range 44 seeding area on 11 November and 16 December and 17 December 2013. Monterey gilia, Monterey spineflower, and seaside bird's-beak seeds were hand broadcast within transects and excavated areas in North Range 44. Monterey gilia and Monterey spineflower seed were hand broadcast in open areas without vegetation in South Range 44 restoration area. Seaside bird's-beak was hand broadcast next to established potential host plants (e.g., chamise, manzanita, California coffeeberry) along the perimeter of the excavated areas.

Figure 8 shows the seeding areas in the Range 44 restoration areas. Table 6-1 lists the species and seed amounts per species.

6.2.2 Shrub and Herbaceous Perennials Seeding

6.2.2.1 Range 47 Subarea A Seeding

Approximately 8 pounds (3.6 kg) of Ceanothus Seed Mix (Table 6-2) were pre-treated and hand broadcast into Subarea A. The seed mix was lightly raked into the topsoil. Seeding in Subarea A was conducted on 14 January 2013, prior to container plant installation.

6.2.2.2 Range 47 Subarea B Seeding

Approximately 12.8 pounds (5.8 kg) of the Central Maritime Chaparral Seed Mix (Table 6-2) and 0.8 cubic feet (0.02 m^3) of Rush-Rose Soil Seedbank were hand broadcast into six small polygons in Subarea B. Polygons were staked and the areas of each recorded with a hand-

held GPS unit. Seeding in Subarea B was conducted in February 2013, concurrently with container plant installation.

6.2.2.3 Range 47 Subarea C Seeding

Approximately 2 pounds (0.9 kg) of Ceanothus Seed Mix (Table 6-2) were pre-treated and were hand broadcast within a linear scrape (small-scale excavation area) in Subarea C in Range 47. Seeding in Subarea C was conducted on 14 January 2013.

6.2.2.3 Range 44 Seeding

Approximately 10.5 pounds (4.94 kg) of the Central Maritime Chaparral Seed Mix (Table 6-2) were hand broadcast in the Range 44 seeding area on 11 November and 16-17 December 2013. In addition, approximately 1.7 cubic feet (0.05 m^3) of Rush-rose Soil Seedbank and 0.3 cubic feet (0.001 m^3) of Ceanothus Soil Seedbank were hand broadcast in the Range 44 seeding area.

6.3 Shaggy-barked Manzanita Salvaging

Three sizes of shaggy-barked manzanita transplants were salvaged from the adjacent development parcel in the IAR MRA in an attempt to provide larger individuals of this dominant species in the Range 47 Restoration Area and because contracted nurseries had difficulty growing shaggy-barked manzanita from plant cuttings. Between 26 December and 28 December 2012, 137 shaggy-barked manzanitas were salvaged from the adjacent development parcel and transplanted into the Range 47 Restoration Area. UXO-qualified personnel were required to perform the salvaging.

Prior to salvaging, over 150 shaggy-barked manzanitas were flagged in accessible parts of the IAR MRA development parcel. Once an area was cleared for potential MEC, flagged shaggy-barked manzanitas were dug out with a backhoe and placed in five-gallon (18.9 l) buckets filled with water and one capful of plant vitamin supplement (Superthrive®). The bucket was then covered with moist burlap. Plants were held in buckets for no longer than 20 minutes.

Each plant was placed into pre-dug and pre-watered holes in the Range 47 Restoration Area at the same depth as it was prior to salvaging, with the root crown completely covered with topsoil. Salvaged manzanitas were watered again after final planting.

On 15 January 2013, 21 of the 137 plants were transplanted again to spread plants more evenly throughout the Range 47 Restoration Area. On 26 February 2013, hydromulching slurry that was incidentally sprayed on the transplanted manzanitas was washed off.

6.4 Container Planting

Container plants were installed in the Range 47 Restoration Area between 24 January and 11 February 2013, with the exception of Monterey gilia (see Section 6.4.4). Approximately 46,233 container plants were delivered and planted, including three HMP shrub species

(Monterey ceanothus, sandmat manzanita, Eastwood's ericameria) and 13 common shrub, subshrub, and perennial herb species (deerweed, chamise, shaggy-barked manzanita, coyote bush, dwarf ceanothus, dune-heather [*Ericameria ericoides*], golden yarrow, California coffeeberry, rush-rose, coast horkelia, silver bush lupine, sticky monkeyflower [*Mimulus aurantiacus*], and black sage) within the Range 47 Restoration Area.

Of these, about one-third of the plants in the delivered containers were categorized "too immature" for planting, primarily due to poor root development and small size. Although these immature plants were planted in a good faith effort to boost native plant establishment in the Range 47 Restoration Area in the hope that some would survive, it was decided that the initial container plant census would be conducted four weeks after planting. This delay allowed those young plants that would have been unlikely to survive to be excluded from the baseline (see Section 9.4). A summary of container plantings from the March 2013 census is provided in Table 6-4.

Prior to nursery deliveries, the Range 47 Restoration Area was divided into 61 planting cells based on the existing grid cell system, in order to facilitate documentation of inventory and planting numbers by species. The majority of the cells were 100 x 100 feet (10, 000 square feet; 929.03 m^2); however, some of the planting cells were smaller owing to the geometry of restoration area borders and Subareas. The numbers of species per planting cell were calculated based on predicted nursery plant production and on planned placement of species throughout the Range 47 Restoration Area in similar proportions. A planting cell inventory sheet detailed total planting numbers by species for each planting cell.

A planting crew was contracted to install the container plants. Because of the potential hazards of working in areas recently remediated for MEC, the crew members were provided with Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response 24-hour awareness training. A total of four planting teams were comprised of one ESCA RP biologist and six planting crew members.

Figure 4 shows the container planting areas in Range 47 Subarea B. Table 6-4 lists the number of each species planted. Photographs in this IRACR Volume 2 include photo-documentation of the nursery deliveries, plant distribution, and plant installation. Implementation of plant delivery, placement, and installation is described in the following sections.

6.4.1 Nursery Deliveries

Nursery deliveries were made from 15 January 2013 through 06 February 2013 for a total of 38 deliveries of container plants. Container plant staging areas were established near designated access road prior to the deliveries. Plants were stockpiled in groupings by species within the staging areas until ready for distribution into planting cells.

Plants were delivered to the staging areas on the western edge of the Range 47 Restoration Area first and continued east to facilitate a 'planting out' strategy.

6.4.2 Plant Placement

Plant placement commenced immediately upon receipt of the first delivery of plants on 15 January 2013. Using planting cell inventory sheets, ESCA RP biologists oversaw "spotting" of container plants in designated planting locations prior to planting. Small plant species that grow in dense clusters in the IAR MRA (e.g., coast horkelia and rush-rose) were planted in groupings. The number of containers and the planting spacing depended on the container sizes. Moreover, plants in very small containers were planted in groups of at least three per species in order to increase their visibility so that they would not be trampled. For example, some containers of silver bush lupine were delivered with cotyledons still visible. In contrast, manzanita species and California coffeeberry were placed further apart from neighboring container plants, because of their potential to quickly overgrow other plant species. Compaction-tolerant species (e.g., deerweed and coyote bush) were planted in greater densities in de-compacted access roads, along with a mixture of other species so that the road would blend into the surrounding vegetation over time.

6.4.3 Container Plant Installation

Container plant installation began 24 January 2013. Holes were dug as close to the container size as practicable using hand tools (shovel, trowel, or post-hole digger). Before plants were placed into the hole, a pinch of mycorrhizal inoculant was placed at the bottom of the hole. The root ball was then removed from the container and, if significant root binding was visible, the roots were gently loosened from the bottom of the root ball. The root ball was placed into the hole, and soil was backfilled to grade and soil gently but firmly pressed around the plant. Water basins were not created. The new planting was immediately watered with a hose or watering can to help settle the soil and eliminate air pockets. Plants were then given a deep watering using approximately 2 gallons (7.6 l) of water per plant.

6.4.4 Monterey Gilia Container Plantings

A total of 297 Monterey gilia container plants were propagated by Patti Kreiberg at Sunset Coast Growers and planted in 10 Monterey gilia planting polygons in Range 47 Subarea B on 04 April 2013 by ESCA RP biologists and Patti Kreiberg. The Monterey gilia planting polygons range in size from 99.9 to 190.3 square feet (9.3 to 17.3 m^2) and were placed in areas that share characteristics (slope, aspect) typical of Monterey gilia habitat in the IAR MRA. Between 28 and 30 plants were installed in each polygon at approximately 1- to 1.5-foot (0.3-0.5 m) on-center spacing.

7.0 RESTORATION MAINTENANCE AND MONITORING

Routine restoration maintenance in the Range 47 Restoration Area includes weed abatement, irrigation system monitoring, erosion control monitoring, and animal deterrent fence monitoring. Restoration site maintenance and monitoring are described in the following sections.

7.1 Weed Abatement in Range 47 Restoration Area

As required by the HRP, weed abatement has been performed by the ESCA RP Team on a continuous basis since the start of implementation (ESCA RP Team 2013b). All weeds were initially removed from the Range 47 Restoration Area during soil excavation. Shortly after soil replacement, germinating weeds were observed in the Range 47 Restoration Area, so weed abatement activities commenced early in the first-year monitoring period.

Abatement of iceplant, pampas grass, and weedy non-native annuals is routinely performed by ESCA RP biologists during routine monitoring. Weeds are removed by hand or using hand tools. Weeds are either left onsite to decompose or disposed of offsite if seeds are present or are likely to mature after the plant is removed.

As the soil warmed in late spring 2013, recruitment of iceplant seedlings escalated, and young iceplant individuals began to enlarge. On 19 July 2013, all observable iceplant was removed by hand. Additional iceplant removal was conducted on 01 August 2013.

7.2 Irrigation Maintenance and Monitoring

Ongoing irrigation maintenance and monitoring has been conducted from the start of irrigation system installation in January 2013.

On average, the irrigation system was maintained and operated weekly from February through June 2013 when there was insufficient natural precipitation. From July through December 2013, the Range 47 Restoration Area was irrigated every two to three weeks to allow plants to harden-off while still augmenting moisture to the roots of small plants. Irrigation was conducted each month based on field observation and evaluation.

Irrigation was conducted on the following dates in 2013:

- February 26, 27, 28
- March 6, 8, 12, 13, 14, 15
- April 2, 5, 9, 10, 15, 16, 17, 18, 22, 23, 24, 29, 30
- May 1, 2, 6, 8, 10, 13, 15, 16, 20, 21, 22, 23
- June 5, 6, 7, 18, 19, 20, 24, 26, 27, 28
- July 1, 2, 3, 8, 9, 11, 15, 16, 17, 22, 23, 24, 29, 30, 31
- August 5, 6, 7, 13, 19, 20, 21, 22, 26, 27, 28, 29

- September 10, 17, 18, 23, 24, 25, 30
- October 16, 17, 18, 22, 23
- November 4, 11
- December 9

Between 03 and 09 April 2013 a soil moisture monitoring system was installed to monitor soil moisture at different depths. In order to evaluate irrigation patterns and quantify soil moisture, monitoring tubes were installed in each of the fourteen irrigation zones plus one unirrigated control area.

Soil moisture data were gathered at each location using a hand-held soil moisture logger. Data were analyzed routinely and irrigation timing and duration was adjusted as necessary. Moisture monitoring was conducted on the following dates in 2013:

- April 3, 8, 9, 16, 17, 22, 24, 25, 29, 30
- May 31
- June 7, 12, 13, 20, 21, 24, 25, 26, 27, 28
- July 8, 15, 22, 29
- August 26
- September 10, 23
- October 4, 16, 22, 28
- November 4

7.3 Erosion Control Maintenance

Erosion control maintenance and monitoring were ongoing from the initiation of soil replacement in December 2012 until the end of the rainy season in April 2013. Restoration areas are typically monitored before and after significant rain events and periodically during rain events using an erosion control checklist. Erosion control checklists and reports are presented in Appendix E of the 2013 Annual Natural Resources Report (ESCA RP Team 2014).

Repairs to sandbags and wattles were made as needed. Following the post-rain event monitoring on 20 February 2013, water bars were installed at the active restoration site access road to address water and sediment flow from the road into the active restoration area.

Following the rainy season, as soils dried out, wind erosion was noted in bare-soil areas of the development parcel adjacent to the Range 47 Restoration Area. During high wind events, surface soils were eroded and transported eastward. Wind erosion was controlled by application of hydromulch to all bare-soil areas in the development parcel (approximately 11.5 acres [4.7 ha]) between 08 and 12 July 2013. The hydromulch mixture consisted of 2,000 pounds (907 kg) per acre of wood fiber matrix and 5 gallons (19 l) per acre of

EarthGuard® tackifier. No seed was added to the hydromulch mixture. Since the hydromulching event, regular monitoring has detected no further wind erosion issues in the development parcel.

7.4 Animal Deterrent System Maintenance

Animal deterrent system maintenance has been ongoing since the fencing system was completed in January 2013. ESCA RP biologists routinely inspect the system for potential damage from animal entry. Evidence (bite marks on the deer fencing and scat) of black-tailed jackrabbits (*Lepus californicus*) and desert cottontails (*Sylvilagus audubonii*) entering the site have been observed including gaps in the fencing. Gaps in the fencing are repaired and additional hardware cloth or galvanized metal fencing is added, as needed.

Animal deterrent system repairs were conducted on the following dates in 2013:

- April 24
- May 1, 2, 6
- June 5, 10
- September 23
- October 16, 17, 18

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8.0 QUANTITATIVE MONITORING METHODS

Quantitative monitoring was conducted in all restoration areas to document native plant establishment during the reporting period. Monitoring methods vary, depending on the investigation activity.

8.1 Native Plant Species Richness Methods (All Activities)

Field logs and species lists for vascular plants and wildlife are maintained and updated on a routine basis during each monitoring visit. Documentation includes conditions prior to investigation activities and subsequent to activities.

For non-HMP shrub species, the number of expected shrub species after a given activity type when compared with baseline numbers is used as a performance metric in the HRP for Activities B, C and D, based on performance targets in the HRP (Table 3-3).

For HMP shrub species richness metrics, a maximum value of three species was established in the HRP as the baseline. The number of HMP shrub species present in each location for each activity type is compared with this baseline, based on performance targets in the HRP (Table 3-3).

Plant nomenclature follows the *Jepson Manual: Vascular Plants of California*, Second Edition (Baldwin et al. 2012). In addition, pertinent volumes of the *Flora of North America* (Flora of North America Editorial Committee, eds. 1993+) are also utilized for plant identification. Nomenclature for bird species follows the most recent taxonomy as reflected in the 1983 American Ornithologists' Union (AOU) *Check-List of North American Birds* and published supplements through 1998.

8.2 HMP Shrub Species Frequency Methods (Activities B, C, and D)

HMP shrub species frequency is calculated based on the number of transects in which a given HMP species appears divided by the total transects in a given sampling location.

8.3 HMP Herbaceous Species (Annuals and Herbaceous Perennials) Presence and Density Methods (All Activities)

General reconnaissance surveys for HMP herbaceous species are conducted throughout North Range 44, South Range 44, and Range 47 during the peak flowering period for each species.

HMP herbaceous species are monitored along ingress/egress corridors, in Range 44, and in Range 47 Subarea C using plot counts according to the 2009 vegetation monitoring protocol (Burleson 2009); the 2009 protocol describes the use of meandering visual surveys to identify the presence and size of HMP annual species stands/colonies.

For Monterey spineflower, population size was sampled in 52 grid cells that were affected by activities as well as in one control (reference) grid cell. For Monterey gilia, population size

was sampled in 65 grid cells as well as in one control (reference) grid cell. For seaside bird's-beak, population size was sampled in 43 grid cells as well as in one control (reference) grid cell. Coast wallflower individuals were documented in 8 grid cells as well as in two control (reference) grid cells.

Numbers of individuals were either counted directly, or, in areas with high population density, were sampled with circular plots (8.2 feet, or 2.5 m radius) following the 2009 vegetation monitoring protocol (Burleson 2009). Where individuals were concentrated in only a portion of a grid cell, the stands/colonies were mapped with a hand-held GPS unit. In parts of Range 44 and along remediation ingress/egress corridors the plot shape is adjusted to fit the shape of the disturbance area. In accordance with the HRP, HMP plants are counted in each monitoring plot every year for seven years after habitat disturbance.

8.4 Container Plant Survival Methods (Range 47 Restoration Area – Subarea B, Activity D)

Initial container plant censuses were performed after plant installation between 12 March and 03 April 2013. All live installed plants were recorded within planting cells; planting cells were subdivided into 10-foot wide transects to facilitate the census process. This census was conducted approximately one month after planting was complete because many hundreds of container plants were either very immature at the time of planting, damaged, or consisted of cuttings that had not fully rooted. Therefore, there is a difference between the number planted in February 2013 and those still alive in March and early April 2013; the latter number was used as the baseline for container plantings.

The first-year container plant survival census was performed between 05 August and 04 September 2013. The monitoring protocol for the first-year survival census was essentially the same as for the baseline; however, it also included identification and quantification of naturally recruited volunteers of container-grown species. In order to differentiate the container plants from the recruited volunteers, ESCA RP biologists used characteristics such as: size, growth form, second year wood, soil smoothing around container plants, stakes/flags, or other diagnostic features. Many of the recruited volunteers grew rapidly in spring and summer 2013 and were equal in size to container plantings at the time of the summer census.

8.5 Salvaged Shaggy-barked Manzanita Monitoring Methods (Range 47 Restoration Area – Subarea A and B, Activity D)

Monitoring of salvaged shaggy-barked manzanitas was performed immediately after transplanting to assess the size and health of individual plants and to record the GPS position of each plant. A stake was pounded into the ground near the transplant, and the transplant was flagged and labeled with a unique identification number. Plants were classified as small, medium, or large. Small plants ranged from 6 – 12 inches (15.2 to 30.5 cm) in height; medium plants ranged from 12 – 18 inches (30.5 to 45.7 cm) in height; and large plants were 18 inches (45.7 cm) or taller. A few plants were classified as large even though they were somewhat shorter than 18 inches (45.7 cm) because they were wide and had a thick burl or woody base. Plant health assessment was identified as one of the following: good, fair, poor,

bad, and dead. Salvaged manzanitas were assessed on 03 January 2013, 26 January 2013, 01 May 2013, 24 July 2013, and 17-18 September, 2013, with a census during the September monitoring event.

8.6 Native Vegetation Cover Methods (Activities B, C, and D)

Shrub and herbaceous vegetation cover in areas subjected to munitions response activities are measured in 164-foot-long (50-meter-long) line-intercept transects. Transects are concentrated in central maritime chaparral communities (Figure 9).

Prior to transect installation, site history and aerial images are reviewed, followed by vegetation mapping. Differences in stand age, plant diversity, or other characteristics are documented in order to stratify transect placement into areas that are likely to have distinct species composition and distribution. A random number generator is used to 1) select a grid cell (total number of grid cells in strata), 2) select the quadrant of the grid cell for transect starting point (1-4), and 3) select which compass direction in which to align the transect from the starting point (0-360 degrees). If a transect location is randomly selected and overlaps another transect, it is discarded and a new transect location is chosen.

Aerial cover by shrub and tree species is recorded on data sheets for all individuals that intercept the 50-m monitoring tape; all layers of shrub and tree species cover are recorded, so there may be two or more species recorded in the same location. Herbaceous cover is only recorded in the absence of shrub or tree overstory, as per the 2009 protocol (Burleson 2009). Cover by herbaceous plants in areas lacking a shrub canopy are not recorded by species but are combined as "herbaceous cover," also called vegetated ground. However, beginning in 2013, a species list of herbaceous species is kept for each transect. Bare ground and/or litter is recorded in transect segments devoid of vegetation. Waypoints obtained from a GPS unit are recorded for each end of the transect so that the same transect can be revisited in subsequent years. A photograph is taken from one end.

Modifications to the 2009 vegetation monitoring protocol were necessary for the 2012 IAR MRA baseline surveys because safety concerns prevented ESCA RP biologists from entering the SCAs and NCAs to establish baseline vegetation conditions. In order to establish baseline vegetation conditions for the SCAs and NCAs, a proxy approach was developed that involved establishing reference monitoring plots and transects in areas close to the SCAs/NCAs that contain similar vegetation. The IAR MRA-wide shrub and herbaceous cover baseline was developed from data gathered from 29 164-foot-long (50-meter-long) transects located throughout the IAR MRA in similar-appearing central maritime chaparral. Some of these were follow-up monitoring transects from previous monitoring associated with Army remediation in 2004.

In 2013 new shrub and herbaceous cover transects were established in IAR MRA North Range 44 and Range 47 Subarea A and B. Shrub and herbaceous cover transects established in 2012 were revisited in South Range 44 SCA/NCA and Range 47 Subarea C. Some shrub and herbaceous cover transects established in North Range 44 were shorter than 164 feet (50 m) in length, when the area excavated during munitions investigation activity was shorter than the standard transect length. For example, shrub and herbaceous cover transects were

established in previously excavated areas in North Range 44. These four transects ranged from 32.8 feet (10 m) to 60.7 feet (18.5 m) in length.

Supplemental herbaceous 2.7 square-foot (0.25 m^2) quadrats are installed if transects contain high cover of herbaceous species and/or a low cover of shrubs, following the Army's 2009 sampling protocol (Burleson 2009). ESCA RP biologists use approximately 50% cover of herbaceous species as the threshold for establishing quarter meter plots. Supplementary herbaceous quadrats are placed on alternating sides of each transect every 32.8 feet (10 m) for a total of six plots per transect. Percent aerial cover for all plant species in the plot is recorded. If any HMP annuals occur within the quadrat, number of individuals are counted and recorded. Baseline data may not be available for quadrats.

Vegetation types are characterized by using the *Manual of California Vegetation, Second Edition* (Sawyer et. al 2009), legacy plant community descriptions by Holland (Holland 1986), and the California Natural Diversity Database (CNDDB; CDFW 2013).

8.7 Target Weed Cover Methods (All Activities)

Several weedy species found at the site are listed by the California Invasive Plant Council as invasive weeds (Cal-IPC 2006). Three target weeds are given priority attention during monitoring events, pampas and/or jubata grass (*Cortaderia selloana, C. jubata*), French broom (*Genista monspessulana*), and iceplant (*Carpobrotus* spp., especially *C. edulis*).

In Range 44 and Range 47, cover by non-native species was recorded during vegetation transects, and also estimated visually during monitoring events. In Range 47 Subarea A and B, however, once non-native species were observed, they were usually immediately removed or targeted for subsequent removal.

9.0 QUANTITATIVE MONITORING RESULTS

Results of quantitative monitoring for species richness, HMP shrub frequency, HMP herbaceous species presence and density, container plant survival, salvaged manzanita survival, native vegetation cover, and target weed cover are provided in this section.

9.1 Native Plant Species Richness Results

Comparisons of plant species diversity prior to munitions response action and subsequent to activities are provided in this section and are shown in Table 9-1. Observed species in the IAR MRA work areas are summarized in Table 9-2. A comparison of number of HMP plant species observed prior to munitions response action and subsequent to activities is provided in Table 9-3. Where required in the HRP, the percentage of non-HMP shrub species present in each location is compared with this baseline (Table 9-4). For HMP shrub species richness metrics, a maximum value of three species was established in the HRP as the baseline. The percentage of HMP shrub species present in each location is compared with this baseline in Table 9-4. HMP herbaceous species are discussed in more detail in Section 9.3.

9.1.1 Ingress/Egress Routes (Activity A) in IAR MRA

Fourteen native species were documented along ingress/egress routes prior to munitions response action. The same number of species was documented subsequent to munitions response action. There is no performance standard for overall plant species richness for ingress/egress routes.

Monterey spineflower and Monterey gilia have been observed growing along ingress/egress routes prior to munitions response action, although Monterey spineflower is observed more frequently. In 2013, Monterey spineflower, Monterey gilia, and seaside bird's-beak were documented in small numbers along ingress/egress routes in the IAR MRA during and after munitions response action (Tables 9-3, 9-6 to 9-11).

The frequency of Monterey spineflower and Monterey gilia along ingress/egress routes in 2013 is consistent with the Year 1 performance target in Table 3-3.

9.1.2 Vegetation-Cut Areas (Activity B) in Range 44 and Range 47 Subarea C

A total of 100 native species were documented in Range 44 and Range 47 Subarea C prior to munition response action, including 23 shrub species (Table 9-4). Subsequent to vegetation cutting and target-specific excavation activities, the total number of species in these areas dropped to 79 and the number of shrub and subshrub species dropped to17 in Year 1, primarily as a result of removal of obligate seeding species and species with fleshy fruits. Shrubs and subshrubs not present immediately after vegetation cutting and target-specific excavation include dune-heather, California coffeeberry, chaparral currant (*Ribes malvaceum*), and fuchsia-flowered gooseberry (*Ribes speciosum*).

The 14 non-HMP shrub species present after vegetation cutting activities in Year 1 (100% of the baseline shrub number target) is comparable to the Year 7 performance target for non-HMP shrub species (Table 9-4).

A total of six HMP species were documented in Range 44 prior to vegetation cutting: sandmat manzanita, Eastwood's ericameria, Monterey ceanothus, Monterey spineflower, Monterey gilia, and seaside bird's-beak. In 2013 after vegetation cutting, the same six HMP species were observed in South Range 44 and all of these species plus a seventh HMP species were mapped in North Range 44. A previously unreported colony of approximately 65 individuals of coast wallflower (*Erysimum ammophilum*) was discovered in Year 1 post-activity vegetation-cut areas in May 2013 in North Range 44. This HMP herbaceous perennial species was discovered in Year 1 post-activity vegetation-cut areas in May 2013 (Figure 8d, ESCA RP Team 2014).

Three HMP shrub species were documented in Range 44 and Range 47 Subarea C both before and after vegetation cutting, either due to resprouting or seedling germination: sandmat manzanita, Eastwood's ericameria, and Monterey ceanothus (seedlings and juveniles).

The presence of all three HMP shrubs in North Range 44, South Range 44, and Range 47 Subarea C in 2013 is consistent with the Year 7 performance target for HMP shrub species richness for areas subject to Activity B (Tables 3-3 and 9-4).

9.1.3 Small-scale Excavation Areas (Activity C) in Range 44 and Range 47 Subarea C

Central Maritime Chaparral: A total of 100 native species were documented in Range 44 and Range 47 Subarea C in central maritime chaparral vegetation prior to munition investigation activities, including 23 shrub species (Table 9-4). Subsequent to small-scale excavation activities (Activity C), the total number of species in these areas dropped to 24 in Year 1 and the number of shrub and subshrub species dropped to 8. The decrease in species diversity may be a result of removal of the burls and root systems of existing shrubs and perennial species, the mixing and redistribution of topsoil and subsoil layers, and the time it takes for a newly excavated area to be recolonized via seed dispersal from the surrounding area.

The seven non-HMP shrub species present after vegetation cutting activities (50% of the baseline shrub number target) is consistent with the Year 7 performance target for non-HMP shrub species (Tables 3-3 and 9-4).

Three HMP shrub species were documented in these areas before small-scale excavation activities. Seedlings of two HMP shrub species, sandmat manzanita and Monterey ceanothus (seedlings and juveniles), have appeared after small-scale excavation activities in both North Range 44 and South Range 44 NCAs and SCAs (Table 9-3).

The presence of two HMP shrub species (66.7% of the baseline HMP shrub target) is comparable to the Year 7 performance target for HMP shrub species richness for areas

subject to Activity C. Also present after small-scale excavation activities in North Range 44 were three HMP annuals: Monterey spineflower, Monterey gilia, and seaside bird's-beak.

In South Range 44, Monterey spineflower and Monterey gilia were present after small-scale excavations, which is consistent with the Year 1 performance targets for HMP annual species presence.

Grassland: A small grassland area in South Range 44 supported 18 native species both before and after munitions response action.

Total species richness compares favorably with the Year 7 performance target for this grassland area. Monterey spineflower was present before and after munitions response action, which is consistent with the Year 1 performance target for Monterey spineflower species presence.

9.1.4 Large-scale Excavation Areas (Activity D) in Range 47 Subareas A and B

A total of 25 native species were documented in Range 47 Subareas A and B prior to munition response action. Access to Range 47 was limited prior to munitions response action for biological surveys, which may have contributed to the paucity of species recorded for these areas, which were primarily woody species.

In 2013, approximately 113 native species were recorded in Range 47 Subarea B after soil replacement, planting, and seeding, and 47 native species were recorded in Subarea A after soil replacement and seeding.

Subarea B: Subarea B plant diversity includes five species of trees, including one existing coast live oak tree (*Quercus agrifolia*), and seedlings of Pacific madrone (*Arbutus menziesii*), arroyo willow (*Salix lasiolepis*), black cottonwood (*Populus trichocarpa*), Monterey pine (*Pinus radiata*), and Monterey cypress (*Hesperocyparis macrocarpa*).

Twenty-five shrub and subshrub species currently occur in the Subarea B restoration area, eight more species than the 17 shrub species that were planted, which includes three planted HMP shrub species. A total of 22 shrub and subshrub species were recorded in Range 47 prior to munitions response action, and the HRP requires a minimum of 8 non-HMP shrub species and three HMP shrub species to be present after restoration implementation.

Shrub species diversity in Subarea B compares favorably with performance targets for all years (Tables 3-3 and 9-4).

Although there is no performance target for herbaceous plant species diversity in the Range 47 Restoration Area, the presence of 83 native herbaceous species mimics the elevated diversity of herbaceous species often recorded after wildfire. Many of the species have not been previously recorded in the surrounding area but were likely present in low numbers or as dormant seed. Surrounding areas supported fewer than 20 native herbaceous species at the same time that the high diversity of native annuals and herbaceous perennials were observed in the Range 47 Restoration Area.

Four of the annual species observed in the Range 47 Restoration Area may have been accidentally introduced by the hydromulching company. Although the contractor was asked to provide a clean tank prior to work in Range 47, wildflowers and/or garden plants typical of commercial mixes appeared in the Range 47 Restoration Area that have not been previously reported in the former Fort Ord area.

Two HMP annual species were documented in Subarea B prior to soil excavation and replacement: Monterey spineflower and Monterey gilia. Both species have appeared as seedlings from soil seedbank after soil replacement and have been planted as well. Details are provided in Section 6 and Section 9.3.4. In addition, one individual of seaside bird's-beak, an HMP annual species, not observed in this area prior to munitions response action, germinated from the soil seedbank in spring 2013 and flowered in summer 2013.

The Monterey spineflower and Monterey gilia presence data in Range 47 Subarea B are consistent with the Year 1 performance targets for HMP annual species presence.

Subarea A: Prior to soil replacement in Range 47 Subarea A, 12 native shrub and subshrub species were documented in this subarea, including at least two HMP shrubs: sandmat manzanita and Monterey ceanothus. Monterey spineflower and Monterey gilia were also noted.

Although Subarea A vegetative cover and species diversity has been reportedly low for decades (less than 10%), the topsoil from this area was removed during remedial activities and mixed with topsoil from Subarea B and Range 44 before soil replacement. Subsequent germination and plant establishment in this area has been vigorous in the past year. Seedlings and juveniles of 18 native shrub species appeared in Subarea A, including three HMP shrubs (sandmat manzanita, Monterey ceanothus, and Eastwood's ericameria), along with two HMP annuals (Monterey spineflower and Monterey gilia).

Shrub species diversity and Monterey spineflower presence in Subarea A compare favorably with performance targets for all years (Tables 3-3 and 9-4).

9.2 HMP Shrub Species Frequency Results

HMP shrub species frequency data were gathered during vegetation transect sampling. Frequency is a measure of evenness of a given species distribution, that is, how frequently a given species occurs in a sample across a site. In this case, HMP shrub species is calculated based on the number of transects in which a given HMP species appears divided by the total transects. Performance targets for HMP shrub species frequency are included in the HRP for Activities B and D, with current data shown in Table 9-5.

9.2.1 Vegetation-Cut Areas (Activity B) in Range 44 and Range 47 Subarea C

All three HMP shrub species found in the IAR MRA (sandmat manzanita, Monterey ceanothus, and Eastwood's ericameria) were present after vegetation cutting and associated munitions response action in 2013 (Table 9-5). Monterey ceanothus and sandmat manzanita

exhibited the highest frequency of these three HMP shrubs in Year 1 post-activity Range 44 transects, a pattern that extended to South Range 44 as well.

Monterey ceanothus, sandmat manzanita, and Eastwood's ericameria frequencies are consistent with the Year 7 performance target for HMP shrub frequency for all areas (Tables 3-3 and 9-5).

9.2.2 Large-scale Excavation Areas (Activity D) in Range 47 Subarea B

All three HMP shrub species found in the IAR MRA (sandmat manzanita, Monterey ceanothus, and Eastwood's ericameria) were planted from containers and also produced volunteer recruits. Monterey ceanothus exhibited the highest frequency of the three HMP shrubs in the Range 47 Restoration Area (31%), followed by sandmat manzanita (21%), and Eastwood's ericameria (17%). Both Monterey ceanothus and sandmat manzanita produced many volunteer recruits, and both have seeds that often require fire or scarification treatments in order to germinate, a process that may have been facilitated by the sifting activity during munitions response action. Germination studies of the fire-induced response of Eastwood's ericameria suggest that seed viability of this rare species is low in general and that this species does not respond to fire-related germination cues (Detka and Lambrecht 2010).

Monterey ceanothus and sandmat manzanita frequencies are consistent with the Year 7 performance target for HMP shrub frequency, and Eastwood's ericameria exceeds the Year 5 performance target for HMP shrub frequency.

9.3 HMP Herbaceous Species (HMP Annuals and HMP Herbaceous Perennials) Presence and Density Results

Comparisons of HMP herbaceous plant species density prior to munitions response action and subsequent to activities are provided in this section. Data for baseline conditions prior to munitions response action are shown in tables for both 2010 and 2012, but only 2012 baseline data are used for calculation of performance metrics, as specified in the HRP (ESCA RP Team 2013b).

In 2013, numbers of individuals were either counted directly in grid cells, or, in areas with high population density, small portions of grid cells were sampled with circular plots (8.2 feet, or 2.5 m radius) following the 2009 vegetation monitoring protocol (Burleson 2009) in order to obtain population estimates. Where individuals were concentrated in only a portion of a grid cell, the stands/colonies were censused and mapped with a hand-held GPS unit and the proportion of the grid cell providing suitable habitat was estimated and used for density calculations. In parts of Range 44 and along remediation ingress/egress corridors, the plot shape is adjusted to fit the linear shape of the disturbance area. In accordance with the HRP, HMP plants are counted in each monitoring plot every year for seven years after habitat disturbance.

Data are presented in Tables 9-6, 9-7, 9-8, 9-9, 9-10, 9-11, and 9-12, and include density values expressed as the number of individuals per 211 square feet (25 m^2) plot ("plot") in

order to facilitate comparisons with other 25 m^2 plot data from previous years. Data are reported separately for North Range 44, South Range 44, Range 47 Subareas A and B, and Range 47 Subarea C. Because Range 47 Subarea C is small, it was combined with North and South Range 44 in the success criteria table in the HRP (Table 3-3, ESCA RP Team 2013b). Discussion of performance targets in the following sections focuses on North and South Range 44, but data are presented for Range 47 Subarea C separately for reference only.

9.3.1 Ingress/Egress Routes (Activity A) in IAR MRA

When present, HMP annuals are concentrated primarily along the disturbed open margins of ingress/egress routes. Monterey spineflower is particularly tolerant of these disturbance conditions. In 2013 a total of 241 Monterey spineflower individuals were found along ingress/egress routes in North Range 44 and 3,349 individuals were found along ingress/egress routes in South Range 44 (Tables 9-6 to 9-12).

Monterey gilia generally occurs in lower densities than Monterey spineflower throughout its range. No Monterey gilia were found along ingress/egress routes in North Range 44 and three individuals were found along ingress/egress routes in South Range 44.

Seaside bird's-beak was only found along ingress/egress routes in South Range 44, where two individuals were located in 2013.

The presence of Monterey spineflower and Monterey gilia along ingress/egress routes in the IAR MRA is consistent with the Year 1 performance target in the HRP (Table 3-3).

9.3.2 Vegetation-Cut Areas (Activity B) in Range 44 and Range 47 Subarea C

Monterey spineflower: Monterey spineflower ranged from an average of 27.2 to 40.5 individuals per plot in the 2012 baseline sampling prior to disturbance, depending on the location, a lower number than observed in baseline sampling in 2010 (Table 9-6). In 2013, one reference grid cell was sampled, and there were 450 Monterey spineflower individuals in this grid cell, with a mean density of 19.0 individuals per plot.

North Range 44: In areas that were subject to vegetation cutting in 2012 in North Range 44, Monterey spineflower exhibited a mean density of 68.9 individuals per plot (Table 9-6). Monterey spineflower was located in 30 grid cells in Year 1 post-activity vegetation-cut areas in North Range 44 in 2013, compared with 6 in the 2012 baseline. A total of 64,228 Monterey spineflower individuals were estimated to occur in North Range 44 in areas subject to vegetation cutting.

South Range 44: In South Range 44 in areas subject to vegetation cutting in 2011, an average Monterey spineflower density of 158.6 individuals per plot (Table 9-8) was measured in 2013. Monterey spineflower was located in 3 grid cells in Year 2 post-activity vegetation-cut areas in South Range 44 in 2013, compared with 14 grid cells the 2012 baseline. A total of 3,601 Monterey spineflower individuals were estimated to occur in South Range 44 in vegetation-cut areas.

Range 47 Subarea C: In Range 47 Subarea C in areas subject to vegetation cutting in 2011, there was an average density of 7.8 Monterey spineflower individuals per plot (Table 9-10). Monterey spineflower was located in 7 grid cells in Year 2 post-activity vegetation-cut areas in Range 47 Subarea C in 2013, compared with 5 grid cells in the 2012 baseline. A total of 1,716 Monterey spineflower individuals were estimated to occur in Range 47 Subarea C in vegetation-cut areas.

In summary, Monterey spineflower density was higher in both North and South Range 44 and in Range 47 Subarea C in vegetation-cut areas in 2011 and 2012 than in the 2012 baseline. Monterey spineflower was found in 40 grid cells in vegetation-cut areas in the IAR MRA in 2013 (excluding Subareas A and B), a larger number than presence in 25 grid cells in the 2012 baseline and 43 grid cells in the IAR MRA reported in the 2010-2011 baseline, excluding Subareas A and B (ESCA RP Team 2013b).

Monterey spineflower was present in more grid cells than the 2012 baseline in Year 1 post-activity areas in North Range 44, which is consistent with the Year 1 performance target for vegetation-cut areas. Monterey spineflower was present in 75% of the combined South Range 44 and Range 47 Subarea C grid cells in Year 2 post-activity areas compared with the 2012 baseline, which is consistent with the Year 2 performance target. The presence of Monterey spineflower in areas subject to vegetation cutting compares favorably with the performance targets in the HRP for Year 1 and Year 2 post-activity vegetation-cut areas (Table 3-3).

Monterey gilia: 2012 baseline data for Monterey gilia indicate an average of 0.0 to 2.7 individuals per plot prior to disturbance, depending on location. In 2013, one reference grid cell was sampled, and there were 12.0 Monterey gilia individuals per plot.

North Range 44: In areas subject to vegetation cutting in 2012 in North Range 44, a mean Monterey gilia density of 5.8 individuals per plot (Table 9-7) was observed in 2013. Monterey gilia was located in 29 grid cells in Year 1 post-activity vegetation-cut areas in North Range 44 in 2013, compared with no grid cells in the 2012 baseline. A total of 2,329 individuals were counted in North Range 44 in vegetation-cut areas.

South Range 44: In South Range 44 in areas subject to vegetation cutting in 2011, Monterey gilia had an average density of 3.1 individuals per plot (Table 9-9). Monterey gilia was located in 8 grid cells in Year 2 post-activity vegetation-cut areas in South Range 44 in 2013, compared with 14 in the 2012 baseline. A total of 33 individuals were counted in South Range 44 in areas subject to vegetation cutting.

Range 47 Subarea C: In Range 47 Subarea C in areas subject to vegetation cutting in 2011, Monterey gilia exhibited an average density of 6.6 individuals per plot (Table 9-11) in 2013. Monterey gilia was located in 2 grid cells in Year 2 post-activity vegetation-cut areas in Range 47 Subarea C in 2013, the same number as the 2012 baseline. A total of 66 individuals were counted in Range 47 Subarea C in vegetation-cut areas.

In summary, Monterey gilia density was higher in North Range 44 in vegetation-cut areas in 2012 than in the 2012 baseline data, and was similar or insignificantly higher than baseline data in South Range 44 and Range 47 Subarea C. Monterey gilia was found in 37 grid cells in

the IAR MRA in 2013 in areas subject to vegetation cutting, almost twice as many grid cells as presence in 19 grid cells in 2010-2011, excluding Subareas A and B, as reported in the HRP (ESCA RP Team 2013b), and more than twice as many grid cells as the 16 grid cells in the 2012 baseline.

Monterey gilia was present in more grid cells than the 2012 baseline in Year 1 post-activity areas in North Range 44, which is consistent with the Year 1 performance target for vegetation-cut areas. Monterey gilia was present in 100% of the combined South Range 44 and Range 47 Subarea C grid cells in Year 2 post-activity areas compared with the 2012 baseline, which is consistent with the Year 2 performance target. The presence of Monterey gilia in vegetation-cut areas compares favorably with the performance targets for Year 1 and Year 2 post-activity vegetation-cut areas (Table 3-3).

Seaside bird's-beak: 2012 baseline data for seaside bird's-beak indicate an average of 3.3 to 9.3 individuals per plot prior to disturbance, depending on the location. In 2013, one reference grid cell was sampled, and there were 108 seaside bird's-beak individuals in this grid cell, or 8.5 individuals per plot.

North Range 44: In areas subject to vegetation cutting in 2012 in North Range 44, seaside bird's-beak exhibited a mean density of 45.4 individuals per plot (Table 9-7) in 2013. Seaside bird's-beak was located in 11 grid cells in Year 1 post-activity vegetation-cut areas in North Range 44 in 2013, compared with 9 grid cells in the 2012 baseline. A total of 4,662 seaside bird's-beak individuals were counted in North Range 44 in vegetation-cut areas.

South Range 44: In South Range 44 in areas subject to vegetation cutting in 2011, seaside bird's-beak had an estimated average density of 41.0 individuals per plot (Table 9-9) in 2013. Seaside bird's-beak was located in 3 grid cells in Year 2 post-activity vegetation-cut areas in South Range 44 in 2013, compared with 14 grid cells in the 2012 baseline. A total of 123 individuals were counted in South Range 44 in all in vegetation-cut areas.

Range 47 Subarea C: No seaside bird's-beak plants were observed in Range 47 Subarea C.

In summary, seaside bird's-beak density was higher in both North and South Range 44 in vegetation-cut areas in 2011 than in the 2013 reference plot. Seaside bird's-beak was found in 13 grid cells in the IAR MRA in 2013, compared with 21 grid cells in in 2010-2011, excluding Subareas A and B, as reported in the HRP (ESCA RP Team 2013b), 9 grid cells in the 2012 baseline for North Range 44, and 9 grid cells in the 2012 baseline for South Range 44.

Seaside bird's-beak was present in more grid cells than the baseline in Year 1 post-activity areas in North Range 44, which is consistent with the Year 1 performance target for vegetation-cut areas. Seaside bird's-beak was present in 33% of the combined South Range 44 and Range 47 Subarea C grid cells in Year 2 post-activity areas compared with the 2012 baseline, which is consistent with the Year 2 performance target. The presence of seaside bird's-beak in vegetation-cut areas compares favorably with the performance targets in the HRP for Year 1 and Year 2 post-activity vegetation-cut areas (Table 3-3).

Coast wallflower: Prior to 2013, coast wallflower had not been observed in the IAR MRA, so no reference data from previous years exists. Two reference grid cells were established for coast wallflower in North Range 44, the only location in the IAR MRA where this HMP herbaceous perennial has been observed. A total of 11 individuals were counted in the two grid cells, providing an average density of 0.1 individuals per plot (Table 9-7).

Six nearby grid cells were also surveyed for coast wallflower, and coast wallflower individuals were counted in 3 of these (50%), with an estimated average density of 0.4 individuals per plot. A total of 65 individuals were counted in North Range 44 in all.

There are no performance targets for coast wallflower presence in the HRP.

9.3.3 Small-scale Excavation Areas (Activity C) in Range 44 and Range 47 Subarea C

Monterey spineflower: Monterey spineflower ranged from an average of 6 to 40.3 individuals per plot in the 2012 baseline sampling prior to disturbance, depending on the location (Table 9-6). In 2013, one reference grid cell was sampled, and there were 450 Monterey spineflower individuals in this grid cell, with a mean density of 19.0 individuals per plot.

North Range 44: In North Range 44 in areas subject to small-scale excavations in 2012, an average Monterey spineflower density of 23.2 individuals per plot was documented in 2013 (Table 9-6). Monterey spineflower was located in 11 grid cells in small-scale excavation areas in North Range 44 in 2013, compared with 6 in the 2012 baseline. A total of 1,294 Monterey spineflower individuals were estimated to occur in North Range 44 in small-scale excavation areas.

South Range 44: In South Range 44 in areas subject to small-scale excavations in 2011, Monterey spineflower exhibited an average estimated density of 410.1 individuals per plot in 2013 (Table 9-8). Monterey spineflower was located in 4 grid cells in small-scale excavation areas in South Range 44 in 2013, compared with 14 in the 2012 baseline. A total of 7,763Monterey spineflower individuals were estimated to occur in South Range 44 in small-scale excavation areas.

Range 47 Subarea C: In Range 47 Subarea C in areas subject to small-scale excavations in 2011, none of the 3 grid cells sampled (0%) in 2013 supported Monterey spineflower.

In summary, Monterey spineflower density was higher in both North and South Range 44 in Year 1 and Year 2 post-activity small-scale excavation areas than in the 2013 reference plot. Monterey spineflower was absent in Range 47 Subarea C. Monterey spineflower was found in 15 grid cells in the IAR MRA in 2013 (excluding Subarea B) in areas subject to small-scale excavation, compared with 25 grid cells in the 2013 baseline.

Monterey spineflower densities in Year 1 post-activity areas in North Range 44 were lower than the 2012 baseline, although results were insignificantly different. Monterey spineflower was present in more grid cells in Year 1 post-activity small-scale excavation areas in North Range 44 than the baseline, which is consistent with the Year 1 performance target. Monterey

spineflower densities in Year 2 post-activity areas in South Range 44 were higher than the 2012 baseline, and it was present in 29% of grid cells compared with the baseline, which is consistent with the Year 2 performance target.

The presence of Monterey spineflower in small-scale excavation areas compares favorably with the performance targets in the HRP for Year 1 and Year 2 post-activity small-scale excavation areas (Table 3-3).

Monterey gilia: 2012 baseline data for Monterey gilia indicate an average of 1.0 individual per plot prior to disturbance. In 2013, one reference grid cell was sampled, and there were 12 Monterey gilia individuals in this grid cell, or 0.25 individuals per plot.

North Range 44: In North Range 44 in areas subject to small-scale excavations in 2012, Monterey gilia exhibited a mean estimated density of 4.4 individuals per plot in 2013 (Table 9-7). Monterey gilia was located in 10 grid cells in small-scale excavation areas in North Range 44 in 2013, compared with none in grid cells in the 2012 baseline. A total of 108 individuals were counted in North Range 44 in small-scale excavation areas.

South Range 44: In South Range 44 in areas subject to small-scale excavations in 2011, the average density of Monterey gilia was 3.7 individuals per plot in 2013 (Table 9-9). Monterey gilia was located in 3 grid cells in small-scale excavation areas in South Range 44 in 2013, compared with 14 grid cells in the 2012 baseline. A total of 11 individuals were counted in South Range 44 in small-scale excavation areas.

Range 47 Subarea C: In Range 47 Subarea C in areas subject to small-scale excavations in 2011, Monterey gilia had an average density of 1.0 individual per plot in 2013 (Table 9-11). Monterey gilia was located in 1 grid cell in small-scale excavation areas in Range 47 Subarea C in 2013, compared with 2 grid cells in the 2012 baseline. One individual was located in Range 47 Subarea C in small-scale excavation areas.

In summary, Monterey gilia density was higher in both North and South Range 44 than in the 2013 reference plot and the same as in the reference plot in Subarea C. Monterey gilia was found in 14 grid cells out of 19 grid cells surveyed (74%) in suitable areas subject to small-scale excavation the IAR MRA in 2013.

Monterey gilia densities in Year 1 post-activity areas in North Range 44 were higher than the 2012 baseline, and it was present in more grid cells than the baseline, which is consistent with the Year 1 performance target. Monterey gilia densities in Year 2 post-activity areas in South Range 44 were higher than the 2012 baseline, although the difference is not statistically significant. Monterey gilia was present in 3 grid cells compared with 14 grid cells in the 2012baseline (21%), which is consistent with the Year 2 performance target.

The presence of Monterey gilia in small-scale excavation areas compares favorably with the performance targets in the HRP for Year 1 and Year 2 post-activity small-scale excavation areas (Table 3-3).

Seaside bird's-beak: 2012 baseline data for seaside bird's-beak indicate an average of 3.3 to 9.3 individuals per plot prior to disturbance, depending on the location. In 2013, one reference grid cell was sampled, and there were 108 seaside bird's-beak individuals in this grid cell, or 8.5 individuals per plot.

In small-scale excavation areas in 2012 in North Range 44, 2 grid cells in 2013 supported seaside bird's-beak, with an estimated average density of 1 individual per plot (Table 9-7). A total of 2 individuals were counted in North Range 44 in all, and no individuals were located in South Range or in Range 47 Subarea C in small-scale excavation areas.

In summary, seaside bird's-beak density was lower in North Range 44 in Year 1 post-activity small-scale excavation areas in 2012 than in the 2013 reference plot and lower than the 2012 baseline; small-scale excavation areas lack the host plant for this root-parasite except along the margins. Seaside bird's-beak was found in 2 grid cells in the IAR MRA in areas subject to small-scale excavations. No seaside bird's-beak presence was anticipated in the performance targets for small-scale excavation in Years 1, 2, and 3.

The presence of seaside bird's-beak in small-scale excavation areas is comparable to performance targets in the HRP (Table 3-3).

9.3.4 Large-scale Excavation Areas (Activity D) in Range 47 Subareas A and B

9.3.4.1 HMP Annual Species in Replacement Topsoil

The majority of the effort to re-establish Monterey spineflower and Monterey gilia in Range 47 was concentrated in the HMP annual species polygons in Subareas A and B. These areas were seeded, spread with HMP annual seedbank, or planted with small container plantings, as discussed below in Section 9.3.4.2. However, HMP annual species germinated in the replacement topsoil that originated onsite or in nearby Range 44 (Table 9-12). A total of 274 Monterey spineflowers in 37 grid cells, 21 Monterey gilias in 12 grid cells, and one seaside bird's-beak individual germinated, flowered, and set seed in replacement topsoil in the Range 47 Restoration Area outside of the HMP annual polygons. HMP annual presence for Monterey spineflower and Monterey gilia was higher in 2013, based on grid cell frequency, than in the 2012 baseline. Seaside bird's-beak has not been reported from Range 47 before, but one individual appeared in one grid cell in 2013.

Although densities were generally low in the grid cells in which plants were observed, the numbers of HMP annuals in the Range 47 Restoration Area are expected to increase in future years from seed production by subsequent generations of these annuals.

HMP annual presence data for Monterey spineflower and Monterey gilia are consistent with the performance targets in the HRP for Monterey spineflower and Monterey gilia presence in Year 1 post-activity large-scale excavation areas (Table 3-3).

9.3.4.2 HMP Annual Polygons in Range 47 Restoration Area

Monterey spineflower and Monterey gilia were both successfully established in the Range 47 Restoration Area in HMP annual polygons, and, for both species, density was higher in seeded polygons than in seedbank polygons (Table 9-13). An estimated total of 15,647 Monterey spineflower germinated, flowered, and set seed in Monterey spineflower polygons in 2013. A total of 643 Monterey gilia also germinated, flowered, and set seed in Monterey gilia polygons in 2013.

Monterey spineflower density in the seeded polygons averaged 1,881 individuals per polygon, based on five seeded polygons, for a total of 9,405 individuals. In the six polygons receiving Monterey spineflower seedbank, an average of 1,040.3 Monterey spineflower individuals germinated, flowered, and set seed per polygon, for a total of 6,242 individuals.

These numbers exceed the 2012 baseline density for Monterey spineflower and are consistent with the performance targets in the HRP for Monterey spineflower presence in Year 1 post-activity large-scale excavation areas (Table 3-3).

Monterey gilia density in the seeded polygons averaged 120.5 individuals per polygon, based on two seeded polygons for a total of 241 individuals. In the seven polygons receiving Monterey gilia seedbank, an average of 11.7 Monterey gilia individuals germinated, flowered, and set seed in each polygon. Monterey gilia was also established in the Range 47 Restoration Area in 10 Monterey gilia container planting polygons, with an average of 32 plants per polygon.

These numbers exceed the 2012 baseline density for Monterey gilia and are consistent with the performance targets in the HRP for Monterey gilia presence in Year 1 post-activity large-scale excavation areas (Table 3-3).

In combination with the Monterey spineflower, Monterey gilia, and seaside bird's-beak individuals that germinated in replacement soil, viable colonies of reproducing HMP annual species have become established in the Range 47 Restoration Area.

9.3.5 HMP Herbaceous Species Monitoring Discussion

Central maritime chaparral is a vegetation type of particular concern in the HMP because it supports a number of rare, threatened, and endangered species populations. Herbaceous species densities vary due to changes in canopy cover, climatic variables, substrate type, presence and persistence in the seedbank, disturbance, competition from invasive species, and other variables. Observed patterns of HMP herbaceous species occurrence the IAR MRA in 2013 are summarized here.

The IAR MRA supports the largest expanse of sandhill central maritime chaparral of the three MRAs monitored in 2013, and it is here that the greatest numbers of Monterey spineflower stands are concentrated, especially in sunny openings in natural chaparral vegetation as well as immediately after one-time disturbances. Density declines in the years following disturbance for a variety of reasons, including weed competition and canopy

overgrowth, and may also be affected by repeated disturbance in the same location. Along ingress/egress routes that were in frequent use between 2011 and 2013, average 2013 Monterey spineflower densities were comparable to 2012 baseline conditions but spineflower colonies in 2013 were concentrated in four grid cells compared with nine grid cells in 2012, as expected. A similar pattern was observed for Monterey gilia observations along ingress/egress routes.

The presence of HMP herbaceous species in areas subject to vegetation-cutting followed by target-specific excavations depends on sufficient rainfall coupled with the presence of viable seeds in the seedbank that respond to the increased light and available space. In general, these HMP herbaceous species often exhibit patchy spatial patterns in a given area from year to year, and their geographic distributions in the MRAs may reflect responses to a variety of environmental characteristics that affect the density and frequency of each HMP species in the area.

In the IAR MRA, the mean densities of Monterey spineflower, Monterey gilia, and seaside bird's-beak individuals in Year 1 post-activity vegetation-cut areas in North Range 44 were higher than 2012 baseline values in all locations. Year 2 post-activity vegetation-cut areas in South Range 44 also supported higher densities of Monterey spineflower, seaside bird's-beak, and Monterey gilia individuals than 2012 baseline values, although most data differences are not statistically significant.

Grid cell presence presents these patterns in a different way. Monterey spineflower, Monterey gilia, and seaside bird's-beak were more widely distributed in Year 1 following vegetation cutting compared with the 2012 baseline; that is, they were each found in more Year 1 post-activity vegetation cutting grid cells in 2013 compared with the 2012 baseline. In contrast, these HMP species had a more patchy, reduced distribution in Year 2 post-activity vegetation-cut areas in South Range 44 in 2013, with Monterey spineflower in three grid cells compared with 14 in the 2012 baseline, Monterey gilia in eight grid cells compared with 14 in the 2012 baseline, and seaside bird's-beak in three grid cells compared with 9 in the 2012 baseline. Overall, these data suggest elevated post-disturbance densities of HMP annuals over relatively larger areas the first year or so after disturbance and a gradual decline in numbers and range in subsequent years.

Because small-scale excavations involve the removal of all above-ground and below-ground vegetative parts as well as the topsoil, native vegetation recovery after small-scale excavation depends on either the existing seedbank in topsoil, if topsoil has been salvaged and replaced, or on gradual colonization of the bare excavated areas by means of seed dispersal into the excavated area over time and the contributions of any remaining seedbank. Often, excavated areas exhibit higher cover and diversity at the immediate edge of the excavation and lower diversity in the center.

In a pattern similar to 2013 Year 1 post-activity plots in vegetation-cut areas in North Range 44, Monterey spineflower, Monterey gilia, and seaside bird's-beak exhibited higher densities in small-scale excavation areas in Year 2 post-activity when compared with the 2012 baseline; however, each of these HMP annual species were found in fewer grid cells in Year

2 than in the 2012 baseline. In all cases, most HMP annuals were observed at the outer edges of small-scale excavation areas.

Active restoration of Monterey spineflower and Monterey gilia was conducted in the Range 47 Restoration Area because of concerns that there might be insufficient seed in the replacement topsoil seedbank for re-establishment of these species. However, a total of 274 Monterey spineflower in 37 grid cells, 21 Monterey gilia in 12 grid cells, and one seaside bird's-beak individual germinated, flowered, and set seed in replacement topsoil in the Range 47 Restoration Area outside of the HMP annual polygons in 2013. As discussed in Section 9.2.2, supplemental irrigation and fencing may have played an important role in enhancing survival of HMP seedlings that germinated in the replacement topsoil seedbank. Nonetheless, these data suggest that seeds of these HMP annuals were present and viable in the topsoil, boosting genetic diversity in local colonies of these HMP annual species.

9.4 Container Plant Survival Results in Range 47 Subarea B

Survival of container plantings in Year 1 totaled 19,562 individuals, or 62% of the 31,592 container plantings, which is consistent with the 60% container planting performance target for Years 2 – 4 (Table 9-14).

High survival rates were exhibited by a number of species, including shaggy-barked manzanita, dwarf ceanothus, Monterey ceanothus, rush-rose, and coast horkelia. Chamise and golden yarrow had the lowest survival rates, a pattern observed in nurseries and in restoration efforts in other locations in coastal California as well.

Volunteer recruits of all 16 planted species germinated from the soil seedbank during the winter and spring months, boosting the quantity and density of individuals in the Range 47 Restoration Area (Figure 10). In all, an estimated total of 91,477 recruits of the 16 planted species were counted, along with thousands of individuals of additional native species not included in the planting palette. The combined total for planted and recruited individuals of the container planting palette is 111,039, or 351% of the number of individuals originally planted and counted in March 2013. The highest recruitment totals were recorded for rush-rose, black sage, coast horkelia, and dwarf ceanothus (Figure 11).

Many of these recruits germinated and grew rapidly, making it difficult to distinguish between container plantings and recruited individuals during the summer census.

9.5 Salvaged Manzanita Survival Results

One hundred and thirty-seven shaggy-barked manzanita plants were transplanted into the Range 47 Subareas A and B (Table 9-15). Of these plants, 53 were classified as small (6-12 inches [30.5 cm] tall), 64 as medium (12 to18 inches [30.5 to 45.7 cm] tall), and 20 as large (greater than 18 inches [45.7 cm] tall). Due to field implementation logistics, 21 of the 137 plants, one from Subarea A and the remainder from Subarea B, needed to be transplanted at least a second time and in some cases more than two times.

Survival data are presented on Table 9-15 and shown in Figure 12.

A total of 61 manzanita plants (44.9%) were still alive nine months after initial transplanting. Of the 137 manzanitas initially salvaged, there were 37 surviving small plants (69.8%), 23 surviving medium plants (35.9%), and one surviving large plant (5.0%) in September 2013.

Thirteen manzanitas were transplanted into Subarea A, a small portion of Range 47 that historically supported less than 10% vegetation cover (ESCA RP Team 2013b). Subarea A received replacement subsoil and topsoil similar to Subarea B during large-scale excavation activities. The remaining 124 manzanita transplants were placed in Subarea B. Five manzanitas (38.5%) survived in Subarea A nine months after transplanting, and 56 manzanita survivors (45.2%) were counted in Subarea B during the same census. The highest mortality rates in Subareas A and B were for medium and large manzanita transplants. Mortality for medium and large transplants is more pronounced in Subarea A, but the sample size is small. Twenty-one manzanitas were transplanted twice, and six of these survived (28.6 %), with small manzanitas comprising the greatest proportion of survivors.

Although large salvaged manzanitas have greater biomass and burl structure that might potentially augment survival after transplanting, a greater proportion of roots may be lost during transplanting in large plants compared with small ones. The data suggest that small plants are the best candidates for salvaging using the methods employed for this effort.

9.6 Native Vegetation Cover Results

Native vegetation in the IAR MRA is comprised primarily of central maritime chaparral, with a small grassland area located in South Range 44 SCA. Vegetation cover sampling data prior to munitions investigation activities, as well as subsequent to vegetation cutting and target-specific excavations, small-scale excavations, and large-scale excavation, are summarized in this section.

9.6.1 Vegetation-Cut Areas (Activity B) in Range 44 and Range 47 Subarea C

Central Maritime Chaparral: The entire IAR MRA was burned in 2003. The Army established initial baseline survey transects in this area in 2000 prior to this burn (Parsons 2005).

Nineteen additional ESCA RP baseline transects were established between 2010 and 2011 in the IAR MRA prior to munitions response action. These baseline transects were all located outside the SCAs and NCAs for safety reasons. Three of these transects serve as a vegetation baseline for habitat restoration in Range 47. Sixteen of these baseline transects and 11 follow-up monitoring transects, located in areas previously monitored and remediated by the Army, serve as the baseline for disturbance to habitat by munitions response action in the rest of the SCAs and NCAs in the IAR MRA (North Range 44 SCA, South Range 44/Central Area SCAs/NCAs, Range 47 SCA Subarea C, and ingress/egress corridors). Vegetation cutting was conducted in South Range 44 in 2011 and in North Range 44 in 2012 (Figure 4).

Mean shrub and subshrub cover in these baseline transects was 94.5%, with four dominant shrubs: shaggy-barked manzanita (29.3% average cover), dwarf ceanothus (20.2% cover),

Monterey ceanothus (13.5% cover), and chamise (9.0 % average cover), all of which had frequencies of 90% or greater (Table 9-16).

Follow-up vegetation monitoring transects in the IAR MRA were established in June 2012, with 16 transects located in areas of vegetation cutting and six in areas with small-scale excavation.

South Range 44: As reported in the 2012 Annual Natural Resources Monitoring, Mitigation, and Management Report (ESCA RP Team 2013a), shrub cover in 2012 dropped from 94.5% in baseline transects to 25.1% during the first year after vegetation cutting in the ten transects in South Range 44 (Figure 4; Table 9-16). Shaggy-barked manzanita (9.4 % average cover) and chamise (3.3 % average cover) had the greatest cover of any shrub species; both species are stump-sprouters from a basal burl. Other species exhibited less than 3% cover at the time of sampling after vegetation cutting. No dwarf ceanothus was present and cover by Monterey ceanothus was 0.7%, while herbaceous cover between shrubs was less than 4%. Among the native species exhibiting high frequencies (found in at least 80% of transects) in the Year 1 sampling were shaggy-barked manzanita, chamise, sandmat manzanita, black sage, and deerweed.

By 2013, shrub cover in the same ten transects in South Range 44 increased to 34.7% (Table 9-16), with a slight increase in cover by shaggy-barked manzanita (11.6%) and chamise (4.5%), as well as a variety of other shrubs such as black sage (3.5%), sandmat manzanita (2.7%), and Monterey ceanothus (1.1%). Deerweed exhibited 3.8% cover and dwarf ceanothus was beginning to recolonize the area, while herbaceous cover between shrubs remained low (less than 3%). Shaggy-barked manzanita, chamise, Monterey ceanothus, sandmat manzanita, deerweed, and rush-rose exhibited frequencies of at least 80% in the Year 2 sampling.

North Range 44: Five new transects were established in North Range 44 in 2013 in areas where the vegetation had been cut in 2012 (Figure 4). Transects had not been established in this area in 2012 due to ongoing investigation activities. The 2011 baseline data used in Table 9-16 is also used in Table 9-17.

The Year 1 data from 2013 sampling in vegetation-cut areas in 2012 in North Range 44 show the predictable drop in shrub cover to 35.2% after vegetation cutting. Unlike data from transects in South Range 44, cover data from transects in North Range 44 also include a significant herbaceous component between shrubs, adding 14% cover to bring total native vegetation cover to 49.4%. Chamise (10.2%) and shaggy-barked manzanita (7.6%) dominate and are associated with black sage (4.5%), sandmat manzanita (2.3%), and low cover by Monterey ceanothus and dwarf ceanothus, while subshrubs such as rush-rose contribute 4.4% cover. Shaggy-barked manzanita, chamise, Monterey ceanothus, sandmat manzanita, and rush-rose exhibited frequencies of at least 80% in the Year 1 sampling, along with coast horkelia, an herbaceous perennial found in 100% of the transects.

Range 47 Subarea C: Three transects were installed in Range 47 Subarea C in 2012 in areas that had been subject to vegetation cutting in 2011 (Figures 4 and 5; Table 9-18). Shrub cover in Year 1 (2012) totaled 43.2% and was clearly dominated by shaggy-barked manzanita

(30.1%), with deerweed (5.3%) and chamise (3.9%) as the primary associated shrub and subshrub species. Shrub cover increased in Year 2 (2013) to 67.2%, with 36.9% cover by shaggy-barked manzanita, 10.6% cover by chamise, and 10.5% cover by deerweed. All of these species exhibited 100% frequencies in 2013, along with two HMP shrubs - Monterey ceanothus and sandmat manzanita.

Relative cover data for all areas (Tables 9-16, 9-17, and 9-18) reveal dominance by shaggy-barked manzanita in all transects but the codominant shrub species shift, depending on whether data from the transects are baseline (prior to vegetation cutting) or post-disturbance. In the baseline data set, dwarf ceanothus and Monterey ceanothus have higher relative cover values than chamise. Post-disturbance data suggest dominance by two stump-sprouting shrubs after vegetation cutting, shaggy-barked manzanita and chamise. Obligate-seeder ceanothus species have low initial cover following disturbance, but cover for both species gradually increases after recolonization and years of growth.

The native vegetation cover in areas where vegetation was cut in 2011 is consistent with the Year 6 performance target and is close to the Year 7 target (Table 3-3).

Herbaceous quadrats were not sampled in 2013 but the following native herbaceous species were observed between shrubs in vegetation sampling: white yarrow (*Achillea millefolium*), strigose lotus (*Acmispon strigosus*), small suncups (*Camissoniopsis micrantha*), round-fruited sedge (*Carex globosa*), seaside bird's-beak, diffuse spineflower (*Chorizanthe diffusa*), Monterey spineflower, pygmy weed (*Crassula connata*), California croton (*Croton californicus*), small-flowered cryptantha (*Cryptantha micromeres*), wand woolystar (*Eriastrum virgatum*), horseweed (*Erigeron canadensis*), six-weeks fescue (*Festuca octoflora*), Mission bells (*Frittilaria affinis*), coast horkelia, tidy tips (*Layia platyglossa*), common lessingia (*Lessingia pectinata* var. *pectinata*), small tarplant (*Madia exigua*), and hooked navarretia (*Navarretia hamata subsp. parviloba*). Non-native herbaceous species include iceplant, rattail fescue (Festuca myuros), and narrow-leaved filago (*Logfia gallica*).

This vegetation type is classified as shaggy-barked manzanita chaparral (*Arctostaphylos tomentosa* Shrubland Alliance) by CNPS and CDFW (Sawyer et. al 2009). Shaggy-barked manzanita chaparral has a G2/S2 rating (6-20 viable occurrences and/or 2,000-10,000 acres [518-2590 ha] worldwide and statewide), as listed in the CDFW Natural Communities Hierarchy (CDFW 2010) and in the CNDDB (CDFW 2013). G2/S2 ratings indicate an alliance that is threatened throughout its range.

9.6.2 Small-scale Excavation Areas (Activity C) in Range 44 and Range 47 Subarea C

Central Maritime Chaparral: Five transects were installed in 2012 in South Range 44 in areas subject to small-scale excavation activities in 2011. These transects were monitored in 2012 and 2013. No small-scale excavation activities were conducted in Range 47 Subarea C.

The same 2011 baseline data was used for small-scale excavation activities as for vegetation cutting, as discussed above in Section 9.6.1.

Because all above-ground and below-ground vegetation parts are removed during this process, there are few to no burls or other subterranean stems from which shrubs and herbaceous perennials can resprout. Almost all plant species must colonize these areas by germinating from seed or other propagules. As a result, the vegetation cover during the first two years after small-scale excavation activities is below 15%, an expected outcome.

South Range 44: A total of 2.3% woody vegetation cover was measured in Year 1 and 7.5 % in Year 2 in South Range 44 (Table 9-19). Deerweed, a nitrogen-fixing subshrub frequently observed in open habitats in coastal central and southern California, had the greatest cover of any species in both years: 1.3% and 6.1%. Herbaceous cover between shrubs contributed an additional 5.1% cover in Year 1 and 6.8% in Year 2, boosting total vegetation cover to 7.5% in Year 1 and 14.4% in Year 2.

The native vegetation cover (14.4%) for small-scaled excavation areas in Year 2 after remedial activities in South Range 44 is consistent with the Year 3 performance target, despite the lack of seeding (Table 3-3).

Native cover in herbaceous quadrats in South Range 44 averaged less than 2% in Year 1 after small-scale excavations but encompassed 12 native herbaceous species in the 30 quadrats sampled. Only 0.3% non-native cover was measured in these quadrats (Table 9-21). In Year 2 after small-scale excavations, total native cover increased slightly to 3.9%, with shrubs and subshrubs (especially deerweed) averaging 2.3% cover and herbaceous species averaging 1.6% cover. Only 0.5% cover was provided by nonnative species. There were 16 native herbaceous species in Year 2, an increase in species diversity. Of the 22 native herbaceous species recorded during the two years after vegetation cutting, 16 (73%) were found only in South Range 44 during sampling and not in North Range 44.

In Year 1, the diminutive native grass, six-weeks fescue, had low cover but was found in almost half of the quadrats. Most other species occurred in low frequencies, although several species were found with low cover in 20-25% of all quadrats. These include native species (strigose lotus, diffuse spineflower, and small-flowered cryptantha) and non-native species (red-stemmed filaree [*Erodium cicutarium*] and smooth cat's ears [*Hypochaeris glabra]*).

In Year 2, the subshrub deerweed had the greatest average cover at 1.6%, followed by another sub-shrub, rush-rose, at 0.6%. Both of these native species readily colonize bare sandy areas after fire or disturbance and these two species occurred in one-third or more of all quadrats sampled. Monterey spineflower had the greatest cover of any herbaceous species at only 0.3%, and was found in 16.7% of quadrats. Six weeks fescue occurred in half of the Year 2 quadrats, with hooked navarretia observed in 30% of quadrats, and diffuse spineflower and small-flowered cryptantha observed in 20% of quadrats. Other herbaceous species had lower frequencies.

North Range 44: Eight new 2013 transects were placed in North Range 44 in areas subject to small-scale excavation activities in 2012. Year 1 vegetation cover in these newly excavated areas was 2.8%, with most cover provided by herbaceous species (Table 9-20). Cover and frequency data indicate germination by several shrubs, despite low cover in Year 1, including

shaggy-barked manzanita, dwarf ceanothus, Monterey ceanothus, sandmat manzanita, and others. Unlike South Range 44, North Range 44 transects show little cover by deerweed.

Cover in herbaceous quadrats in areas subject to small-scale excavations in North Range 44 averaged 1.4% in Year 1, with about 0.9% native cover and 0.5% non-native cover (Table 9-22). Native woody cover averaged 0.5% in Year 1 after small-scale excavations. Small numbers of woody seedlings or sprouts of small pieces are appearing, with sandmat manzanita exhibiting the highest frequency (13.9%) but negligible cover. The cover values are expected to increase quickly through time as the newly recruited seedlings enlarge in size.

Unlike in Central and South Range 44, with 22 native herbaceous species in the 30 quadrats, 13 native species were observed in the 48 herbaceous quadrats in North Range 44 during sampling. Approximately half of these species were found only in North Range 44 and the other half were herbaceous species that were sampled in both North and South Range 44.

The native vegetation cover (2.8%) for small-scaled excavation areas one year or less after remedial activities is consistent with the Year 1 performance target, despite the lack of seeding. The lower cover in Year 1 small-scale excavation samples in 2013 compared with 2012 may be a reflection of the subnormal rainfall in winter and spring 2013. A total of 3.2 inches (9.1 cm) of precipitation fell between January and June in 2013.

This vegetation type is classified as shaggy-barked manzanita chaparral (*Arctostaphylos tomentosa* Shrubland Alliance) by CNPS and CDFW (Sawyer et. al 2009). Shaggy-barked manzanita chaparral has a G2/S2 rating (6 to 20 viable occurrences and/or 2,000-10,000 acres [518-2590 ha] worldwide and statewide), as listed in the CDFW Natural Communities Hierarchy (CDFW 2010) and in CNDDB (CDFW 2013). G2/S2 ratings indicate an alliance that is threatened throughout its range.

Grassland: Baseline herbaceous vegetation cover in grassland vegetation in South Range 44 averaged 68% in three herbaceous quadrats, with 33.7% native vegetative cover and 34.3% non-native vegetative cover (Table 9-23). Both the native coast tarplant (*Deinandra corymbosa* subsp. *corymbosa*) and non-native rattail fescue were found in all baseline quadrats, with average cover of 17% and 17.7%, respectively. The HMP annual Monterey spineflower averaged 16.7% cover. Nine species were recorded during baseline sampling.

In Year 1 after small-scale excavation activities, overall cover dropped to 9.2% in six herbaceous quadrats, split almost equally between native herbaceous species and weedy annual grasses and forbs. No single species exhibited greater than 2% average cover, and species with the greatest cover included coastal tarplant, rattail fescue, Monterey spineflower, and smooth cat's ear. Smooth cat's ear was the only species found in all six herbaceous quadrats.

In Year 2 after munitions investigation activities, total average vegetative cover in six herbaceous quadrats exceeded baseline cover at 83.7%, with 59.8% of the vegetative cover comprised of non-native species and 28.8% comprised of native species. The non-native annual grasses, rattail fescue and ripgut brome (*Bromus diandrus*), had the greatest cover at 25.1% and 21.1%, respectively, followed by Monterey spineflower with 7.2% cover and a

frequency value of 68.7%. Tidy tips, sky lupine (*Lupinus nanus*), and California poppy (*Eschscholzia californica*) contributed an average of 5.5%, 3.5%, and 3.4% to native annual cover, respectively. A total of 16 native species occurred in the six herbaceous quadrats. No native grasses occurred in the sampling area.

The Year 2 grassland vegetation cover is consistent with the Year 7 performance target (Table 3-3). Nineteen species were recorded in the grassland herbaceous quadrats and 16 of these taxa are native, consistent with the Year 7 performance target. Monterey spineflower presence is also consistent with the performance target for all years and no target weeds species were observed.

This vegetation type is classified as annual brome grasslands (*Bromus diandrus, hordeaceus* Semi-Natural Herbaceous Stands) by CNPS and CDFW (Sawyer et. al 2009). Annual brome grasslands have no threat ratings, as listed in the CDFW Natural Communities Hierarchy (CDFW 2010) and in CNDDB (CDFW 2013).

9.6.3 Large-scale Excavation Areas (Activity D) in Range 47 Subareas A and B

Prior to munitions response action in Range 47, baseline vegetative cover in Subarea B averaged 72.0% and was dominated by dwarf ceanothus (21.1%), shaggy-barked manzanita (20.8%), with coyote bush (13.9%) and Monterey ceanothus (12.6%) comprising the most common associates (ESCA RP Team 2013b). Non-native pampas grass and iceplant, both HMP target weeds, were also scattered in openings between shrubs.

Average vegetative cover was lower in Subarea A prior to remedial activities, 10% or less (ESCA RP Team 2013b). Non-native pampas grass was abundant in places. Historical aerial imagery indicates that the vegetation of the area has changed little since the 1970s, despite an apparent lack of recent disturbance, except for fire that has affected the whole range.

After soil sifting and replacement in 2012, the vegetation cover in the Range 47 Restoration Area was zero prior to planting and seeding in early 2013. Seven new vegetation transects were established in Subarea B on 25, 26, and 27 June 2013. These transects were placed in areas that were planted with container plantings and received regular irrigation. HMP annual species planting polygons were avoided during vegetation sampling.

Subarea B: Total vegetation cover in Subarea B irrigated planting areas in June 2013 was 32.3%, with 16.7% cover by shrubs and subshrub and 15.6% cover by herbaceous species (Table 9-24). Initial cover was highest among native species that are typical of post-fire habitats, such as deerweed (7.1%), coast tarplant (3.5% cover), red maids (*Calandrinia ciliata*; 2.6% cover), and rush-rose (2.1% cover).

The relatively high cover provided by smaller herbaceous species and subshrubs is expected to shift in the coming years to a shrub-dominated community, based on the high frequency of healthy shrub seedlings and juveniles that currently exhibit low cover but will increase in size through time. Native shrubs and subshrubs that occurred in 70% or more of the transects include: deerweed, chamise, sandmat manzanita, coyote bush, dwarf ceanothus, Monterey ceanothus, dune-heather, rush-rose, bush monkeyflower, and black sage. Native herbaceous

species found in 70% or more of the transects include: red maids, small suncups, diffuse spineflower, Monterey spineflower, small-flowered cryptantha, coast tarplant, horseweed, coast horkelia, hooked navarretia, and blue toad-flax (*Nuttalanthus texana*).

A comparison of HMP species frequency between baseline and Year 1 conditions reveals establishment and site-wide distribution for several sensitive HMP species in the Range 47 Restoration Area. Of the four HMP species present in baseline sampling, three of the four species, sandmat manzanita, Eastwood's ericameria, and Monterey spineflower, occur in higher frequencies in 2013 in the Range 47 Restoration Area than in baseline conditions. Only Monterey ceanothus has slightly lower frequencies currently than in baseline conditions.

Vegetation cover in the Range 47 Subarea B restoration area currently is consistent with the Year 6 performance target of 30% for this performance metric.

In order to evaluate the effectiveness of irrigation in boosting native plant cover in container planted areas in Subarea B, one transect in an unirrigated fenced grid cell in Subarea B was sampled in June 2013 (Table 9-25). Total vegetative cover in this unirrigated fenced transect was 24.6%, in comparison with 32.3% average cover in irrigated fenced transects. Shrub and subshrub cover averaged 14.5% in the unirrigated transect, compared with 16.7% in the irrigated transects. There were fewer native herbaceous species (10 species) in the unirrigated transect compared with the irrigated transects (35 species), a factor that was also observed qualitatively throughout the unirrigated fenced grid cell. Herbaceous cover averaged 10.2%, about 40% lower than the 16.7% herbaceous cover in the irrigated transect. Irrigation and fencing appears to benefit woody plant establishment and herbaceous species cover and diversity at this restoration site.

An unfenced irrigated grid cell in Subarea B was also created to assess the potential effects of herbivory on native plant establishment (Table 9-25). Total vegetative cover in this unfenced irrigated transect was 13.6%, in comparison with 32.3% average cover in irrigated fenced transects. Shrub and subshrub cover in one transect established in the unfenced irrigated grid cell was 10.9%, compared with 16.7% in the irrigated and fenced transects and 14.5% in the unirrigated but fenced transect. The unfenced irrigated area supported nine native herbaceous species, compared with 35 native herbaceous species in irrigated and fenced transects and 10 in the unirrigated fenced transect. Herbaceous cover was only 2.7% in the unfenced transect, suggesting that herbivory likely plays an important role in limiting native plant establishment and growth during the initial phase of habitat restoration in unfenced areas.

Subarea A: Subarea A, an area that historically exhibited low vegetation cover (less than 10%), received the same subsoil and topsoil replacement as Subarea B in December 2012 and was fenced, irrigated, and seeded in January 2013, but did not receive container plantings. Total vegetative cover in one transect in Subarea A in June 2013 was 16.9%, in comparison with 32.3% average cover in irrigated fenced transects in Subarea B that received container plantings (Table 9-27). Approximately 6.9% of the vegetative cover in Subarea A was from newly established shrubs and subshrubs from seed, with the remaining 10% cover contributed by 21 native herbaceous species, including the HMP annual, Monterey spineflower and a few Monterey gilia individuals.

Herbaceous quadrat data reveal a similar pattern, with the highest shrub cover in irrigated, fenced planting areas in Subarea B, followed by fenced planted areas with no irrigation. The lowest cover was measured in unfenced, irrigated planted areas (Tables 9-26 to 9-29).

When comparing data from different planting treatments in the Range 47 Restoration Area (fenced/unfenced, irrigated/unirrigated, container planting/seeding), herbaceous species establishment and diversity was highest in the fenced, irrigated, and planted soil replacement area in Subarea B, followed by the fenced, irrigated and seeded soil replacement area in Subarea A. The quantity of species that germinated from the replacement seedbank surpassed expectations, with 113 native species observed in Subarea B and 45 native species in Subarea A (see Section 9.1.4). All planted species produced volunteer recruits, presumably from the soil seedbank since most species did not have time to flower and set seed between February and June 2013, when the sampling took place.

The vegetative cover in Subarea A compares favorably with the Year 7 performance target of 10%. Monterey spineflower and Monterey gilia are present in Subarea A, including in the vegetation transect, which is consistent with that performance target. Eighteen native shrub and subshrub species compares favorably with the shrub species performance target for all years. Target weed cover is less than 5% (currently at zero due to weed abatement activities).

9.6.4 Vegetation Monitoring Discussion

Different types of munitions response actions have different effects on maritime chaparral vegetation. Vegetation cutting leaves the root systems of many stump-sprouting shrubs intact, whereas soil excavation destroys root systems of all species. These differences are consistently reflected in monitoring data. Year 1 and Year 2 post-activity data show a resurgence of dominance by stump-sprouting manzanita and chamise plants, with 25% or greater cover, and gradual recolonization by obligate-seeding shrubs (Figure 13). Subshrubs such as the nitrogen-fixing deerweed are common immediately after vegetation cutting in some areas, along with rush-rose, which also tolerates disturbance of various types. Canopy cover is expected to increase exponentially over the coming years in vegetation-cut areas, and will include widespread dominants as well as HMP shrubs. Sampling data in the IAR MRA show colonization of HMP shrubs from seed.

In contrast, native vegetation recovery after excavation (small-scale or large-scale) is dependent on either the existing seedbank in topsoil, if topsoil has been salvaged and replaced, or on gradual colonization of the bare excavated areas by means of seed dispersal into the excavated area over time and the contributions of any remaining seedbank. Often, excavated areas exhibit higher cover and diversity at the immediate edge of the excavation and lower diversity in the center. Initial shrub cover is low, usually less than 2 to 3%, since it is derived from seedling growth, with a relatively higher component of herbaceous species and subshrubs providing a sparse scattering of vegetative cover (Figure 14). Once again, deerweed and rush-rose are common in small-scale excavation areas after disturbance, along with other species, including the HMP annual, Monterey spineflower. Although recovery will be slower than in vegetation-cut areas, the presence and cover of dominant species is expected to increase over time.

Vegetation transect data collected in 2013 for areas treated in 2011 and 2012 are presented in Figure 15. Total cover by species was converted to relative cover for each transect before ordination. The transects are ordered based on similarity of vegetation using principal components analysis, which reveals which species vary the most strongly depending on two activity types: vegetation cutting and small-scale excavation. The polygons enclosing each of these four groups of vegetation samples show very little overlap, indicating that each of these groups is, in terms of vegetation composition, fairly distinct from the other groups. In particular, there is no overlap between transect data for vegetation cut areas and small-scale excavation areas because the vegetation composition is clearly different between those areas. Herbaceous vegetation is more pronounced than shrub cover in small-scale excavation areas and the reverse is true in vegetation-cut transects.

9.7 Target Weed Cover Results

Ongoing weed removal efforts in the Range 47 Subareas B and A restoration areas have kept the density and cover of target weeds low during the reporting period, below 1%. After soil replacement and winter rains, iceplant seedlings appeared throughout the Range 47 Restoration Area, often in high densities, appearing every 6 inches (15 cm) to one foot (30 cm). Other weeds that appeared in unexpected numbers include Indian hedge mustard (*Sisymbrium orientale)*, tocalote (*Centaurea melitensis*), red brome (*Bromus madritensis* subsp. *rubens*), filaree (*Erodium* spp.), and others.

All are removed on a routine basis, keeping weed cover low in this area.

Target weed cover for all activity types is below 1%, based on vegetation sampling in 2013 (see Tables 9-16 to 9-27).

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10.0 CONCLUSIONS AND RECOMMENDATIONS

Construction and implementation of the restoration areas has been completed and restoration systems are in place, operational and functioning. Operation and maintenance to support the long-term success of restoration at the site is being implemented through a post-installation adaptive management process to evaluate and manage the restoration areas as described in the HRP (ESCA RP Team 2013b). The adaptive management process will be documented in an annual report, including all activities and accomplishments.

It is anticipated that most of the adaptive management effort will be directed to issues in the active restoration areas; however, monitoring data from the other areas will be evaluated via the adaptive management process to determine the need (if any) for corrective measures at those locations. Adaptive management may result in adjustments and/or additions to pre-determined protocols, methods and procedures (particularly monitoring protocols) and even to the adaptive management process itself, if needed, to accomplish its goal. Adaptive management will continue for all post-installation activities until determination of success is obtained.

Results of the habitat monitoring data are consistent with current year performance targets for all activity types (Activity A - ingress/egress routes; Activity B – above-ground vegetation cutting only, prior to target specific excavation; Activity C - small-scale soil excavation; and Activity D - large-scale soil excavation).

The initiated restoration activities are on track to achieve the prescribed performance criteria in the IAR MRA restoration area, based on the results below:

- Weed cover is less than 1%. Container plant survival (62%) is consistent with the Year 1 performance target of 60%;
- An additional 91,477 volunteer recruits of planted species augment restoration planting numbers and density;
- Species richness (5 tree species, 25 native shrub species, and 83 native herbaceous species) exceeds baseline conditions;
- Native vegetation cover exceeds 32%;
- HMP annual presence is consistent with performance targets for all areas and activity types;
- Erosion issues have been addressed; and
- Wildlife species diversity and the functional value of the restored habitat continue to increase.

Year 2 quantitative surveys will begin in spring 2014 to satisfy conditions set forth in the HRP. Restoration plantings are in good health and on a trajectory to continue increasing in size while maintaining populations of HMP annuals. Subnormal precipitation in 2013 has been offset in part by supplemental irrigation, and no restoration deficiencies have been observed at this time.

The following ongoing mitigation tasks will be performed in 2014:

Range 47 Restoration Area

- Continue aggressive weed control program
- Quantitative sampling in all restoration areas
- Conduct routine maintenance and monitoring of Range 47 Restoration Area, including irrigation, fence repair, and monitoring for erosion issues and herbivory
- Submit annual monitoring report

North Range 44 and South Range 44 Restoration Areas and Range 47 Subarea C

- Conduct weed control program for target weeds, as needed
- Quantitative sampling in all restoration areas
- Submit annual monitoring report

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APPENDIX A

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APPENDIX J

(Please see the enclosed CD)