Supplemental Environmental Assessment and
Finding of No Significant Impact

Protecting Endangered O‘ahu ‘Elepaio Using Rodenticide within Schofield Barracks Military Reservation O‘ahu, Hawai‘i

September 2017

Prepared by:
Directorate of Public Works
U.S. Army Garrison, Hawai‘i

Finding of No Significant Impact for Protecting Endangered Oʻahu ʻElepaio Using Rodenticide within Schofield Barracks Military Reservation, Hawaiʻi

AUTHORITY: Pursuant to the National Environmental Policy Act of 1969, as amended (42 USC 4321 *et seq.*) (NEPA), the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 CFR parts 1500-1508), and the Final Rule on Environmental Analysis of Army Actions (32 CFR Part 651), the United States Army Garrison, Hawaiʻi (USAG-HI) has prepared a Supplemental Environmental Assessment (SEA) to consider the environmental effects of protecting the endangered Oʻahu ʻelepaio through the use of rodenticide within the footprint of Schofield Barracks, Oʻahu, Hawaiʻi. This document supplements the 2010 Oʻahu Implementation Plan Programmatic Environmental Assessment (OIP PEA) with more specific, current information about the proposed action. The SEA is incorporated by reference in this Finding of No Significant Impact (FNSI).

PROPOSED ACTION: USAG-HI proposes to conduct the broadscale distribution of rodenticide in the Lihue Management Unit (MU) as part of an integrated management program to control rat populations that heavily predate and threaten the survival of Oʻahu ʻelepaio and other endangered native Hawaiian plants and animals.

The rodenticide application would consist of a helicopter, using a specialized suspended bucket, flying along predetermined Global Positioning System (GPS)-plotted transects within the treatment area. The rodenticide bait would be broadcast by the rotary spreader bucket as the helicopter flies along these transects. The 430 hectare (ha) treatment area is contained within a fenced enclosure located in the 714 ha Lihue MU. The rodenticide to be used would be Diphacinone-50: Pelleted Rodenticide Bait for Conservation Purposes (EPA Reg. No. 56228-35) containing the anticoagulant rodenticide diphacinone (0.005% active ingredient). Diphacinone-50 (D-50) has been approved for aerial distribution by the U.S. Environmental Protection Agency (EPA) and the Hawaiʻi Department of Agriculture (HDOA). An EPA registered and state licensed diphacinone product comparable to D-50 may be used as a supplement or in the alternative.

ALTERNATIVES CONSIDERED: The Proposed Action and No Action alternatives were evaluated in the SEA. The Proposed Action was first included as a requirement in the 2003 U.S. Fish and Wildlife Service (USFWS) Biological Opinion on Routine Military Training and Transformation of the 2nd Brigade 25th Infantry Division (Light) for installations on Oʻahu, Hawaiʻi. The Proposed Action was more specifically described in the 2010 OIP PEA.

An alternative that would solely use hand-broadcasting of rodenticide within Lihue MU was eliminated from consideration because it would not effectively meet the need to control rat populations on a broad enough scale to sufficiently aid Oʻahu ʻelepaio populations. No additional effective means of meeting the project objectives are known at this time. Therefore, only the "Proposed Action" and "No Action" alternative were considered in the SEA.

SUMMARY OF FINDINGS: The attached SEA incorporates by reference and supplements the 2010 OIP PEA. The SEA evaluated the potential environmental effects of the proposed rodenticide application project. No significant impacts are anticipated as a result of either the No Action Alternative or the Proposed Action. Table 2 of the SEA provides a summary of anticipated impacts

to each resource area analyzed. Impacts are largely anticipated to be minimized through avoidance and through the implementation of best management practices (BMPs) and procedures. Avoidance results from selecting a treatment area already closed to entry and enclosed by ungulate-proof fencing, and by maintaining an application buffer around surface waters. BMPs would include scheduling the application to avoid heavy precipitation events, closely monitoring the application rate, and using licensed applicators with close manager oversight. Army Natural Resources Program and U.S. Department of Agriculture National Wildlife Research Center managers will monitor the bait application rate, the bate availability period, bait condition, water quality, impacts to nontarget species, and the effectiveness of the Proposed Action.

Potential temporary and less than significant negative impacts may include: short-term localized impacts to air quality and the noise environment associated with helicopter operations; and a potential for short-term localized impacts to treatment area soils and surface water from the rodenticide product. Although unintended, there is potential for insignificant impacts to individual nontarget birds within Lihue MU.

The Proposed Action is the only alternative that can satisfy the purpose and need. All possible adverse impacts would be less than significant, and the project would result in substantial beneficial impact for endangered Oʻahu ʻelepaio populations in Lihue MU as well as for other endangered native and endemic species within the management unit.

Consultations with appropriate local and federal agencies have been and will continue to be conducted. Pursuant to Section 7 of the Endangered Species Act (ESA) (16 USC 1531-1544), USAG-HI has consulted with the USFWS regarding the Proposed Action. The USFWS concurred with the USAG-HI determination that the Proposed Action may affect, but is not likely to adversely affect ESA listed species or species proposed for listing. Prior to implementation, USAG-HI will obtain applicable State of Hawaiʻi and U.S. Army authorizations.

PUBLIC REVIEW: The SEA and draft Finding of No Significant Impact (FNSI) were made available for public review and comment on August 8, 2017 when a Notice of Availability was published in the Honolulu Star-Advertiser. USAG-HI issued a Media Release on August 8th as well. The Proposed Action was featured in several television and radio news broadcasts and also received online news coverage. An electronic copy of the draft FNSI and SEA was made available for download at http://www.garrison.hawaii.army.mil/NEPA/NEPA.htm and copies were also made available for public review at the following public libraries: Hawaii State Library, Waialua Public Library, Waianae Public Library, and Wahiawa Public Library.

Twenty-five (25) written comments on the draft FNSI were received within the public comment period. Nineteen (19) comments supported the Proposed Action and three were opposed; three were neutral. The comments are summarized in the Appendix to this FNSI. No substantive issues beyond those already considered in the SEA were identified through public comment. One comment opposed to the Proposed Action expressed concern about "spraying" rodenticide; another included concern with drift. The proposed rodenticide consists of solid pellets and will not be sprayed. It will be broadcast according to label instructions in winds less than 35 mph to avoid drift. One comment suggested updating the SEA reference to Executive Order (EO) 13112 on invasive species. EO 13751 replaced EO 13112 in December 2016. The updated EO includes activities described in EO 13112, albeit with slightly different wording.

CONCLUSION: Based on a careful review of the relevant portions of the 2010 OIP PEA, the Supplemental EA, to include comments received from the public, I have concluded that the Proposed Action to apply diphacinone rodenticide within Lihue Management Unit, Schofield Barracks, O'ahu, Hawai'i would not result in significant impacts to either the man-made or natural environment. Therefore, an environmental impact statement is not required and will not be prepared.

Approved By:

Stephen Dawson

STEPHEN E. DAWSON
Colonel, U.S. Army Garrison, Hawai'i
Commanding

9/14/17
Date

FNSI APPENDIX

USAG-HI Public Comment Tracker - Protecting Elepaio Using Rodenticide SEA / draft FNSI

Standard Response:
"This email confirms receipt of your comments on the proposed project to protect endangered O'ahu 'elepaio on Schofield Barracks. We greatly appreciate you taking time to review the project documents and provide your feedback. We value the community's input and will not make a final decision on the project until after reviewing public comments."

#	Report	Date of Comment	Commenter Name	Organization	Comment	Response
1	draft FNSI	8-Aug-17	Marilyn Bernhardt	Self	Emailed to PAO Box - Strongly oppose spray method to control rats. Advocate "slower but safer method of" placing "hundreds of traps manually" [to avoid harm to nontarget species].	8/10 - Emailed standard response
2	draft FNSI	14-Aug-17	Lisa "Cali" Crampton	Kauai Forest Bird Recovery Project	Emailed to PAO Box - Expresses concern for declining elepaio populations and "strong support for a broad-scale aerial application of 0.005% diphacinone rodenticide within the fenced management unit..."	8/14 - Emailed standard response
3	draft FNSI	14-Aug-17	Gary Schwiter	Self	Emailed to PAO Box - It would be nice if...a grant program could supply the public with discounted traps the homeowner would use to help reduce the overall rat population. (neutral)	8/15 - Emailed standard response
4	draft FNSI	15-Aug-17	Ryan Chang	Oahu Invasive Species Committee (OISC)	Emailed to PAO Box - "I support the army using broad-scale aerial application of .005% diphacinone rodenticide within the fenced management unit on Schofield. Like stated in the media release it will not only help elepaio but help other endangered flora and fauna."	8/15 - Emailed standard response
5	draft FNSI	23-Aug-17	Dr. Aaron Hebshi	Self	Emailed to PAO Box - "...writing to express my support for the Proposed Action..."	8/24 - Emailed standard response
6	draft FNSI	23-Aug-17	Kathy Shimata	Self	Emailed to PAO Box - "...I support your plan to use rodenticides to eliminate the rats that prey on the Elepaio. I have confidence that you will take every precaution to minimize collateral damages."	8/24 - Emailed standard response

#	Report	Date of Comment	Commenter Name	Organization	Comment	Response
7	draft FNSI	24-Aug-17	Chiemi Nagle	Limahuli Preserve Predator Control Coordinator-National Tropical Botanical Garden	Emailed to PAO Box - "I agree that trapping is not as effective in the mountainous areas of Hawaii due to the severe terrain so the next best option would be an aerial broadcast of diphacinone. I look forward to hearing the Army's final decision and to see the results, if/when completed. "	8/24 - Emailed standard response
8	draft FNSI	24-Aug-17	Seth Judge	Self	Emailed to PAO Box - "I'd like to express my support for rat control on Oahu in an effort to protect the Hawaiian Flycatcher, the Elepaio..."	8/24 - Emailed standard response
9	draft FNSI	25-Aug-17	J. Aaron Hogan	Self	Emailed to PAO Box - "I ... express my support for the rat population control project on O'ahu. As a biologist...I can testify to the detrimental effects that invasive species can have on local fauna and flora. ...this project seems well researched, warranted and implementable."	8/25 - Emailed standard response
10	draft FNSI	25-Aug-17	Katherine McClure	Self	Emailed to PAO Box - "I'm writing...in support for the...rodenticide application on Oahu. The elepaio...represents...native Hawaiian bird diversity that would be terribly sad to lose... The proposed rodenticide seems promising, and I support efforts to increase survival of elepaio using these techniques."	8/25 - Emailed standard response
11	draft FNSI	25-Aug-17	Creighton M. Litton	UH Manoa - Department of Natural Resources and Environmental Management	Emailed to PAO Box - "I [am] in strong support of the proposed project to protect native, endangered birds at Schofield Barracks with the use of rodenticide...This project has been well planned based on the best available science, and will undoubtedly result in positive benefits to native bird populations with no known negative consequences for the ecosystem."	8/25 - Emailed standard response
12	draft FNSI	27-Aug-17	James Russell	Self	Emailed to PAO Box - "I am writing a letter in support of this application. I am an international rodent control and eradication on islands expert with 15 years experience..."	8/28 - Emailed standard response
13	draft FNSI	28-Aug-17	Donald Drake, PhD	UH Manoa - Department of Botany	Emailed to PAO Box - "I am writing to express my support for the proposed initiative to use rodenticide to control non-native rodents on O'ahu to protect native birds, other native wildlife, and native plants."	8/28 - Emailed standard response

#	Report	Date of Comment	Commenter Name	Organization	Comment	Response
14	draft FNSI	23-Aug-17	Hillary Palmer	Self	Emailed to PAO Box - "I disagree with this proposal...It seems a lot of poison will need to be dropped. How much drift will there be? How will it effect people? You don't know. Please figure out a better way!" (opposed)	8/24 - Emailed standard response
15	draft FNSI	15-Aug-17	Roland [Chong]? (emailed from "Chong Family" address)	Self	Emailed to PAO Box - Asked how to get a copy of the endangered bird study done for Schofield Barracks. No other feedback or comment.	15 Aug - Responded with instructions for viewing the documents and offered to mail hardcopy if address supplied. No further contact.
16	draft FNSI	29-Aug-17	Daniel Clark	USFWS Refuge Mgr, Florida Keys National Wildlife Refuges Complex	Emailed to PAO Box - Supportive and applauds Army initiative	8/29 - Emailed standard response
17	draft FNSI	29-Aug-17	Nicole Galase	Self	Emailed to PAO Box - Supportive of project	8/29 - Emailed standard response
18	draft FNSI	29-Aug-17	Rachel Moseley	Self	Emailed to PAO Box - "Strongly" Supports project	8/30 - Emailed standard response
19	draft FNSI	29-Aug-17	Paul Krushelnycky	Self	Emailed to PAO Box - "Strongly" Supports project	8/30 - Emailed standard response
20	draft FNSI	3-Sep-17	Clare Aslan	Community Ecologist, Northern Arizona University	Emailed to PAO Box - Supportive of project	9/5 - Emailed standard response
21	draft FNSI	4-Sep-17	Daniel Gruner	University of Maryland Department of Entomology	Emailed to PAO Box - Supportive of project	9/5 - Emailed standard response
22	draft FNSI	6-Sep-17	James D. Jacobi, PhD	USGS Pacific Island Ecosystems Research Center	Emailed to PAO Box - (On USGS Letterhead) "Fully Support" proposal	9/6 - Emailed standard response
23	draft FNSI	7-Sep-17	Chris Lowrey	Self	Emailed to PAO Box - "my family and I are very concerned about the impacts of non-native rats on the populations of native wildlife. We understand there is potential for study concerning control of non-native rats, and hope the Army will support these important works as good stewards..." (tallied as neutral since clear support not stated)	9/7 - Emailed standard response
24	draft FNSI	7-Sep-17	Vince (sirquickwit@aol.com)	Self	Emailed to PAO Box - "We smell corruption…end this cruel dropping of poison!" (opposed)	9/8 - Emailed standard response.

#	Report	Date of Comment	Commenter Name	Organization	Comment	Response
25	draft FNSI	8-Sep-17	David Smith, DOFAW Administrator	DOFAW - Hawaii DLNR	Emailed to PAO Box (on DOFAW letterhead) - "DOFAW is in support of the efforts described in the proposed action." Offered two suggestions: 1) Update documents to reference EO 13751 (which replaced EO 13112 on invasive species, yet still includes the activities described in EO 13112, albeit with different wording). 2) Consider using Bell Labs' DITRAC product which "is also a 50 ppm diphacinone pellet, but utiliizes a new attractant matrix that...has...greater palatability to Pacific rats."	9/8 - Emailed standard response. Updated EO reference to be addressed in the FNSI. The SEA Proposed Action identifies the rodenticide to be used as D-50, "or a comparable EPA registered and state licensed diphacinone product." FNSI to be made consistent with SEA and include the phrase "or a comparable EPA registered and state licensed diphacinone product."
26	draft FNSI	7-Sep-17	Laura Leialoha Phillips McIntyre, AICP Program Manager, Environmental Planning Office	EPO - Hawaii Department of Health	Emailed on DoH letterhead to PAO Box on 12 Sept. (dated 7 Sept.) - EPO acknowledged receipt of the NEPA documents and provided information on Hawaii environmental laws, including the state requirement to consider health effects. The letter provides information about environmental analysis tools available through state and federal websites. EPO suggests the Army review Clean Water Branch requirements as well. Finally, EPO requests the Army to "utilize all relevant information...to increase sustainable, innovative, inspirational, transparent, and healthy design."	9/13 - Emailed standard response. USAG-HI DPW is currently working with Hawaii Clean Water Branch. The Army was careful to consider impacts to public health in its analysis, although these effects are not described in a separate section.

DEPARTMENT OF THE ARMY
U.S. ARMY GARRISON, HAWAI'I

SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT
for
Protecting Endangered O'ahu 'Elepaio Using Rodenticide within
Schofield Barracks Military Reservation

O'ahu, Hawai'i

July 2017

PREPARED BY:

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ACRONYMS AND ABBREVIATIONS

AA	Action Area	LC_{50}	Lethal Concentration to 50% of population
a.i.	active ingredient	LD_{50}	Lethal Dose to 50% of population
Army	United States Army	LLD	Lowest Lethal Dose
BA	Biological Assessment	LOC	Level of Concern
BO	Biological Opinion	LOEL	Lowest Observable Effect Level
bwt	body weight	MBTA	Migratory Bird Treaty Act
CEQ	Council on Environmental Quality	mg	milligram
CFR	Code of Federal Regulations	MIP	Mākua Implementation Plan
CWA	Clean Water Act	MU	Management Unit
CZMA	Coastal Zone Management Act	NAAQS	National Ambient Air Quality Standards
D-50	Diphacinone-50	NARS	Natural Area Reserves System
dBA	decibels on an A-weighted scale	NHPA	National Historic Preservation Act
DMR	Dillingham Military Reservation	NOEL	No Observable Effect Level
DOFAW	Hawai‘i Division of Forestry and Wildlife	NPDES	National Pollutant Discharge Elimination System
DOH	Department of Health	NWRC	National Wildlife Research Center
DPW	Directorate of Public Works	OEQC	Hawai‘i Office of Environmental Quality Control
EA	Environmental Assessment	OIP	O‘ahu Implementation Plan
EIS	Environmental Impact Statement	PEA	Programmatic Environmental Assessment
EPA	U.S. Environmental Protection Agency	ppm	parts per million
ESA	Endangered Species Act	RQ	dietary risk quotient
FGAR	First Generation Anticoagulant Rodenticide	SBER	Schofield Barracks East Range
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act	SBMR	Schofield Barracks Military Reservation
FNSI	Finding of No Significant Impact	SEA	Supplemental Environmental Assessment
g	gram	SHPD	State Historic Preservation Division
GIS	Geographic Information System	SHPO	State Historic Preservation Officer
GPS	Global Positioning System	sp.	species
ha	hectare	SRAA	South Range Acquisition Area
HAR	Hawai‘i Administrative Rules	ssp.	subspecies
HDOA	Hawai‘i Department of Agriculture	USAG-HI	U.S. Army Garrison, Hawai‘i
kg	kilogram	USC	United States Code
KLOA	Kawailoa Training Area	USDA	U.S. Department of Agriculture
KTA	Kahuku Training Area	USFWS	U.S. Fish and Wildlife Service
L	liter	UXO	Unexploded Ordnance

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1 PROJECT SUMMARY

Project Name: Supplemental Environmental Assessment for Protecting the Oʻahu ʻElepaio Using Rodenticide within Schofield Barracks Military Reservation

Proposing Agency: U.S. Army Garrison, Hawaiʻi

Project Location: Lihue Management Unit, Schofield Barracks West Range, Waiʻanae Mountains, Oʻahu

Property Owner: United States of America

LU Classification: Conservation, Subzone P (Protective) and R (Resource)

Anticipated Determination of Supplemental Environmental Assessment:
A Finding of No Significant Impact (FNSI) is anticipated for the project.

Agencies Consulted During Supplemental Environmental Assessment Preparation:

Consulted Parties:

Federal: U.S. Department of Defense - U.S. Army Garrison, Hawaiʻi
U.S. Army Garrison, Hawaiʻi Directorate of Public Works
U.S. Department of Agriculture, Animal and Plant Health Inspection Service, National Wildlife Research Center
U.S. Fish and Wildlife Service

Figure 1: Failed Nest Due to Rat Predation Credit: © Jack Jeffrey Photography

1.1 Introduction

The U.S. Army Garrison, Hawai‘i (USAG-HI) mission is to support military training and readiness. USAG-HI complies with numerous laws and regulations to assess, minimize, and mitigate environmental impacts of its mission. In 2008, the Army completed the Final Implementation Plan for O‘ahu Training Areas or O‘ahu Implementation Plan (OIP) as required by the U.S. Fish and Wildlife Service (USFWS). The OIP identified conservation measures the Army would implement to mitigate for environmental impacts of military training. In 2010, the Army completed a Programmatic Environmental Assessment (PEA) that evaluated potential impacts of the OIP. The 2010 PEA also identified proposed OIP management activities that lacked sufficient information to fully evaluate. One such activity, the broadscale distribution of rodenticide, was described in the OIP as an important tool needed to stabilize certain threatened and endangered species populations including the O‘ahu ‘elepaio, a native forest bird. However, the 2010 PEA concluded more specific project information was needed before the action could be evaluated in the National Environmental Policy Act (NEPA) process.

A specific proposal has now been developed to protect O‘ahu ‘elepaio and other endangered species from invasive rodents within the Lihue Management Unit, Schofield Barracks Military Reservation. Rodenticide would be distributed by helicopter within the Lihue Management Unit (MU) to reduce non-native rat populations that eat native Hawaiian plants and animals. This Supplemental Environmental Assessment (SEA) documents the evaluation of the potential effects of this proposal. It supplements the 2010 OIP PEA and has been prepared in accordance with the National Environmental Policy Act (NEPA).

This supplemental document incorporates information and analyses presented in several other NEPA products developed by the U.S. Army, U.S. Fish and Wildlife Service (USFWS), and Hawai‘i Division of Forestry and Wildlife (DOFAW):

- Programmatic Environmental Assessment for the Final Implementation Plan for O‘ahu Training Areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawailoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. U.S. Army, March 2010 (the 2010 PEA).
- Final Supplemental Environmental Assessment, Lehua Island Ecosystem Restoration Project. USFWS and DOFAW, October 2008.
- Draft Environmental Assessment (EA) for Restoration of Habitat on the Desecheo National Wildlife Refuge through the Eradication of Non-Native Rats. USFWS, December 2015.
- Draft Environmental Assessment for Evaluation of the Field Efficacy of Broadcast Application of Two Rodenticides (diphacinone, chlorophacinone) to Control Mice (*Mus musculus*) in Native Hawaiian Conservation Areas. USFWS, February 2017.

1.2 Background

The O‘ahu ‘elepaio is a territorial, non-migratory, monarch flycatcher (Monarchidae) endemic to the island of O‘ahu in the Hawaiian Archipelago (VanderWerf 1998). It is found nowhere else in the world. O‘ahu ‘elepaio were abundant and widespread in forested habitat throughout O‘ahu in the early 20th century, but their numbers have declined steadily. The current geographic range encompasses about 5,187 hectares (ha) and has declined by 75% since 1975 (VanderWerf et al. 2001). ‘Elepaio distribution is fragmented into numerous small populations often isolated by urban

and agricultural development (VanderWerf et al. 2001, 2013). In 2012, the total population was estimated to be 1,261 birds, down from 1,974 birds based on surveys in the 1990s (VanderWerf et al. 2013). The O‘ahu ‘elepaio has been in decline for decades due to low adult survival and low reproductive success resulting mainly from nest predation by rats and introduced, mosquito-borne diseases such as avian pox virus (USFWS 2006, VanderWerf et al. 2006, VanderWerf 2009).

In 2000, U.S. Fish and Wildlife Service (USFWS) granted the O‘ahu ‘elepaio endangered species status under the federal Endangered Species Act of 1973. USFWS designated critical habitat on O‘ahu for the ‘elepaio in 2001. Due to the highly negative impact of introduced rats on O‘ahu ‘elepaio and other natural resources in Lihue Management Unit, the USAG-HI Natural Resources Program has conducted rodent control since 2001 using various techniques including snap traps, automatic traps, and rodenticide bait stations. Ongoing challenges complicate these efforts. Lihue Management Unit is a large area with severe terrain containing unexploded ordnance (UXO). It is located on an active Army training range and is only accessible to natural resource managers 4 to 5 days each month to avoid conflicting with the military training schedule. Army Natural Resources Program managers support isolated populations of rare plants, endangered snails *(Achatinella mustelina)*, and O‘ahu ‘elepaio *(Chasiempis sandwichensis* ssp. *ibidis)* with a system of small grids of traps and/or bait stations attempting to control rat predation. However, limited access and the intensive nature of servicing these traps and stations means that, in general, they may only be re-baited every 2-6 weeks. This restricted rat control strategy has had limited effect, and rat populations have risen since the program’s inception (Kawelo, pers. comm.).

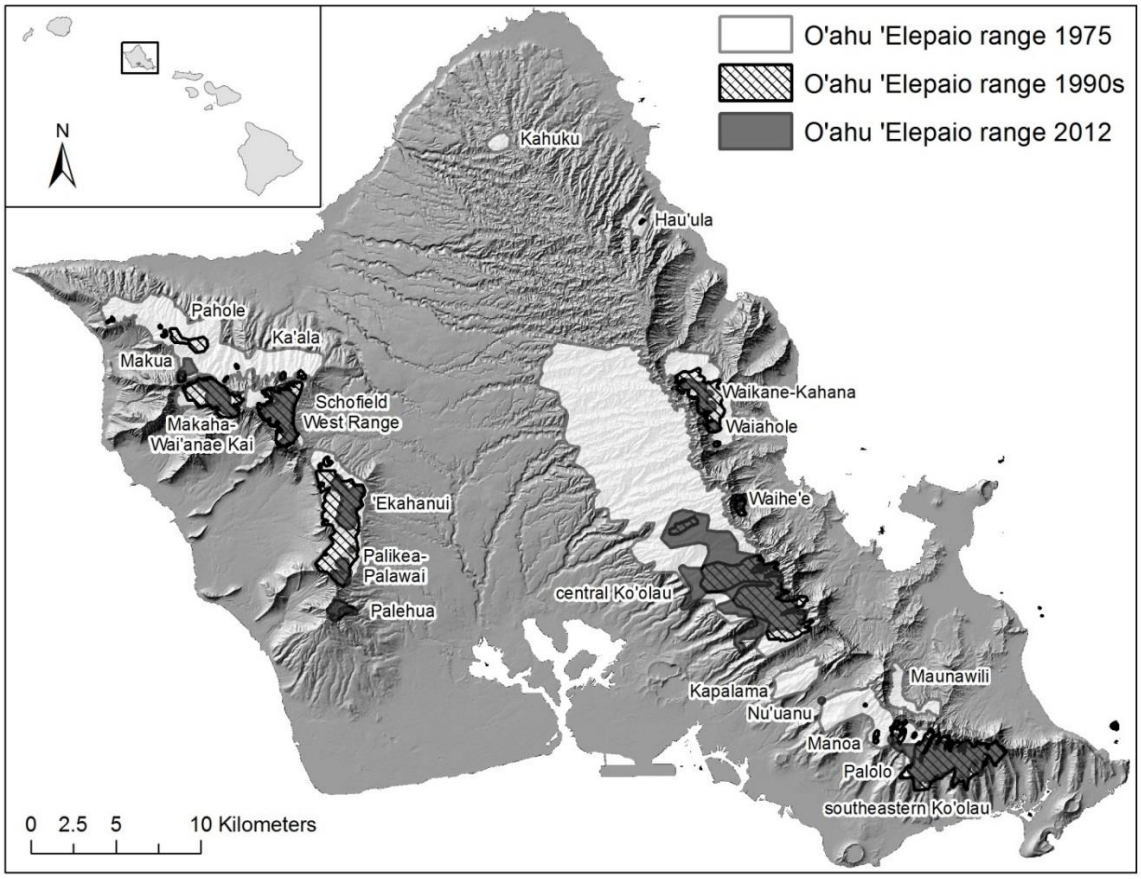

Figure 2: Range of the O‘ahu ‘Elepaio in 1975, the 1990s, and 2012 (VanderWerf et al. 2013)

In 2003, after the U.S. Army (Army) initiated formal consultation under Section 7 of the Endangered Species Act (ESA; 16 USC 1531 et seq.), the USFWS issued a biological opinion (BO) for the Oʻahu Training Areas, including Dillingham Military Reservation (DMR), Kahuku Training Area (KTA), Kawailoa Training Area (KLOA), Schofield Barracks Military Reservation (SBMR), Schofield Barracks East Range (SBER), and South Range Acquisition Area (SRAA). The 2003 BO concluded that the routine military training and the conservation measures identified by the Army in its Oʻahu Biological Assessment (BA) (Army 2001) would not jeopardize the continued existence of endangered species found within the Oʻahu Action Area (AA), the area of potential impact as defined in the BA. The conclusion of no jeopardy was based on preparation and implementation of both a wildland fire management plan and an Oʻahu Implementation Plan (OIP) for ESA listed species within the Oʻahu training areas.

The 2008 OIP is the result of the 2003 USFWS consultation. The consultation included endangered plant, bird, and tree snail species that may be affected by military training activities on the referenced Oʻahu Army installations. The OIP identified management actions needed beyond those the Army was already implementing to stabilize the endangered target species. OIP goals and geographic scope are described in greater detail in the 2010 OIP PEA.

The 2003 BO also directed the Army to "pursue implementation…and application of a more effective rodenticide including broad scale distribution of rodenticides to improve rat control in remote areas, especially in areas with threatened and endangered species." Accordingly, the OIP identified aerial broadcast of rodenticide as an important management option to control rat populations and limit predation of endangered Oʻahu ʻelepaio and other endangered species.

The USFWS has been in the process of preparing the Integrated Pest Management Plan (IPM): Programmatic Environmental Impact Statement (PEIS) for the management of invasive rodents and mongoose in Hawaiʻi. USFWS intended to complete the PEIS by 2014 and include effects analyses of broadscale rodenticide distribution and the aerial application of rodenticide. Unfortunately, the PEIS has been delayed indefinitely. However, USAG-HI must move forward to achieve the objectives required by the 2003 BO. Consequently, in the absence of a completed IPM PEIS, the evaluation of this Proposed Action is documented with this supplement to the 2010 OIP PEA.

The Oʻahu Implementation Plan outlines the stabilization of numerous endangered species including 23 plant species, one bird species, and 10 snail species. To stabilize these endangered target species, each must be maintained with a sufficient number of separate populations to ensure long-term survival. The OIP also directs that threats to individuals in each population must be controlled, and each species must be adequately represented in *ex situ* (out of the wild) collections.

The 2010 OIP PEA concluded that the long-term benefits of proposed OIP management activities far outweighed the limited short-term negative effects of these management actions. The PEA concluded that implementing the proposed OIP activities would not constitute a federal action that would significantly negatively affect the quality of the environment and a Finding of No Significant Impact (FNSI) was signed. OIP activities included fencing; ungulate control; alien plant, animal, and invertebrate control; alien invertebrate exclosures; collection of endangered snails and plants; reintroductions/augmentations; and erosion control.

The geographic scope of this current analysis is limited mainly to the Lihue Management Unit (MU), an ungulate-proof, fence enclosed unit, located in the northern Waiʻanae Mountains within SBMR. Management units are the focal point for OIP management actions, and typically equate

to fenced, ungulate-free areas. Management units were developed to manage designated populations of each target species and appropriate habitat. Most of the rare species involved in the consultation for SBMR in the Wai‘anae Mountains are associated with native-dominated vegetation in mesic (moderately moist) habitats to wet boggy forest at the summit of Ka‘ala. Figure 3 depicts Lihue Management Unit and nearby management units in the Wai‘anae Mountains.

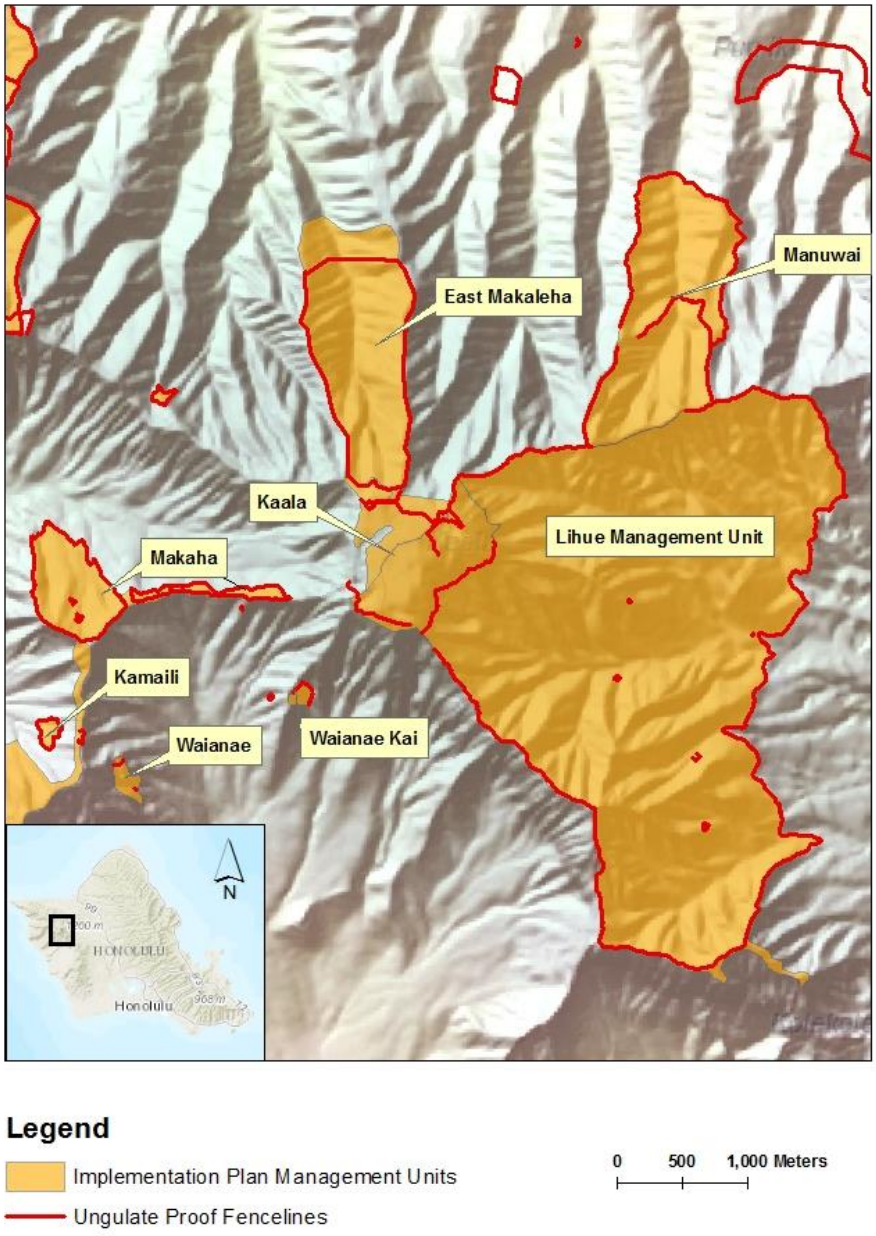

Figure 3: Army Natural Resources Program Management Units in the Northern Wai‘anae Mountains

1.3 Public Involvement

The Army provides opportunities for the public to participate in the NEPA process. Persons and organizations having potential interest in the Proposed Action are encouraged to participate in the environmental analysis process. The public may review and provide comments during a 30-day review period for the Supplemental Environmental Assessment (SEA) and draft Finding of No Significant Impact (FNSI). A notice of availability of the SEA and draft FNSI will be published in the State of Hawaiʻi Office of Environmental Quality Control's twice-monthly bulletin, *The Environmental Notice*. A legal notice of availability will also be published in the Honolulu Star-Advertiser. The SEA and draft FNSI will be made available on the USAG-HI website, and provided to local libraries. Copies will be mailed upon request to interested individuals, organizations, and agencies. Comments received during the public comment period will be reviewed by USAG-HI and factored into the Army's decision-making process.

1.4 Decisions to be Made

The Army will use this SEA and other appropriate documents to determine whether:

1. The proposed management actions, as described, might have significant impacts requiring analysis in an Environmental Impact Statement (EIS);
2. No new action should be taken to control rat populations and improve survival of Oʻahu ʻelepaio and other ESA-listed species populations; or
3. The Army should conduct the proposed management actions as described.

This SEA will remain valid, unless either the Proposed Action is so modified and/or new information is available that the effects would be different than those anticipated and documented in this SEA. If the effects would be different, then additional supplemental documentation would need to be prepared.

2 PURPOSE OF AND NEED FOR ACTION

2.1 Summary of Proposed Action

USAG-HI proposes to conduct the broadscale distribution of rodenticide in the Lihue Management Unit (MU) as part of an integrated management program to control rat *(Rattus rattus, R. norvegicus, and R. exulans)* populations in order to stabilize populations of endangered species as required by Biological Opinions (BOs) issued by the U.S. Fish and Wildlife Service. Army Natural Resources Program managers will continue to employ other rat control measures including deploying snap and automatic traps and hand broadcasting rodenticide within Oʻahu ʻelepaio territories. These activities will complement other population stabilization efforts including: pedestrian and aerial surveying; monitoring; specimen collection; phytosanitation; manual and aerial herbicide application; manual rodenticide and insecticide application; weed control; invasive snail and slug control; invasive reptile/bird control; construction of ungulate exclusion fences (including helicopter drop zones and landing zones) and ungulate control; construction of snail exclosures; construction of cabins, camp sites, water catchments, and weather stations; construction of small radio antennae; and unexploded ordnance (UXO) removal. Detailed descriptions of these management measures are provided in Section 3 of the 2010 PEA.

The rodenticide application would consist of a helicopter, using a specialized suspended bucket, flying along predetermined Global Positioning System (GPS)-plotted transects within the 430 ha treatment area. The rodenticide bait would be broadcast by the rotary spreader bucket as the helicopter flies along these transects. The 430 ha (1063 acre) treatment area is contained within the ungulate-proof fence enclosed 714 ha (1764 acre) Lihue MU. The rodenticide to be used would be Diphacinone-50: Pelleted Rodenticide Bait for Conservation Purposes (EPA Reg. No. 56228-35) containing the anticoagulant rodenticide diphacinone (0.005% active ingredient). Diphacinone-50 has been approved for aerial distribution by the U.S. Environmental Protection Agency (EPA) and the Hawai‘i Department of Agriculture (HDOA).

2.2 Purpose and Need

There is a need to ensure the Army is in compliance with ESA and the 2003 BO so it may continue to accomplish its training mission. Specifically, there is a need for the Army to effectively sustain endangered plant and animal populations as stipulated by the 2003 BO. The 2003 BO requires the Army to manage O‘ahu ‘elepaio territories and maintain stable ‘elepaio populations. Fire ignition and introduction of alien and invasive[1] plants and animals are the most important threats to ESA listed plants and animals in the O‘ahu Action Area (CEMML 2003). In particular, introduced rats are primary threats to nesting ‘elepaio (egg and chick predation), endangered snails (direct predation), and rare plant species (fruit and seed predation). The Army needs to control rat predation within O‘ahu ‘elepaio nesting areas to enable higher reproductive success critical to maintaining stable populations.

The Army’s Proposed Action is to conduct broadscale distribution of diphacinone rodenticide in the Lihue Management Unit (MU) to reduce the rat population and predatory pressure on ‘elepaio nesting areas. The aerial broadcast of rodenticide was identified in both the OIP and 2003 BO as the most effective way to limit rat predation on a management unit scale. This activity will complement other ongoing management activities that also help meet OIP objectives.

The purpose of this Proposed Action is to control rat populations on a management unit scale and improve survival rates of O‘ahu ‘elepaio within Lihue MU. Rat predation of O‘ahu ‘elepaio in Lihue MU is preventing the Army from sustaining ‘elepaio population objectives of the 2003 BO. Other means of controlling rat populations have been implemented, including snap traps, automatic traps, bait stations, and limited hand broadcasting of diphacinone rodenticide. These methods are very labor intensive and complicated by the fact that the Lihue MU is only accessible by Army natural resource managers 4-5 days each month during range maintenance week. The lower boundary of Lihue MU borders the upper boundary of the Schofield Barracks West Range ordnance impact area, so at other times, Lihue MU is closed to all entry to prevent conflict with military training activities. Terrain within Lihue MU is severe and difficult to traverse. In addition, the ‘elepaio breeding territories within Lihue MU contain unexploded ordnance (UXO) which severely limits where managers may conduct their activities.

[1] Executive Order 13112 defines an alien species as “any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to [a respective] ecosystem,” and invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.” Therefore, in this SEA, the term “invasive” will be used to mean any nonnative species introduced into an area that causes ecological harm.

2.3 Regulatory Overview

A complete discussion of the federal laws and consultations that may be relevant to implementing the Proposed Action appear in Section 2.3 of the 2010 OIP PEA. The Proposed Action would take place solely on federally owned land managed by the Army.

2.3.1 National Environmental Policy Act of 1969 (NEPA)

This SEA was prepared by USAG-HI in accordance with NEPA, as implemented by Council on Environmental Quality (CEQ) regulations at 40 CFR 1500-1508 and the U.S. Army's rule governing NEPA, Environmental Effects of Army Actions (32 CFR Part 651). This SEA analyzes the potential impact of the Proposed Action in order to determine whether to sign a FNSI or prepare an EIS.

2.3.2 Endangered Species Act of 1973 (ESA)

The ESA, as amended (16 USC 1531 *et seq.*), requires federal agencies to implement programs for conservation of federally listed endangered and threatened plants and animals. Section 7 of the ESA requires federal agencies proposing actions that may affect listed species or critical habitats to first consult with USFWS to ensure they do not jeopardize listed species or destroy critical habitat. The steps taken by USAG-HI to implement the Proposed Action are in accordance with the requirements for federal agency compliance with the ESA.

2.3.3 Migratory Bird Treaty Act of 1918 (MBTA)

The MBTA protects over 1000 species of birds, including the species native and not native to Hawaiʻi, by implementing U.S. obligations under four treaties within the United States. The MBTA provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior.

2.3.4 National Historic Preservation Act 1966 (NHPA)

The NHPA, as amended (16 USC 470), established both a national policy for preservation of historic properties as well as the National Register of Historic Places. Section 106 of the NHPA requires federal agencies to take into account the effects of federal actions on historic properties, and affords the State Historic Preservation Officer (SHPO) a reasonable opportunity to comment on such undertakings. Hawaiʻi implements the NHPA, under the jurisdiction of the Hawaiʻi Department of Land and Natural Resources (DLNR), State Historic Preservation Division (SHPD). The SHPD concurred with Section 106 determinations associated with the 2010 OIP PEA. Based on literature reviews and surveys previously conducted, known cultural resources are present within the Lihue MU. However, there is no anticipated potential for impact to these cultural resources from the aerial distribution or broadcast of D-50.

2.3.5 Clean Water Act of 1972 (CWA)

The CWA amended the Federal Pollution Control Act of 1948 and is the primary federal law that protects the nation's waters, including lakes, rivers, and coastal areas. The primary objective of the CWA is to restore and maintain the integrity of the nation's waters. The National Pollutant Discharge Elimination System (NPDES) program regulates discharges from pesticide applications consistent with Section 402 of the CWA. The State of Hawaiʻi Department of Health (DOH) administers the NPDES program in Hawaiʻi.

2.3.6 Coastal Zone Management Act of 1972 (CZMA)

The purpose of the CZMA, as amended (16 USC §1451 *et seq.*), is to encourage coastal states to manage and conserve coastal areas as a unique, irreplaceable resource. The Hawaiʻi coastal zone management (CZM) area encompasses the entire state. Federal agency activity that affects land or water use or natural resources of the coastal zone shall be carried out in a manner which is consistent, to the maximum extent practicable, with the policies of approved state management programs. This proposed treatment area is located in central Oʻahu far from the coastline. The Proposed Action is consistent with the CZMA and the Hawaiʻi CZM Program to the maximum extent practicable.

2.3.7 Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (FIFRA)

The Proposed Action involves use of the rodenticide diphacinone for controlling invasive rodents. The use of rodenticides and other registered pesticides in the United States is regulated by the U.S. Environmental Protection Agency (EPA) under the FIFRA, as amended in 1972 (7 USC §136). General or specific use of a particular rodenticide formulation must be formally approved by the EPA, with specific use requirements and restrictions identified on the label. Currently, conservation uses in Hawaiʻi are allowed under a FIFRA Section 24(c) registration for diphacinone in bait stations (Ramik Mini Bars kills Rats and Mice (SLN No. HI-980005; EPA Reg. No. 61282-26)) and a nationwide label under Section 3 that includes aerial broadcast (Diphacinone-50 (EPA Reg. No. 56228-35)). A Section 24(c) registration and label has been approved and licensed by HDOA for broadcast application of Diphacinone-50 for conservation purposes, such as currently proposed.

2.3.8 Executive Order 13112, Invasive Species

Executive Order 13112 of February 3, 1999, requires federal agencies whose actions may affect the status of invasive species to, subject to the availability of appropriated funds and within Administrative budgetary limits, use relevant programs and authorities to:

- Prevent the introduction of invasive species;
- Detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner;
- Monitor invasive species populations accurately and reliably;
- Provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
- Conduct research on invasive species and develop technologies to prevent introduction of and provide for environmentally sound control of invasive species; and
- Promote public education on invasive species and the means to address them.

The natural resource management actions described within the OIP and this Proposed Action assist the Army in compliance with this Invasive Species Executive Order.

Figure 4: Invasive Rat Eating Bird Eggs Credit: © Jack Jeffrey Photography

3 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

The Proposed Action, as summarized in Section 2.1 and described in detail in Section 3.1, is to conduct the broadscale distribution of Diphacinone-50, or comparably registered and licensed diphacinone product, in Lihue MU of SBMR to control invasive rat populations and thereby limit predation of Oʻahu ʻelepaio eggs and chicks. Reduced predatory pressure during the critical nesting season will improve ʻelepaio reproductive success and support stable ʻelepaio populations within Lihue MU (Figure 5). The Proposed Action is one of a number of management activities already implemented and ongoing to support target species. These other activities are described in Section 3 of the 2010 OIP PEA.

Section 3.2 describes other strategies considered during evaluation of this Proposed Action. The No Action Alternative, in which no new management action would be taken, is considered in this document, and described in Section 3.2.2.1.

3.1 Broadscale Use of Rodenticide in Lihue Management Unit (Proposed Action)

The Army is proposing to conduct the broadscale application of rodenticide within the Lihue Management Unit of SBMR. This broadscale application would consist of a helicopter dispersing rodenticide within the treatment area, using a specialized bucket suspended underneath, and flying along predetermined transects. The rodenticide product would be broadcast by the rotary spreader bucket as the helicopter flies along these transects. EPA and the HDOA have approved Diphacinone-50: Pelleted Rodenticide Bait for Conservation Purposes (EPA Reg. No. 56228-35) containing the anticoagulant rodenticide diphacinone (0.005% active ingredient) for this type of conservation use. Diphacinone-50 (hereafter D-50), or a comparable EPA registered and state licensed diphacinone product, would be used in this application. The 430 ha treatment area has been selected to include almost all the ‘elepaio territories contained within an ungulate-proof, fenced enclosure located in the 714 ha Lihue MU.

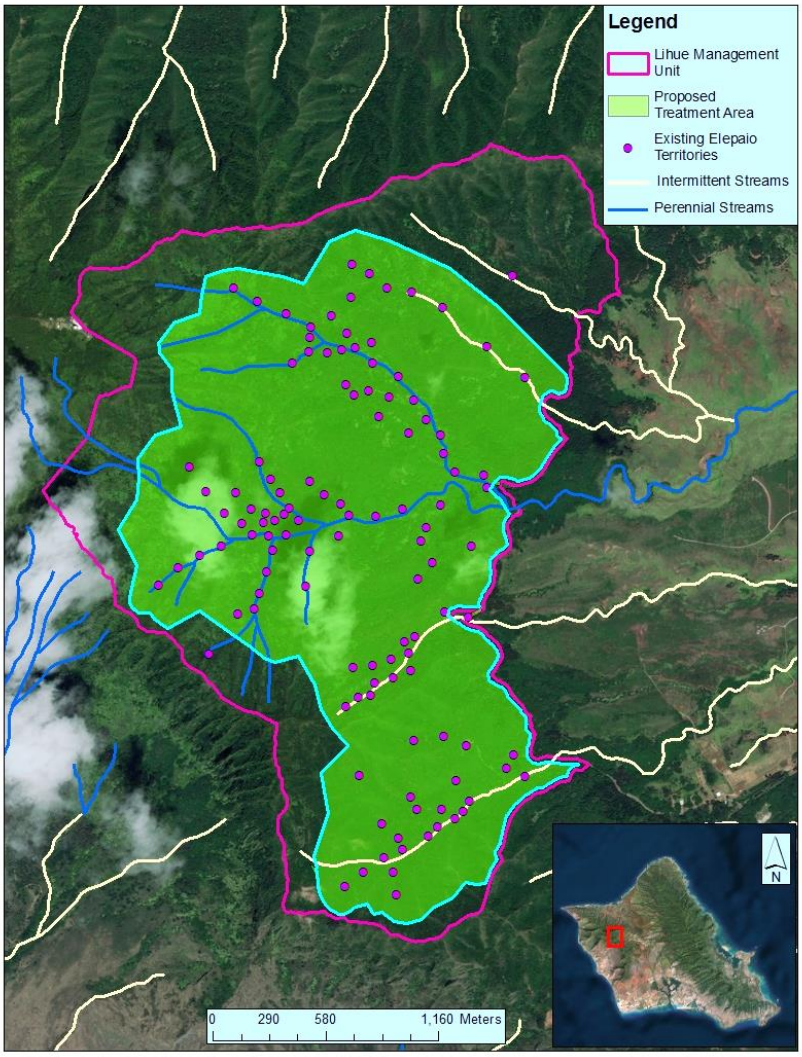

Figure 5: Proposed Rodenticide Treatment Area – Lihue MU

USDA APHIS National Wildlife Research Center (NWRC) would purchase and oversee storage and use of the D-50 bait product. The D-50 bait would be applied according to the EPA registered product label. For D-50, a single treatment consists of two applications of rodenticide bait. The applications are typically spaced 5-7 days apart. For aerial distribution or broadcast, rodenticide bait is applied at 11.1-13.8 kg/ha for the first application, and no more than 13.8 kg/ha for the second application, 5-7 days later. In situations where weather or logistics only allow one bait application, a single application may be made at a rate no higher than 22.5 kg/ha. The treatment area consists of 430 ha within ungulate fencing, and completely contained within the 714 ha Lihue MU. The number and duration of flights would be dependent on the size of the bucket available for applying bait. It is anticipated that the entire treatment area would require 2-4 days to complete a single application. Consistent

with label direction, the second application would occur 5-7 days after the first application and would follow the same application pattern.

Although not required by label direction, additional measures would be implemented to avoid sensitive areas. Surface waters within Lihue MU will be buffered by 50 feet. For example, flowing streams will be buffered by 50 feet from each bank. All fences will be buffered by 50 feet to ensure that the entire application is contained within the management unit. In some areas of high rodent activity, D-50 may be applied by hand within these buffer areas. Some rats may survive within untreated buffer areas, but it is expected that overall rat populations will be effectively reduced to an acceptable range enabling sustainable ‘elepaio territories.

The diphacinone treatment would take place as early as November 2017. The primary weather-related logistical constraints are wind and rain. Rodenticide application will not be conducted in winds higher than 35 mph. For each application day, a forecast of five days and nights without significant rainfall (>13 mm) is preferred (Dunlevy 2007). The treatment would be scheduled for a period with little forecasted rain. If the weather window is too narrow, a single application may be necessary as per label direction. November/December timing coincides with the disappearance of strawberry guava fruit which is one of the major food sources for rats at Lihue (Shiels 2010, Shiels and Drake 2011). Strawberry guava fruiting normally occurs June-October (peaking in September/October), and October/November is generally the beginning of increased rodent activity at other management units as monitored by rat activity tracking tunnels. By late November and December, strawberry guava fruit has disappeared and the lowest seasonal abundance and diversity of alternative foods is available for rats (such as seeds, invertebrates, and vulnerable ‘elepaio eggs and chicks). December is also the beginning of ‘elepaio breeding season.

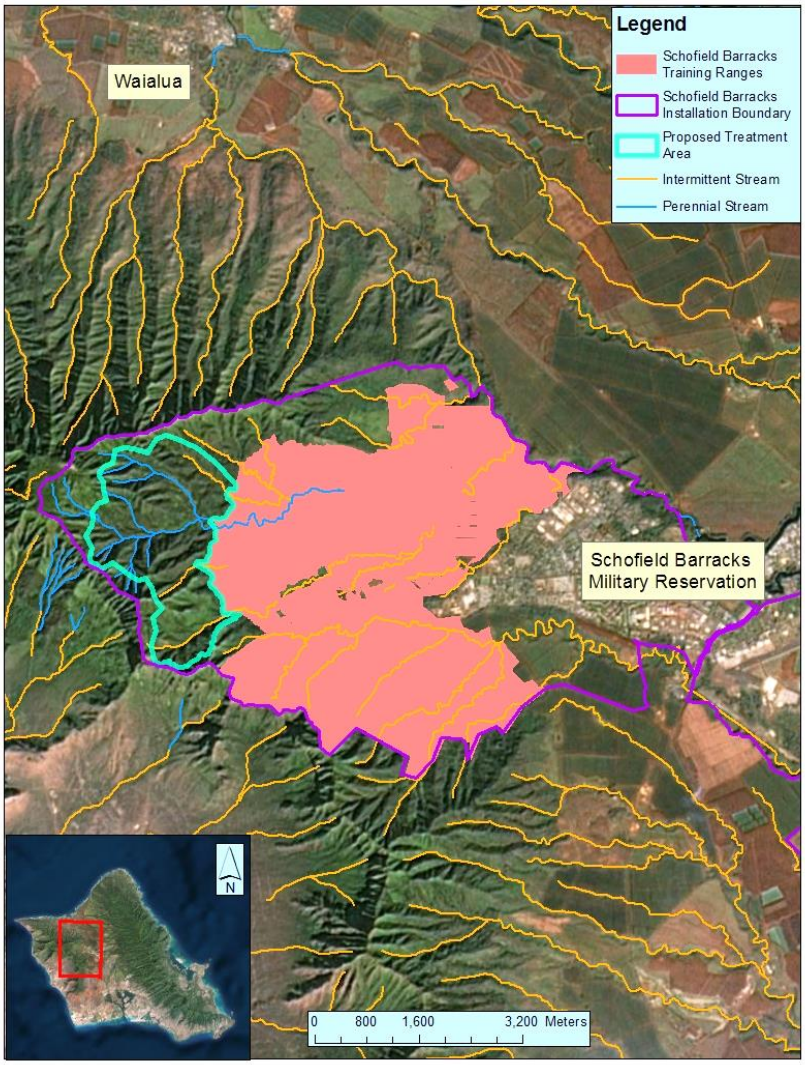

Figure 6: Proposed Treatment Area and Schofield Training Ranges

Access to Lihue MU must be coordinated with training range managers (Range Control), and the management unit is only accessible via military land. The area is closed to the public and unauthorized entry is not expected. The management

unit is also down range from an active firing range (Figure 6) and authorized access is closely monitored by Range Control. As an added measure to inform authorized personnel, warning signs would be posted along the fence line and on the gates leading to Lihue MU. Signs would include the date of the broadcast and they would remain in place for 2 months following the first bait application.

3.1.1 Lihue Management Unit Description[2]

The Proposed Action will take place completely within Lihue MU. Lihue MU is not contiguous with any other management units. Other O’ahu management units are described in the 2010 PEA. Lihue is a large management unit, comprising 714 ha (1,764 acres) at Schofield Barracks West Range within SBMR. The management unit is on the eastern side of the Wai‘anae Range at elevations ranging from 2,000 to 3,500 feet. The majority of the management unit is within the Resource subzone of the Conservation District, with areas in the upper elevations in the Protective subzone (Figure 7). Topography includes ridges and gulches running up to the Ka‘ala summit and northern ridges with moderate to steep slopes on the ridges and gentle to moderate slopes in the gulches. Natural communities include mesic to wet mixed native and introduced forest in the lower elevations, with native wet forest in the higher elevations.

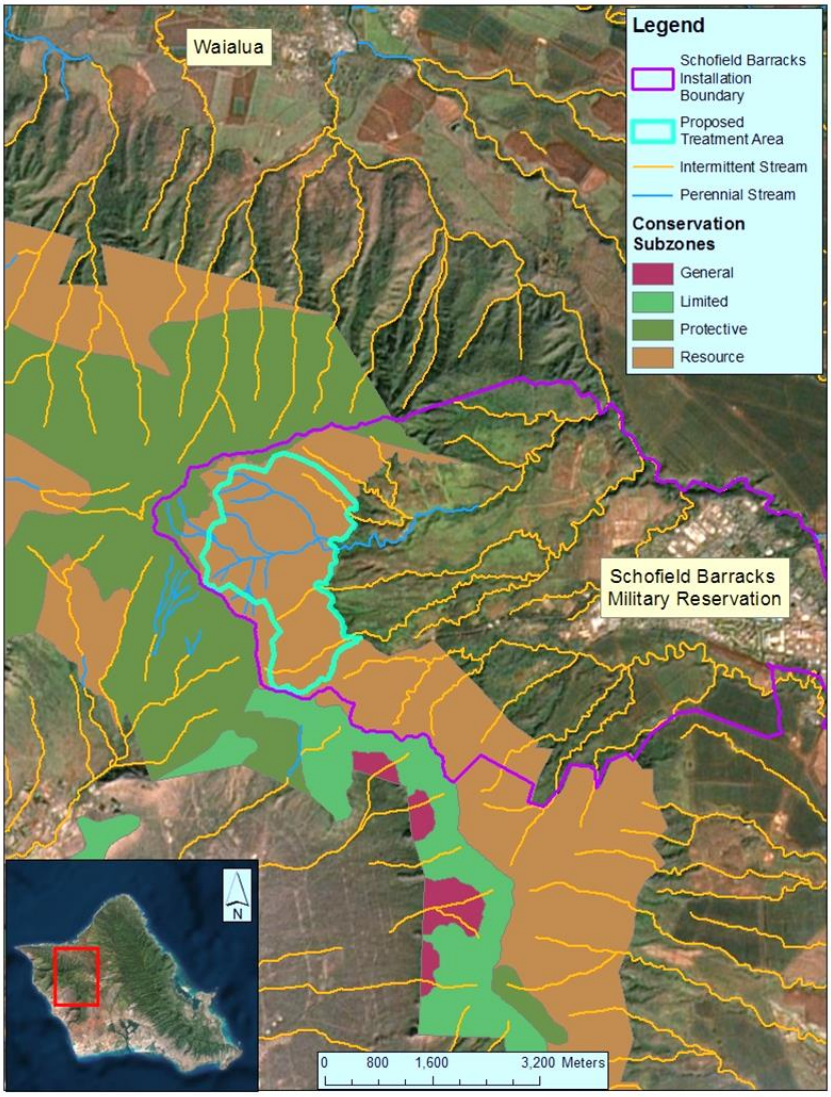

Figure 7: Conservation District Subzones near Lihue MU

Lihue MU is surrounded by State of Hawai‘i Forest Reserves to the north and west (Figure 8), the SBMR Military Training Areas to the east (Figure 6), and Lualualei Naval Magazine to the south.

[2] Note that MU acreages in this document do not always correspond exactly to MU acreages listed in the OIP. Since publication of the OIP, additional GPS surveying has been conducted, and MU boundaries have been refined.

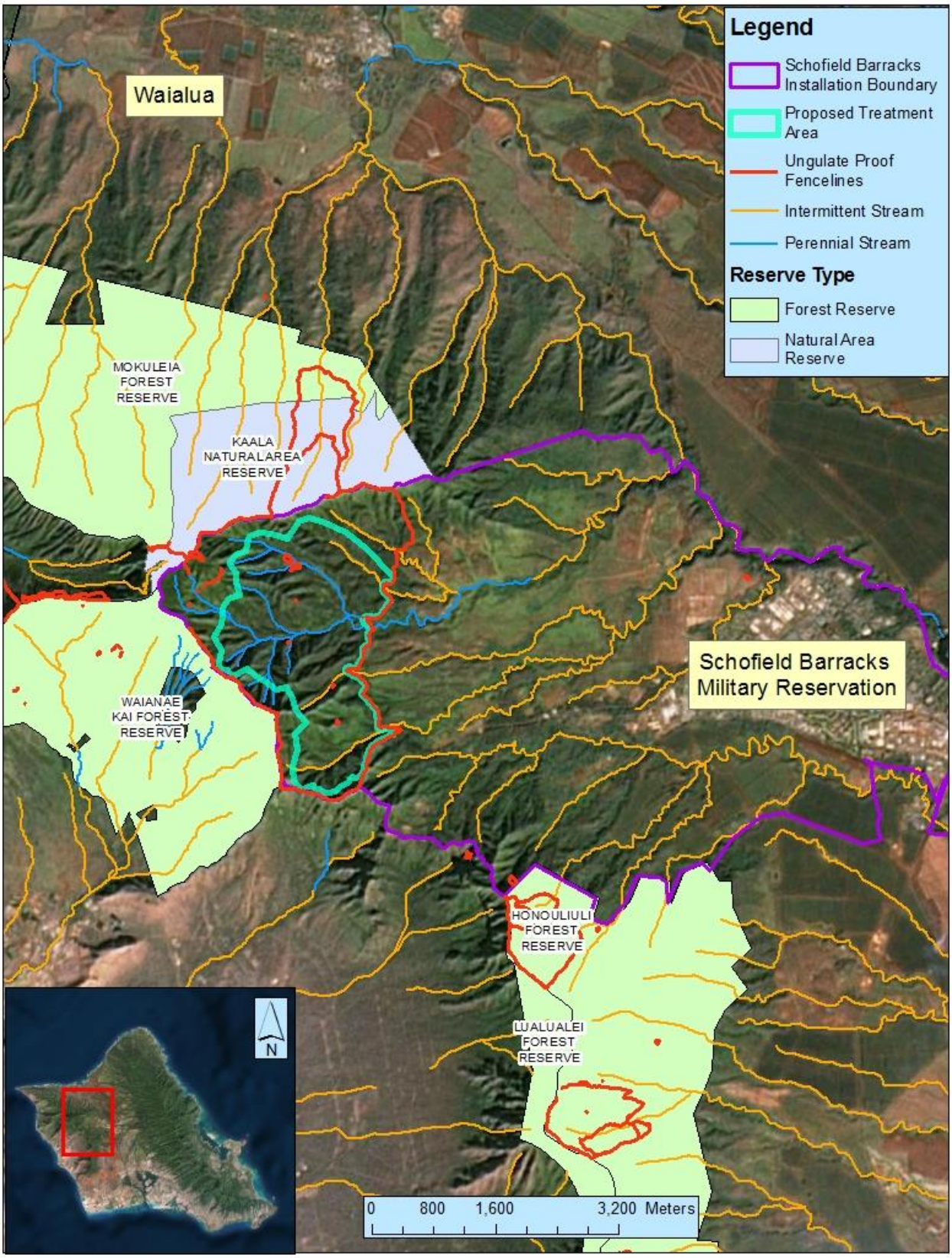

Figure 8: State of Hawai‘i Forest Reserves near Lihue MU and Proposed Treatment Area

3.1.2 Proposed Management Activities

3.1.2.1 Broadscale Rodenticide Distribution

Broadscale distribution of rodenticide has been, and continues to be, investigated in Hawaiʻi to eradicate rats from remote areas, particularly off-shore islands, where hand distribution of the pelletized rat bait is impossible. The goal of a rodent control operation is not eradication, however. A rodent control operation is intended to reduce rodent populations to acceptably small sizes and to maintain those lower population densities. The purpose of this Proposed Action is to control the rat population within Lihue MU because eradication is not feasible. Rat numbers will again rise as new rats enter from areas bordering the treatment area, but treating a large area like Lihue MU will increase the time rats will take to repopulate the unit from outside. The reduction of overall rat population levels within the management unit will increase trapping effectiveness in managed territories, and rare species should experience substantially longer periods of relief. Without continued treatment, however, rat populations will eventually recover.

A rodenticide treatment would occur when rat reproduction is ramping up (typically winter months). Rat abundance monitoring using tracking tunnels at other sites indicate rat populations are increasing by December due to peak breeding after the fall fruiting season. December is also the beginning of ʻelepaio breeding season when ʻelepaio have vulnerable nesting females, eggs and chicks. Additionally, this preferred treatment period coincides with the lowest seasonal abundance and diversity of alternative foods available for rats, such as seeds and invertebrates. In Lihue MU, aerial rodenticide distribution is the only broadscale means of addressing the spiking rat population threat to nesting ʻelepaio.

A helicopter, using a specialized bucket slung from the base of the aircraft, would fly along predetermined Global Positioning System (GPS)-plotted transects as the bait is distributed in 70 meter-wide swaths. The bait bucket system is comprised of a bait storage compartment, a remotely-triggered adjustable gate to regulate bait flow, and a motor-driven broadcast device that can be turned on (to broadcast bait over a wide swath) or off remotely and independently of the outflow gate. The number and duration of flights would be dependent on bucket capacity and rate of application. The length of time to complete the Lihue MU application within the 430 ha treatment area would depend on how long bucket loading and transect flight operations require, but it is anticipated that it could be completed in two to four days. A second distribution would occur in the same area approximately five to seven days after the first application. If a second distribution is to be made, the entire treatment operation may need to be scheduled when the training range is available for more days than typical months.

Broadscale rodenticide distribution allows for greater bait interaction than bait boxes or mechanical traps (bait boxes deter some individuals from entry; Recht 1988), and thus, potentially, a better control method for suppressing rat populations. In 2012, the USAG-HI Natural Resources Program was forced to halt use of bait boxes because a label change made bait box use unfeasible in Lihue MU. Aerial application of rodenticide may be the most efficient and effective way of adequately controlling the seasonal spike in rat activity within the management unit.

3.1.2.2 Monitoring

A number of monitoring activities already in place are described in the OIP. Current monitoring relating to the Proposed Action include: (1) assessment of the distribution and status of alien plant and animal species within the management units and in the vicinity of target species population

units, (2) assessment of the status and stability of native plant, snail, and bird communities within a management unit, (3) assessment of alien species control methods as related to alien species population levels, (4) bird banding, and (5) snail mark and recapture. Army Natural Resource managers regularly monitor ungulate activity transects to detect feral ungulate ingress and assess the integrity of the ungulate exclosure fence. Monitoring protocols are further described in OIP Chapters 6 (plants) and 9 (snails).

Rat activity is currently monitored at Lihue MU using tracking tunnels. Tracking tunnels consist of ink cards baited and inserted into tunnel boxes. Rodent activity levels are based on foot-tracks in the tracking tunnels. General management objectives for SBMR management units state there should be less than 10% activity levels in rat tracking tunnels. In New Zealand, studies have shown that rat activity levels of 10% are low enough to maintain certain rare bird populations (Innes et al. 1999). A 10% activity level during ‘elepaio breeding season may also be the most achievable level using a broadscale distribution of rodenticide. Under the Proposed Action, rodent monitoring will continue within the proposed treatment area, and also at a control site where no broadscale rodenticide treatment will occur. Comparison of rodent activity at these two sites will help determine the effectiveness of the initial application and subsequent treatments.

3.1.3 Diphacinone and Diphacinone-50

Selection of the most appropriate rodenticide for the specific conditions of a project is one of the main decisions for any rodent control project. Rodenticides must be used in the lowest quantity and toxicity which ensures that every rodent is exposed to a lethal dose while minimizing adverse environmental effects, especially impacts to nontarget species. Prudent use is also critical to ensure that regulators will allow effective rodenticides to continue to be made available for future use (Marsh 1985, Cromarty et al. 2002).

Products containing diphacinone, an anticoagulant rodenticide, were first registered for rodent control in 1960 at active ingredient concentrations of 0.005% to 0.01 % (50 to 100 ppm). It is described as a “first generation” rodenticide. Generally “second generation” rodenticides, such as brodifacoum, are both more toxic and more persistent. Diphacinone (0.005% active ingredient) is currently registered for use for conservation purposes in the United States. D-50 rat bait with diphacinone (0.005% active ingredient) has been approved for aerial distribution by the U.S. EPA and the Hawai‘i Department of Agriculture. Diphacinone has been trialed or used with favorable results in a number of landscape-scale rodent control efforts (Dunlevy et al. 2000, Spurr et al. 2003a, Spurr et al. 2003b). Diphacinone is often a preferred rodenticide because of the reduced environmental risk in comparison to other rodenticides such as brodifacoum (Fisher et al. 2003, Eason and Ogilvie 2009). At least 32 successful island rodent eradications have been reported using diphacinone as the primary toxicant (Howald et al. 2007, Island Conservation unpubl. data, cited in USFWS 2015).

The primary advantage of diphacinone as a rodenticide for conservation purposes is the low risk it poses to nontarget organisms in comparison to brodifacoum. Diphacinone has comparatively low persistence in animal tissues; the chemical does not stay very long in the body. This makes toxicity to nontarget species through secondary exposure less likely than for brodifacoum (Fisher 2009).

Diphacinone-50 (D-50) is a cereal bait product, available in 1-2 g pellets, with an added fish flavor. The bait contains 0.005% diphacinone. D-50 pellets are dyed green, which has been shown to make pellets less attractive to some birds and reptiles (Pank 1976, Tershy et al. 1992, Tershy and Breese 1994). D-50 bait product is similar to commercially available Ramik®Green bait products,

however D-50 is licensed by the State of Hawai‘i and labeled to allow aerial broadcast for “control of invasive rodents for conservation purposes on islands.” (D-50 Product Label, Appendix B.) The label also stipulates that D-50 may only be purchased by USDA APHIS Wildlife Services, USFWS, or NPS and used by Certified Applicators or persons under their direct supervision.

The physiological action of diphacinone is the same as for other anticoagulants such as brodifacoum; diphacinone interferes with the blood’s clotting ability and causes profuse bleeding. Although diphacinone can be lethal to some rats when administered in a single, large dose, it is relatively more potent in small doses administered over several days (Buckle and Smith 1994, Timm 1994). Several properties indicate that diphacinone generally takes longer than other anticoagulants to accumulate in a rodent and achieve a lethal dose. LD_{50}, or a single dose that is lethal to 50% of the test subjects in a population or study group, is a measure of acute oral toxicity. Single lethal doses of 1.93 - 43.3 mg/kg have been reported for laboratory rats, but doses of < 1 mg/kg over five successive days are more effective (Hone and Mulligan 1982, Jackson and Ashton 1992). Jackson and Ashton (1992) reported LD_{50} values over a five-day period of 0.21 and 0.35 mg/kg/day in domestic and wild Norway rats respectively. Tobin (1992) demonstrated that for mortality to occur, black and Polynesian rats required a mean of 8.6 mg/kg (11.8 - 28.4 g of pellet) and Norway rats required a mean of 10 mg/kg (34.6 g pellet) ingested over an average of six to seven days, with a range of between four and 12 days.

From an operational perspective, diphacinone bait should be available to all rats for 10 - 12 days. This requires that (a) the bait is highly attractive to rats to ensure that rats prefer it above natural food items, (b) that sufficient bait is available daily to ensure rats frequently encounter bait within their environment, and (c) that the consistent bait uptake in the environment through ingestion by rats, other animals, and degradation by invertebrate, microbial and other environmental action does not diminish the amount of bait available below sufficient daily ingestion levels for rats (USFWS 2015).

According to the Extension Toxicology Network[3], diphacinone has a low potential to leach in soil, and is rapidly decomposed in water by sunlight. Diphacinone is slightly toxic to birds. The LD_{50} for diphacinone in mallard ducks is 3,158 mg/kg, and in bobwhite quail is 1,630 mg/kg. Diphacinone is moderately toxic to fish species. The 96-hour lethal concentration for half the exposed subjects (LC_{50}) for diphacinone in channel catfish is 2.1 mg/L, in bluegills is 7.6 mg/L, and in rainbow trout is 2.8 mg/L. The 48-hour LC_{50} in Daphnia, a small freshwater crustacean, is 1.8 mg/L. Studies with cattle indicate a high degree of tolerance for the compound. Ramik, the rodenticide most commonly used by natural resource managers, contains 0.005% diphacinone.

From the perspective of nontarget risk, diphacinone is the optimum choice of registered rodenticides for natural areas in Hawai‘i. Laboratory trials have indicated that diphacinone has low toxicity to birds when compared with brodifacoum (Erickson and Urban 2004, Eisemann and Swift 2006). Recent research suggests that the toxicity of diphacinone to some birds may be considerably higher than previously thought (Rattner et al. 2010), yet overall, the toxicity of diphacinone still remains low compared with brodifacoum.

[3] Extension Toxicology Network is a pesticide information project of cooperative extension offices of Cornell University, Oregon State University, the University of Idaho, and the University of California at Davis and the Institute for Environmental Toxicology, Michigan State University funded by USDA. http://extoxnet.orst.edu/pips/diphacin.htm. Accessed October 13, 2009.

Bait palatability is another important aspect important for successful rat control and eradication. In field trials, the products Brodifacoum-25D and Ramik® Green (comparable to D-50) have both been shown to be preferred by most rats over locally available natural food sources (Pitt et al. 2011). While bait product choice is an important component of control efficacy, the most important component is the methodology used for bait delivery. Success is most often a function of how many rats within the target area are exposed to a lethal dose. Aerial broadcast of diphacinone is the most promising methodology for controlling rat populations within Lihue MU due to the large size of the management area, the brief and infrequent access windows for land management personnel, its severe terrain, UXO hazard, and low risk to nontarget species.

Issues and Concerns

- *Impacts to Soil and Water from the presence of the toxicant.*

Impacts to Soil and Water are addressed in the Affected Environment and Environmental Consequences Sections 4 and 5, respectively. Surface waters within the treatment area would be buffered by 50 feet. No rodenticide would be aerially broadcast within the buffered areas.

- *Impacts to the Marine Environment from the presence of the toxicant.*

Impacts to Water Resources are addressed in the Affected Environment and Environmental Consequences Sections 4 and 5, respectively. The Proposed Action would take place on Army owned land far from the ocean, in the Waiʻanae Mountains above Schofield Barracks. Haleʻauʻau Stream flows out of the treatment area through the Schofield Barracks West Range Impact Area and becomes intermittent (dries up) before leaving Schofield Barracks. No impacts associated with the Proposed Action have the potential to affect the marine environment.

- *Impacts to Birds and Reptiles*

Rat control activities would include the use of a toxicant that is lethal to rats. The impact of the toxicant to species other than rats or mongoose (another invasive rodent species approved to control with diphacinone bait in Hawaiʻi), and the persistence of the toxicant in the environment are important environmental issues related to impacts of the action to biological resources because animals other than rodents, including reptiles and birds, could ingest the toxicant either directly or indirectly. D-50 pellets are dyed green, which has been shown to make pellets less attractive to some birds and reptiles (Pank 1976, Tershy et al. 1992, Tershy and Breese 1994). No native reptiles are found in Hawaiʻi and several introduced species, including the Jackson chameleon have adverse impacts to rare endemic species in the Waiʻanae Range near Lihue MU (Chiaverano and Holland 2014). Even so, impacts to invasive reptile species are not expected to be significant due to their relatively low numbers in Lihue MU. The impact to birds is also of concern because many birds are known to be physiologically sensitive to anticoagulant rodenticides (Erickson and Urban 2004). In a recent hand-broadcast diphacinone study conducted in the Waiʻanae Range at Kahanahāiki, several common bird species survived and appeared healthy after some diphacinone ingestion (Shiels 2017). Overall, bird survival would benefit from reduced rodent predation.

Risk of rodenticide poisoning for an animal is based on both the toxicity of the chemical and its exposure to the chemical. Exposure can arise from directly ingesting the rodenticide (i.e., primary exposure) or eating an animal that has ingested the rodenticide (i.e., secondary exposure). Toxicity is taxa specific and is determined by the quantity of active ingredient (a.i.) for a given body weight

(bwt) to achieve a certain effect, usually measured as milligrams active ingredient (mg a.i.) / kilogram (kg) bwt. Toxicity is most frequently represented as the LD_{50} and LC_{50}. LD_{50} is the chemical dose where 50% of the test animals died and is usually administered as a single dose. LC_{50} is the concentration of the chemical in feed where 50% of the test animals died and the test is usually administered over a multi-day period (e.g., five to 10 days). A third measure of toxicity is the LLD, the lowest lethal dose of a chemical at which a test animal died. The lower the LD_{50}, LC_{50}, or LLD value, the more toxic the chemical, or more sensitive the species. LD_{50}, LC_{50}, and LLD measure the lethality of a chemical to the subject species. Toxicants are also evaluated by their sublethal effects on animals. These are represented by metrics, such as NOEL (no observable effect level) and LOEL (lowest observable effect level). NOEL is the highest dose or exposure level of a toxicant that produces no measureable toxic effect on the test group of animals and LOEL is the lowest dose or exposure level of a toxicant that produces a measurable toxic effect on the test group of animals. Sublethal effects observed in the anticoagulant acute oral studies included lethargy, subcutaneous, intramuscular, and internal hemorrhaging, piloerection, diarrhea, bloody diarrhea, and anorexia (Anderson et al. 2011).

Individual species of birds and mammals vary in their relative sensitivity (i.e., the toxicity) to different rodenticides. For mammals, diphacinone is considered "very highly toxic" as measured by acute oral toxicity (LD_{50}) and dietary toxicity (LC_{50}) (Anderson et al. 2011). For birds, the acute oral and dietary toxicity of diphacinone is considered "slightly toxic" and "moderately toxic," respectively. The Shiels (2017) hand-broadcast diphacinone study observed that some birds gained exposure, but there appears to be very little chance of mortality at these application rates.

- *Impacts to Visitors and Recreation*

Lihue MU is closed to the public. It is within SBMR and it is part of an active Army training range. Access is closely controlled due to potential conflict with training activities and unexploded ordnance hazards.

- *Impacts to Historical and Cultural Resources.*

Based on literature reviews and surveys previously conducted, known cultural resources are present within the Lihue MU. However, there is no potential to impact these cultural, archaeological or historic resources by implementing the Proposed Action.

3.2 Alternatives Considered

3.2.1 Basis for Considering only the No Action and Proposed Action Alternatives

This Proposed Action was first included as a requirement in the 2003 BO and then more specifically described in the 2008 OIP. The 2003 BO stated "the Army will pursue implementation and funding for the licensing and application of a more effective rodenticide including the broad scale distribution of rodenticides to improve rat control in remote areas, especially in areas with threatened and endangered species." The 2008 OIP resulted from a ten year process of extensive development by both the Mākua and Oʻahu Implementation Teams, with substantial input from participants including the U.S. Army, USFWS, State of Hawaiʻi, Nature Conservancy of Hawaiʻi, University of Hawaiʻi, U.S. Geological Survey, Oʻahu Plant Extinction Prevention Program, and independent botanists and ornithologists. It repeats the need to pursue "implementation of broad scale application of rodenticide in areas with threatened and endangered plants and animals." During OIP development and the subsequent NEPA evaluation, multiple landowners were consulted, including the U.S. Army, State of Hawaiʻi, the City and County of Honolulu, and private

landowners. The OIP was grounded in extensive experience with natural resource management actions, in particular threatened and endangered species protection.

The regulations implementing NEPA state that an environmental assessment must include alternative ways of meeting the need only if the project would involve "unresolved conflicts regarding alternative uses of resources of concern" (section 102(2)(E) of NEPA). This Proposed Action would take place in an area designated for conservation and watershed protection; therefore, there are no unresolved conflicts regarding alternative uses of resources of concern. As described below, an alternative that would solely use hand-broadcasting of rodenticide within Lihue MU was eliminated from consideration because it would not effectively meet the need to control rat populations on a broad enough scale to sufficiently aid Oʻahu ʻelepaio populations. No additional effective means of meeting the project objectives are known at this time. Therefore, no additional alternatives except the "No Action" alternative will be considered in this SEA.

3.2.2 Alternatives to be Evaluated in this Analysis

The Proposed Action and No Action alternatives will be evaluated in this document. The Proposed Action is described in Section 3.1.2.

3.2.2.1 No Action Alternative

Under the No Action Alternative, the Army would not implement the Proposed Action. The No Action Alternative represents a baseline activity level in which broadscale distribution of rodenticide would not be conducted. The No Action Alternative serves as a baseline against which to assess the environmental impacts of the Proposed Action. In accordance with CEQ regulations, the No Action Alternative is included to compare its impacts with the action alternatives (40 C.F.R. § 1502.14(d)). The No Action baseline in this analysis means that the Army will compare the environmental impacts of not conducting broadscale distribution of rodenticide with the impacts of applying diphacinone rodenticide from helicopter-borne buckets. Selection of the No Action Alternative would mean that the Army would not proceed with the Proposed Action.

3.2.3 Alternatives Eliminated From Further Consideration

3.2.3.1 Hand Broadcast of Rodenticide

An alternative to applying rodenticide by helicopter would be to apply rodenticide solely by hand which involves field technicians walking a grid of trails while evenly distributing rodenticide bait. At Lihue, bait would be spread 10 meters in all directions from locations spaced every 20 meters along the trails to each territory. This would provide continuous baiting 10 meters from each side of the trail throughout the trail system. The application rate at each "broadcast location" would be 13.8 kg/ha. Staff would use pre-measured bait containers for each location and broadcast the product by hand uniformly throughout the area. No bait would be cast into water.

UXO are present throughout Lihue MU and limit overland hiking. Due to area logistics, including difficult terrain, UXO safety and application costs, a hand broadcast method would only be applied along UXO cleared trails. This would severely limit the amount of area that could be treated and thus limit its effectiveness in controlling rat populations on a management unit scale. Using this hand-broadcast method, the total area treated would be ~33 ha. The linear treatment patterns would be narrow corridors surrounded by untreated territory. Re-invasion by rats would be very rapid and the temporary suppression achieved would be minimal. At Kahanahāiki Management Unit a hand-broadcast application was conducted over a 20 ha area and rat activity levels registered in the tracking tunnels were higher than pre-broadcast levels just 2 months after treatment. This

method would require a re-broadcast interval of every 2-3 months, demanding significantly more staff time and increasing the potential for unsafe contact with UXO. To achieve effective population control for a longer period of time a larger area must be treated.

Hand broadcasting rodenticide to suppress rat population for such a short period would be insufficient to enable Army compliance with the USFWS 2003 BO for the Oʻahu Training Areas. This could force the Army to restrict training options on Oʻahu. Oʻahu ʻelepaio may continue to decline in numbers due to the threats they face, which could ultimately lead to their extinction. For these reasons, USAG-HI has determined the hand broadcast alternative would not meet the need to effectively sustain ʻelepaio populations in accordance with the 2003 BO, and it was eliminated from further consideration.

4 AFFECTED ENVIRONMENT

This section describes the environmental resource areas which may be affected by the Proposed Action and No Action Alternative. More information about the existing environment affected by Army training and management activities throughout Oʻahu is included in the 2010 OIP PEA.

4.1 Topography and Soils

Elevation ranges and topography are described for each management unit in Section 3.2.1 of the 2010 PEA and management unit locations are shown on Figures 1a – 2b of the 2010 PEA.

4.1.1 Waiʻanae Range Management Units

For the management units found in the Waiʻanae Range near SBMR (Lihue, Kaʻala, Manuwai, and East Makaleha), Tropohumults-Dystrandepts soils are common in the mountainous areas. Areas of the Lihue MU consist of Helemano Silty Clay with 30 to 90% slopes. Soil erosion is locally significant in areas where natural drainage and gulches occur; however, the dry climate and lack of permanent streambeds may reduce the risk of erosion, as well as in areas where soils are not as well developed because of exposed lava.

4.2 Water Resources

4.2.1 Groundwater Resources

On Oʻahu, there are six groundwater aquifer sectors (Honolulu, Pearl Harbor, Waiʻanae, North, Central, and Windward). Aquifer sectors reflect broad hydrogeological similarities, yet maintain traditional hydrographic, topographic, and historical boundaries. Aquifer systems, subsets of aquifer sectors, are more specifically defined by hydraulic continuity among aquifers in the system (Yuen 1990). The 2010 PEA describes the characteristics of these aquifers in greater detail. All of the aquifer systems overlain by the OIP management units share the characteristics of being fresh water, irreplaceable, and highly vulnerable to contamination. Lihue MU overlays parts of two aquifer systems: Mokulēʻia (in the North Sector) and Wahiawa (in the Central Sector). The Wahiawa Aquifer is currently used for drinking water.

4.2.2 Surface Water Resources

There are many ephemeral drainages and intermittent streams which flow from upper elevations through the management units in the Waiʻanae and Koʻolau mountains. These streams generally flow during precipitation events and for a short period thereafter. Haleʻauʻau is the sole perennial stream located within the Lihue MU Treatment Area. It flows east from Lihue MU directly

through the SBMR Impact Area which contains a wide range of both exploded and unexploded ordnance. Before leaving SBMR, Haleʻauʻau Stream percolates to the water table and becomes an intermittent stream that flows only during substantial precipitation events. Haleʻauʻau sometimes disappears above the firebreak road on the upper side of the SBMR Impact Area. Haleʻauʻau Stream is part of the Kaukonahua Watershed that eventually empties into Kaiaka Bay, Waialua. Figure 8 depicts surface waters related to the Lihue MU.

The State of Hawaiʻi DOH Clean Water Branch assigns surface water quality standards based on the CWA requirements. Surface waters, generally ephemeral streams in the uppermost portions of the Waiʻanae and Koʻolau mountains, are classified as Class 1 (Inland Freshwater) water (HAR 11-54-3). The objective of Class 1 waters is that the waters remain in their natural state as nearly as possible with an absolute minimum of pollution from human-caused sources. Conduct resulting in demonstrable increases in point or nonpoint source contamination is prohibited. Haleʻauʻau Stream and other ephemeral streams in Lihue MU are designated Class 1 waters.

4.3 Climate/Air Quality

The State of Hawaiʻi DOH Clean Air Branch monitors the ambient air in the state of Hawaiʻi for gaseous and particulate air pollutants. The U.S. EPA has set national ambient air quality standards (NAAQS) for six criteria pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, ozone, and particulate matter (40 CFR Part 50), and Hawaiʻi has established state standards for the criteria pollutants plus hydrogen sulfide (HAR 11-59) which are as stringent or more stringent than the NAAQS. The island of Oʻahu is an attainment area for the NAAQS and state standards. The nearest air monitoring stations on Oʻahu are in industrial areas on the south and southwest coast of the island. The proposed treatment area is within undeveloped, naturally forested mid-slope mountainous terrain; there are no man-made structures or emission sources.

4.4 Noise Environment

The State of Hawaiʻi DOH Indoor Radiological Health Branch has promulgated Community Noise Control rules (HAR 11-46) which define maximum permissible sound levels for various zoning districts. The Lihue MU is located in a Class A zoning area, which includes lands zoned residential, conservation, preservation, public space, open space, or similar. Maximum permissible sound levels in dBA (decibels on the A-weighted scale) for Class A zoning districts are 55 dBA daytime (0700 to 2200) and 45 dBA nighttime (2200 to 0700), measured at the property line. According to HAR 11-46-4(c), noise levels shall not exceed the maximum permissible sound levels for more than 10% of the time within a twenty minute period, except by permit or variance.

Generally, little ambient noise is produced from within the management units, as they are far removed from residential or agricultural areas, and there are no man-made structures or sensitive noise receptors (such as schools, hospitals, or churches). Management units adjacent to training areas may receive occasional noise from vehicles, aircraft, artillery, and human activity.

4.5 Biological Resources

Biological resources (endangered plants, birds, and snails) are described in extensive detail in the OIP. The descriptions of these resources in this document are derived from the OIP. Many non-native species are also found in Lihue MU. The species within Lihue MU that are listed as endangered or threatened under the Endangered Species Act are found in Table 1.

Table 1. ESA Listed Endangered Plants and Animals Found in Lihue Management Unit

Plants	Common Name	Animals	Common Name
Alectryon macrococcus macrococcus	māhoe	Drosophila montgomeryi	picture wing fly
Asplenium dielfalcatum		Drosophila substenoptera	picture wing fly
Chrysodracon forbesii	halapepe	Drosophila obatai	picture wing fly
Cyanea calycina	haha	Chasiempis ibidis	O'ahu 'elepaio
Cyanea grimesiana obatae	haha	Achatinella mustelina	kāhuli (O'ahu tree snail)
Delissea waianaeensis		Lasiurus cinereus semotus	ōpe'ape'a (Hawaiian hoary bat)
Flueggea neowawraea	mehamehame		
Gardenia mannii	na'u, nanu		
Hesperomannia oahuensis			
Labordia cyrtandrae	kamakahala		
Lepidium arbuscula	anaunau		
Nothocestrum latifolium*	aiea		
Phyllostegia mollis			
Platydesma cornuta var. decurrens			
Pteralyxia macrocarpa	kaulu		
Schiedea hookeri			
Schiedea kaalae			
Sicyos lanceoloidea	anunu		
Stenogyne kanehoana			
Plantago princeps	laukahi kuahiwi, 'ale		
Tetramolopium filiforme			
*Threatened			

4.5.1 Flora

A variety of native species and habitats exist in the Waiʻanae and Koʻolau mountains. The Waiʻanae mountains contain a significant portion of the rare plant taxa in the Hawaiian Islands. OIP target plants are ESA listed endangered species endemic to the Hawaiian Islands (see OIP Table 5, p. 45), and the majority of the target species are endemic to Oʻahu alone. Many species are endemic to their respective mountain range and are some of the state's rarest species. Most of the rare Waiʻanae species are associated with native-dominated vegetation in mesic (moderately moist) habitats to wet boggy forest at the summit of Kaʻala.

4.5.2 Fauna

Target faunal species are listed in OIP Table 6 (OIP, p. 46). Animal life in the upper elevations of the Koʻolau and Waiʻanae mountains generally consists of a majority of non-native and a few native bird species, and large and small non-native mammals such as feral pigs, feral goats, mongooses, rats, and mice.

4.5.2.1 Birds and Mammals Present in Lihue Management Unit

Several species of native and non-native birds and mammals present in the Waiʻanae Mountains are protected under the ESA, MBTA, or State of Hawaiʻi statutes. The Hawaiian hoary bat (*Lasiurus cinereus semotus*) is one such species. Hoary bats populations are thought to be increasing on O'ahu but no hoary bats have been observed in Lihue MU. Hawaiian hoary bats have been detected along the SBMR Impact Area firebreak road using echolocation bat detectors. It is impossible to determine the number of bats utilizing SBMR with the tools available, thus the Army

can only conclude that bats are present within SBMR. Feral pigs are common in the Waiʻanae mountains, however, the Lihue MU ungulate-proof fence keeps feral pigs or goats out of the management unit. Monitoring activities are ongoing to ensure no ungulates enter or remain within the Lihue MU exclosure.

Native bird species such as the ʻamakihi (*Hemignathus flavus*) ʻiʻiwi (*Vestiaria coccinea*) and ʻapapane (*Himatione sanguinea*), members of the honeycreeper family, have been observed at high elevations in the Waiʻanae mountains, and may be present in Lihue MU. The ʻiʻiwi (*Vestiaria coccinea*) is being proposed for ESA listing and is still found in some forested areas on O'ahu, but it is rare. The last time an ʻiʻiwi was observed in Lihue MU was in 1999 (Kawelo, pers. comm.). The Oʻahu ʻelepaio (*Chasiempis ibidis*) is a native forest bird endemic to Oʻahu which has been in decline for decades due to low adult survival and low reproductive success resulting mainly from nest predation by rats and introduced diseases such as avian pox virus. In 2000, USFWS granted the Oʻahu ʻelepaio endangered species status under the federal Endangered Species Act and designated critical habitat on Oʻahu for the ʻelepaio in 2001. This project's purpose is to control rodents threatening Oʻahu ʻelepaio populations in Lihue MU.

Birds Protected by the MBTA that are not listed under the ESA

Additional native bird species are protected by the Migratory Bird Treaty Act (MBTA), but not the ESA: Pacific golden plover or kōlea (*Pluvialis fulva*), Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis)*, ʻamakihi (*Hemignathus virens virens)*, ʻapapane (*Himatione sanguinea)*. Non-native species introduced from mainland U.S. that are also protected by the MBTA include barn owl (*Tyto alba*), house finch (*Carpodacus mexicanus*), and northern cardinal (*Cardinalis cardinalis*).

Lihue MU is heavily forested and kōlea, pueo, and barn owls primarily inhabit open country. Pueo have never been observed in the forested treatment area (Kawelo, pers. comm.). Although individual kōlea and barn owls may at times be found in Lihue MU, they are not expected to be commonly present in Lihue MU.

Game birds and mammals

Some game birds, all non-native species, are also present in Lihue MU. Zebra dove *(Geopelia striata)*, spotted dove *(Streptopella chinensis)*, and Erckel's francolin *(Francolinus erckelli)* could be present. These birds are protected under Hawaiʻi state game regulations (DOFAW 2002).

State protected, non-game birds

Several species of native and non-native birds, which are not game species, are protected by the State of Hawaiʻi: Oʻahu ʻelepaio (*Chasiempis sandwichensis ibidis)*, rock dove (*Columba livia*), Japanese bush-warbler (*Cettia diphone*), nutmeg mannikin (*Lonchura punctulata*), and red-billed leiothrix (*Leiothrix lutea*).

Vertebrates Without Protected Status

Several species of invasive mammals with no protected status could also be present in Lihue MU: feral cat (*Felis catus*), small Indian mongoose (*Herpestes auropunctatus*), black rat (*Rattus rattus*), house mouse (*Mus musculus*); and one introduced bird with no protected status could also be present: Japanese white-eye (*Zosterops japonicus*).

4.5.2.2 Other Terrestrial Species in Lihue Management Unit

There are no native reptiles in the Hawaiian Islands. Cannibal snail *(Euglandina rosea)*, giant African snail *(Lissachatina fulica)*, and various non-native reptiles including skinks, lizards, and geckos are present within Lihue MU. Introduced Jackson chameleon could also be present. Non-native invasive species have substantial negative impacts to native flora and fauna.

4.5.2.3 Aquatic Organisms

A biological survey of O'ahu training area streams was conducted in 1997 and the Haleʻauʻau drainage was included in this aquatic survey. A handful of endemic and introduced aquatic species were observed, but none were considered rare or threatened. No Megalagrion damselflies were observed. The survey report did note the upper reaches of Haleʻauʻau exhibited "relatively high habitat quality, and the stream was rich in Megalagrion species historically." The report recommended Haleʻauʻau "be considered for trial reintroductions of any of the Megalagrion historically known from the area, which includes currently rare and endangered taxa."

Subsequent incidental observations during regular site visits to Lihue MU have noted *Megalagrion hawaiiensis, Anax strenuous*, bullfrog *(Rana catesbiana)* and wrinkled frog *(Rana rugose)*.

4.6 Cultural, Historic, and Archaeological Resources

Archeological sites and/or cultural resources, including prehistoric and contact period sites as well as historic era features, have primarily been identified at lower-elevation flat lands and stream gulches within military lands on Oʻahu. Historic settlement (as early as AD 100 to 800) typically started along the coastline, with the population relying on the wealth of marine resources for subsistence. As populations and subsistence demands increased, settlements expanded inland to take advantage of upland resources and more reliable water sources. Archaeological resources are diverse and may include heiau (religious structures), koʻa (small shrines), fishponds, fishing shrines, habitation sites, caves and rock shelters, mounds, burial platforms, stone walls and enclosures, agricultural terraces, canals or ditches, rock art sites, and trails (Tomonari-Tuggle 2002, as cited in Tetra Tech 2004). Historic period archaeological sites may include gun emplacements, concrete structures and bunkers, concrete walls, wooden structural remains, masonry platforms, concrete revetments, bermed depressions, berms and rock piles, tunnels, miscellaneous feature complexes, road beds, railroad remnants, and trash deposits.

4.7 Land Use/Recreational Resources

Management activities supporting native plant and animal species are ongoing in much of the Waiʻanae and Koʻolau mountains. Portions of the Waiʻanae mountains, including some of the management units described in the OIP, are designated reserves of the state Natural Area Reserve System (NARS), and the land is managed primarily to protect and preserve native ecosystems and species. Natural Area Reserve (NAR) managers actively conduct ungulate and weed management, native vegetation restoration, and native species reintroduction.

The Army's environmental program is engaged in a variety of active management programs in SBMR and other selected areas of the Waiʻanae mountains. Ongoing Army programs for rare plant, snail, ʻelepaio, and insect protection include fencing, ungulate control, weed control, predator control and native vegetation restoration.

State Forest Reserves also occur in both the Waiʻanae and Koʻolau mountains and provide protective conservation zoning and programs for public hunting. Hiking and hunting are the

primary recreational uses within the Forest Reserves. Board of Water Supply lands in the Waiʻanae mountains are designated as protected watershed with limited public access.

No hunting is allowed in Lihue MU. Feral pigs are kept out of the unit by ungulate-proof fencelines, however some areas near Lihue MU are within Public Hunting Areas. Hunting is allowed in a portion of the Mokuleīʻa Forest Reserve and in the Kaʻala NAR when an entry permit is granted by the Oʻahu NARS manager. Hunters must be accompanied in the Forest Reserve and NAR by a staff member of the Division of Forestry and Wildlife (DOFAW). Game allowed to be taken in the Public Hunting Areas includes feral pigs and feral goats, and birds including ring-neck pheasant, green pheasant, California valley quail, Japanese quail, Gambel's quail, Erckel's francolin, gray francolin, black francolin, chukar partridge, barred dove (small dove), and spotted dove (large dove). Permitted hunting methods include rifles, shotguns, handguns, knives, spears, and bows and arrows. Dogs are permitted but must be kept under physical restraint and control except when actually hunting.

Lihue MU lies within the state Land Use Conservation District. The Conservation District Subzone for most of Lihue MU is "Resource." The Proposed Action treatment area is fully contained in the "Resource" subzone. A portion of Lihue MU has been assigned a Conservation District Subzone of "Protective." The Protective subzone includes the most environmentally sensitive areas. Federal agency activity on federal land shall be carried out in a manner which is consistent, to the extent practicable, with the policies of approved state management programs.

4.8 Socioeconomic Environment

Lihue MU is located in an undeveloped portion of SBMR. It is owned by the federal government. Nearby population centers include Schofield Barracks, but no public access or commercial activity is authorized in Lihue MU, as it is part of SBMR West Range.

4.9 Visual and Aesthetic Resources

Visual resources are usually defined as the visual quality or character of an area, consisting of both the landscape features and the social environment from which they are viewed. Visual characteristics of the project area and surrounding regions include undeveloped forested land, mountain ridges, military training areas and views of the Pacific Ocean. Views from within the project area can include local unique landforms, sweeping views of mountain ridges, and panoramic coastal views. Scenic vistas and views of the area from public settings include views of the undeveloped mountains.

4.10 Environmental Justice and Protection of Children.

Lihue MU is Army owned land located in an undeveloped portion of SBMR. It is completely surrounded by military lands and state forest reserves. Nearby population centers include Schofield Barracks, but no public access or commercial activity is authorized in Lihue MU.

5 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND NO ACTION ALTERNATIVE

This section describes the potential environmental consequences associated with the Proposed Action and the No Action Alternative. The Proposed Action is described in Section 3. This section has been organized by resource area to provide a comparative framework for evaluating the

impacts of the Proposed Action and the No Action Alternative. Table 2 summarizes the impacts of the Proposed Action on the relevant resource areas of the affected environment.

5.1 Impact Methodology and Significance Criteria

Project actions are evaluated by their potential direct, indirect, and cumulative effects. Direct impacts are those caused by project actions and occur at the same time and place. Indirect effects are those caused by project actions and are later in time or farther removed in distance. Impacts may be short term or long term, depending on how resource areas are affected during the course of the project implementation and operation. Cumulative impacts are addressed in Section 7.

Quantitative and qualitative analyses were used to determine whether, and the extent to which, a significance threshold would be exceeded. Based on the results of these analyses, this SEA identifies whether a particular potential impact would be adverse or beneficial, and to what extent. Context and intensity were taken into consideration in determining a potential impact's significance, as defined in 40 CFR Part 1508.27. The severity of environmental impacts has been characterized as none, negligible, minor, moderate, significant, or beneficial:

- None – No impacts are expected to occur.
- Negligible – An impact so small, it is not detectable or so small it would be discountable.
- Minor – A minor impact would either be isolated and localized, not measurable on a wider scale, or so insignificant it would be discountable.
- Moderate – A moderate impact would be measurable on a wide scale (e.g., outside the footprint of disturbance or on a landscape level). If it was adverse, it would not exceed limits of applicable local, state, or federal regulations.
- Significant – A significant impact could exceed limits of applicable local, state, or federal regulations or would untenably alter the function or character of the resource. It would be considered significant unless mitigable to a less than significant level.
- Beneficial – This impact would benefit the resource/issue.

Impacts that range from none to moderate are considered less than significant. Examples of potential impacts that would be considered significant would be ones that:

- Cause the "take" of a highly sensitive resource, such as a threatened, endangered, or special status species;
- Damage or degrade wetlands or riparian habitat regulated by the local, state, or federal government, or another sensitive habitat (such as designated critical habitat) identified in local or regional plans, policies, or regulations or by the USFWS;
- Introduce or increase the prevalence of undesirable non-native species;
- Cause long-term loss or impairment of a substantial portion of local habitat (species-dependent);
- Degrade water quality in a manner that would reduce the existing or potential beneficial uses of the water; or
- Cause impacts to human health or safety.

Table 2. Potential Environmental Impacts of Proposed Action and No Action Alternative

		Broadscale Rodenticide Application (Proposed Action)	No Action Alternative
Resource Areas	Topography and Soils	Minor short-term impact	Moderate long-term impact
	Groundwater/Surface water	Minor short-term impact	None – No Impact
	Air Quality	Negligible Impact	None – No Impact
	Noise Environment	Minor short-term impact	None – No Impact
	Biological Resources	Beneficial impact; minor short-term impact	Moderate long-term impact
	Cultural/Historical/ Archaeological Resources	None – No Impact	None – No Impact
	Land Use/Recreation	Negligible Impact	None – No Impact
	Socioeconomic Environment	None – No Impact	None – No Impact
	Visual/Aesthetic Resources	None – No Impact	None – No Impact
	Environmental Justice	None – No Impact	None – No Impact

5.2 Topography and Soils

The Proposed Action and No Action Alternative were evaluated to determine the significance of change to the topography and soil resources. Factors considered in determining whether the Proposed Action would have a significant impact on topography and soils include the extent to which its implementation would do the following: 1) contaminate the soil; 2) cause a substantial loss of soil, such as through increased erosion; 3) increase the likelihood of slope failure; or 4) alter the function of the landscape, such as altering drainage patterns.

5.2.1 Proposed Action

No significant impacts to topography or soils would occur from the Proposed Action. Effects to topography or soils would be minor. The very low concentration of diphacinone in bait pellets would not lead to measurable soil contamination beyond the localized soil beneath an uneaten and decaying bait pellet. D-50 is not persistent in soil. The half-life in soil is 30 to 60 days for diphacinone, depending on the soil type (USFWS and DOFAW 2008). Diphacinone has extremely low solubility in water and binds tightly to organic material in soil where the rodenticide is degraded by soil micro-organisms and exposure to oxygen and sunlight. Microbial degradation is dependent on climatic factors such as temperature and the presence of microbes enabling degradation. Therefore, degradation times will be longer in colder climates and shorter in warmer places like Hawai`i (Eason and Wickstrom 2001, Eisemann and Swift 2006). Hawaiʻi forest environments are generally warm and moist and these conditions promote rapid degradation of the chemical. Soil samples collected one week after diphacinone aerial bait application on Lehua Island in Hawaiʻi resulted in little to no detectable concentrations of diphacinone (Orazio et al. 2009). On Palmyra Atoll in 2010 two out of 48 samples tested had concentrations of the diphacinone high enough to be quantified (soil collected directly under a pellet), all other samples yielded a zero (undetectable) or ‘trace’ value (Island Conservation 2010a).

5.2.2 No Action Alternative

Under the No Action Alternative, high levels of rats would remain within Lihue MU and would continue to burrow in areas with a substantial soil layer. Through comparisons of rat-invaded and rat-free islands, rats have been shown to reduce soil fertility, and the diversity and abundance of soil fauna (Fukami et al. 2006, Towns et al. 2009). Consequently, under the No Action Alternative, soil fertility and invertebrate diversity would remain reduced and less capable of supporting healthy native Hawaiian habitat; such degradation adds to the potential for impacts to spread beyond Lihue MU resulting in moderate, long-term impacts.

5.3 Water Resources

The evaluation of potential impacts on water resources is based on the project's potential to contribute to lower water quality. The Proposed Action and No Action alternatives were considered to have a significant impact on the resource if they were to result in the following: 1) cause a substantial increase in sedimentation; or 2) degrade water quality in a manner that would reduce the existing or potential beneficial uses of the water.

5.3.1 Proposed Action

D-50 has been registered by EPA and licensed by the State of Hawaiʻi for conservation purposes using aerial and ground broadcast application techniques. Before EPA may register a pesticide under FIFRA, the applicant must show, among other things, that using the pesticide according to specifications "will not generally cause unreasonable adverse effects on the environment" (EPA 2017). Scientific research corroborates the Army's determination that the Proposed Action would not degrade Lihue MU water quality in a manner that would reduce its existing or potential beneficial use. The broadcast distribution of D-50 would have minor short-term impacts to groundwater or surface water resources.

Surface waters within Lihue MU, will be buffered by 50 feet. Rodenticide will not be aerial broadcast into these buffer areas. In some places D-50 may be hand applied within the stream buffer areas with care taken to avoid water. Diphacinone has extremely low solubility in water and binds tightly to organic matter in soil, where the rodenticide is degraded by soil micro-organisms and exposure to oxygen and sunlight. Upon breakdown of any uneaten bait, most of the chemical is expected to remain in the top soil layers, and its potential to reach ground water is very low. Bait contact with surface water, although unlikely, may occur in less-permeable areas and in areas closer to streams. In the event of reaching surface water, diphacinone would be expected to be partitioned into the suspended and bottom sediments instead of the water column. (USFWS 2016, Eisemann and Swift 2006)

If heavy precipitation events are forecasted, the application would be postponed to prevent potential runoff or floodwater transport of additional bait pellets to surface waters. If the forecast reduces the operational window to eliminate an opportunity for two distributions then a single higher dose may be applied (per label instructions).

Seawater sampling conducted both one day and one week after aerial application of diphacinone pellets to Lehua Island in January 2009 found no diphacinone residues in seawater surrounding Lehua Island (Orazio et al. 2009). Similarly, water sampling conducted after aerial application of diphacinone pellets to Mokapu Island in February 2008 found no diphacinone residues in the seawater samples (Gale et al. 2008). This low water solubility decreases the likelihood of exposure of aquatic organisms to dissolved rodenticides. Furthermore, the Lihue MU is located far from

marine resources, whereas both the Lehua Island and Mokapu Island applications treated each entire island including shoreline areas.

5.3.2 No Action Alternative

No impacts are expected from the No Action Alternative.

5.4 Climate/Air Quality

Potential air quality impacts from the alternatives were assessed by evaluating emissions and dust generated from helicopter and vehicular use. The likelihood of exceeding federal or state ambient air quality standards was considered in determining whether the Proposed Action would have a significant impact on air quality.

5.4.1 Proposed Action

No significant impacts to air quality are expected from the Proposed Action. Emissions from the engine exhaust system of a helicopter would be generated during the application operation. Emissions generated by the helicopter would be negligible, over the course of the two applications within the single rodenticide treatment. Each application would span two to four days. The two applications would be separated by 5 to 7 days, and they would not cause an exceedance of either state or federal ambient air quality standards.

Some fugitive dust may be generated by helicopter hovering during bucket loading, however this would be localized for very short periods. Dust emissions would be negligible.

5.4.2 No Action Alternative

No significant impacts are anticipated from the No Action Alternative. Potential sources of air quality impacts (helicopter exhaust and fugitive dust from helicopter operations) would not be generated.

5.5 Noise Environment

Potential effects of the Proposed Action and No Action Alternative on noise were evaluated by examining the typical noise that would be generated by helicopter operations. Factors considered in determining whether an alternative would have significant impacts include the extent to which its implementation would do the following: 1) generate new sources of substantial noise; 2) increase the intensity or duration of noise levels to sensitive receptors; or 3) expose people to high levels of noise.

5.5.1 Proposed Action

No significant impacts to the noise environment are anticipated from the Proposed Action. Noise associated with the Proposed Action would be due to helicopter operations. A single helicopter would be used to conduct the aerial broadcast application. This would result in a minor impact from a localized increase in noise; however, helicopter use would be for two overflights separated by 5 to 7 days. This constitutes a short exposure duration, and operations would be spread out over the entire 714 ha management unit. Helicopter use is common at SBMR and this use would not substantially add to these common types of noises at SBMR. In addition, the Proposed Action would take place away from populated areas.

5.5.2 No Action Alternative

No significant impacts to the noise environment are anticipated from the No Action Alternative. There would be no noise associated with rodenticide application under this alternative.

5.6 Biological Resources

Impacts on biological resources were assessed based on whether the activities would be consistent with applicable natural resource statutes, executive orders, permits, and regulations. An action is considered to have a significant impact on a biological resource if it would result in the following: 1) harm, harassment, or destruction of any endangered, threatened, or rare species, its habitat, migration corridor, or breeding area; 2) cause a reduction in the population of a sensitive species; or 3) introduce or increase the prevalence of undesirable nonnative species.

No significant impacts to biological resources are anticipated from the Proposed Action to apply D-50 rodenticide within the Lihue MU ungulate-proof fence area. The broadscale application of rodenticide, including the aerial application of rodenticide, was specifically identified in the 2008 OIP as an important management action needed to stabilize many plant and animal species throughout the Oʻahu AA. The OIP is a result of close coordination between the USFWS and the U.S. Army. The core goal of the OIP is the continued existence and benefit to listed endangered species. Actions planned in the OIP, including this Proposed Action, are expected to result in long-term net benefits to the listed threatened and endangered species within the Oʻahu AA, which would far outweigh potential short-term negative impacts. The Proposed Action would result in the control of the main threats to Oʻahu ʻelepaio in the area, which should benefit ʻelepaio and lead to an increase in the number of individuals of these species and an increase in the quality of their habitat. Other native Hawaiian plant and animals will also benefit from reduced rodent pressure resulting in healthier native habitat conditions. There is the potential for minor, short-term impacts to nontarget species. Negative impacts that could occur will be minimized through implementation measures and best management practices (BMPs) incorporated into the Proposed Action.

5.6.1 Flora

Plants are not known to be susceptible to toxic effects from diphacinone (USFWS 2015).

5.6.1.1 Proposed Action

D-50 is nontoxic to plants and would have no effect on them, however control of invasive rodents will benefit endangered and other native plants. Invasive rodents eat the fruit of many native plants and facilitate the spread of invasive plants they have eaten. Controlling invasive rodents would improve conditions and be beneficial for individual native plants and benefit native plant populations (USFWS 2003).

5.6.1.2 No Action Alternative

Impacts to plants from continuing the present rat control practices without broadscale rodenticide application has the potential to be moderate, long-term and negative. Using the present control means, rat populations have not been adequately limited. Endangered and native plant species continue to be negatively impacted by rodent predation (USFWS 2003). As a result, the long-term impacts of continuing the existing management activities under the No Action Alternative would be the continued degeneration of the native forest within Lihue MU. As Lihue MU forest degradation continues the potential for increased degeneration beyond Lihue MU increases.

5.6.2 Fauna

Potential impacts may occur from rodenticides on nontarget species (e.g., pigs or birds); either from accidental direct consumption or consuming affected rodents. Both primary (direct consumption) and secondary hazards (consuming a poisoned rodent) can occur from rodenticide use. These impacts would be minor, short term and localized. There is also the potential for some nontarget species individuals to benefit from reduced predatory pressure.

5.6.2.1 Proposed Action

The proposed treatment area within Lihue MU is enclosed by ungulate-proof fencelines that prevent pigs and goats from entering the area. The Lihue MU ungulate exclusion is formed almost entirely by ungulate-proof fencing and gates. In several locations along the fenceline severe topographic features such as cliffs prevent ungulate passage (and feasible fence construction). Ongoing monitoring, fence maintenance, and control work maintain the ungulate exclusion. The entire treatment area is within the ungulate exclusion area so feral pigs and goats outside the exclusion area will not be exposed to any rodenticide.

Birds that are most at risk from feeding directly on rodenticides are those that are naturally inquisitive, terrestrial ground-feeders, and that have a diet that includes grains and seeds. The risk of secondary poisoning is greatest for predatory and scavenging birds, especially those that feed directly on the target rodent species, such as owls. In order to consume sufficient diphacinone bait to reach a dose equivalent to the LD_{50} for the northern bobwhite (or a single dose that is lethal to 50% of test subjects), a passerine bird would have to eat 0.53 pounds of bait or 5,027 pounds of invertebrates in one day. Neither of these amounts is even physically possible (USFWS and DOFAW 2008).

However, hazard calculations for sublethal exposure show that a 30 g bird, such as a small passerine, would only need to eat 0.07 g (a 100^{th} of a bait pellet, or 0.2% of its body weight) or 0.65 g of invertebrates per day for multiple days to ingest a dose that resulted in measurable blood clotting effects in golden eagles. Therefore, small passerine birds could be vulnerable to sublethal or possibly lethal effects through both primary and secondary exposure if they forage on diphacinone bait or contaminated invertebrates over time (Eisemann and Swift 2006).

Species protected by the Endangered Species Act (ESA)

Oʻahu ʻelepaio – ʻElepaio belong to the large family of monarch flycatchers and prefer feeding on insects and spiders. The Proposed Action is not likely to adversely affect ʻelepaio since it is not likely that forest birds will consume enough insects that have come in contact with the diphacinone rodenticide to cause lethal or sublethal effects (USFWS 2014). The USFWS concurs with this determination (See USFWS Concurrence Letter, Appendix C). Managers actively monitor ʻelepaio territories in Lihue MU and regularly maintain traps in an effort to curb rat predation of nests and birds. Diphacinone bait stations have been used in the past to reduce rat predation of ʻelepaio in Lihue MU, however a change in label direction has eliminated this option in Lihue MU. No adverse impacts to ʻelepaio have been observed during long term use of diphacinone bait stations. It has been documented that Oʻahu ʻelepaio reproductive success dramatically improves in rat controlled environments (del Hoyo 2006). Oʻahu ʻelepaio populations will benefit substantially from the Proposed Action to control rodent populations in Lihue MU. Reduced rodent predation on ʻelepaio nests, in particular, will improve ʻelepaio reproductive success and nestling survival rates, thus leading to more sustainable ʻelepaio populations.

Hawaiian hoary bat – The Hawaiian hoary bat has been observed in the vicinity of Lihue MU. Although no hoary bats have been observed within the treatment area, it is assumed they may occur in Lihue MU. Hoary bats are insectivorous and could possibly forage in areas where rodenticide is used, however "the likelihood that bats will ingest sufficient numbers of potentially contaminated insects to accumulate a dose at which effects could occur is extremely low." (USFWS 2014). Thus, no bats are likely to be affected by the Proposed Action. The USFWS concurs with this determination (See USFWS Concurrence Letter, Appendix C).

Oʻahu tree snail – Primary or secondary poisoning from diphacinone is not likely to occur for the Oʻahu tree snail since it primarily forages on fungus that grows on trees. Oʻahu tree snails primarily forage in trees and it is not likely it will come into contact with the rodenticide on the ground. The USFWS concurs with the determination that any effects are discountable and therefore not likely to adversely affect the Oʻahu tree snail.

Primary or secondary poisoning from diphacinone is not likely to occur for the Hawaiian picture-wing fly since it primarily forages on decaying plant matter. The USFWS concurs with the determination that any effects are discountable and therefore not likely to adversely affect the Hawaiian picture-wing fly.

Species protected by the Migratory Bird Treaty Act (MBTA)

ʻApapane and ʻAmakihi – ʻApapane and ʻamakihi are at extremely low risk of impact from the Proposed Action due to their food habits. They feed on nectar, and foliar insects and spiders, and forage primarily in the mid- to upper strata of the forest canopy. ʻAmakihi are also at relatively low risk due to their diet. They feed mostly on insects, and other arthropods, nectar, fruit, and sap. Some of the invertebrate taxa that ʻamakihi consume could potentially eat rodenticide baits; however, the bird mostly gleans insects from trees, ferns, and shorter plants (USFWS 2014). Therefore no ʻapapane or ʻamakihi would be affected by the Proposed Action.

ʻIʻiwi – The ʻiʻiwi was last observed in Lihue MU in 1999. The ʻiʻiwi is proposed for endangered status, but populations are unlikely to be impacted by the proposed rodenticide application. It is a nectar feeder and not likely to encounter rodenticide residues through normal feeding. Because of the rare presence of this bird on the island of Oʻahu and its normal diet of nectar, populations of ʻiʻiwi are not likely to be affected by the proposed action. The USFWS concurs with this determination (See USFWS Concurrence Letter, Appendix C).

Kōlea – Even if Pacific golden plover or kōlea were to pick up diphacinone bait pellets, an individual would have to consume approximately 1,200 g (almost 2.7 pounds) of diphacinone bait to deliver an LD_{50}–equivalent dosage (based upon the lower reported acute oral LD_{50} of >400 mg/kg body weight for bobwhites). It would be physically impossible for kōlea to consume that much bait in one or several days. The projected LOEL (extrapolated from the lowest reported LOEL for diphacinone in birds, 0.11 mg/kg/day, Savarie et al. 1979) of diphacinone for a Pacific golden-plover is 0.02 mg/day or about 0.3 gram of bait per day. As long as bait is present in the area, such a level of non-lethal exposure would be possible (USFWS 2014). However, kōlea are not common in the treatment area because they favor open rangeland habitat and they would likely not consume bait based on their preference for insects, worms, crustaceans and spiders.

Northern cardinal – Cardinals eat a wide range of seeds, fruits, and invertebrates (Halkin et al. 1999), indicating they would likely consume the rodenticide baits or the invertebrates feeding on the baits if available. However cardinal numbers are thought to be low in Lihue MU, and they are

predominantly canopy dwellers so relatively few cardinals would have the potential to be affected. Population level effects are highly unlikely.

House finch – Incidental impacts to house finches may result from the Proposed Action. House finches are canopy dwellers observed within Lihue MU. House finches primarily eat vegetation, much of their diet consisting of seeds (Badyaev et al. 2012); so they could possibly eat the grain-based bait. A 22 g house finch would need to eat about 25% of a diphacinone pellet per day over multiple days (e.g., 5 days) to ingest a LLD. To receive a sublethal dose, that same bird would need to eat about 4% of a pellet per day over multiple days. These impacts are unlikely to occur, and lead to population level effects.

Owls – Pueo or Hawaiian short-eared owl are not present in the treatment area and typically forage in open country. Therefore, no pueo would be affected by the Proposed Action. Barn owls only capture live prey and therefore would not ingest grain-based pellets or scavenge dead rodents on the ground. Therefore, there is no potential for the barn owl to ingest rodenticide directly. Because barn owls hunt live prey, they could eat live rats carrying rodenticide residues in their tissues prior to dying. The most conservative (worst case) analyses of these situations has been examined using data from the literature. To assess secondary nontarget hazards for the barn owl, the analysis used whole body values with the maximum residue levels documented in rodents (Erickson and Urban 2004). The LD_{50} for an average sized 315 g (0.7 pound) owl is 126 mg of diphacinone. To ingest these amounts of rodenticides secondarily via rodents contaminated to the highest level documented, an owl would need to consume 37 kg (81.6 pounds) of diphacinone-loaded rats. An owl could obtain an LOEL dosage of diphacinone by eating 10 g of these contaminated rodents. Even under these extreme situations, the risk of mortality due to using a diphacinone formulation is essentially zero.

Game birds and mammals

Game birds that could be present in Lihue MU include zebra dove *(Geopelia striata)*, spotted dove *(Streptopella chinensis)*, and Erckel’s francolin *(Francolinus erckelli)*. Doves tend to utilize open habitat, such as the training lands below the firebreak road (and below the treatment area). As with some MBTA-protected birds, game birds found in the area would be at some risk of being affected by the Proposed Action and that risk will vary with their relative abundance and distribution, in combination with their diet and body size. The diet of these birds is comprised primarily of vegetation (e.g., seeds and fruits) and animal matter (e.g., insects and snails), which puts them at risk of both primary and secondary poisoning. However, bait pellets would be dyed green which has been shown to make pellets less attractive to some birds and reptiles (Pank 1976, Tershy et al. 1992, Tershy and Breese 1994). As with kōlea, it is unlikely that individual game birds would ingest lethal amounts of diphacinone, although there could be some exposure to non-lethal levels. It is also unlikely that affecting a small number of these game birds from the area would cause population level effects.

Vertebrates Without Protected Status

Several species of invasive mammals and one introduced bird, with no protected status, could also be present in Lihue MU: feral cat (*Felis catus*), small Indian mongoose (*Herpestes auropunctatus*), black rat (*Rattus rattus*), house mouse (*Mus musculus*), Kalij pheasant *(Lophura leucomelanos)*, and Japanese white-eye (*Zosterops japonicus*). Mammals that consume sufficient quantities of bait could be subject to lethal or sub-lethal effects. It is unlikely the Japanese white-eye would ingest sufficient quantities to experience lethal effects.

Other Terrestrial Species in Lihue Management Unit

There are no native reptiles in the Hawaiian Islands. Cannibal snail *(Euglandina rosea)*, giant African snail *(Lissachatina fulica)*, and various non-native reptiles including skinks, lizards, and geckos are present within Lihue MU. Non-native invasive species have substantial negative impacts to native flora and fauna.

Aquatic Organisms

Diphacinone has low solubility in water, and studies indicate it is unlikely to be consumed by any aquatic organisms present. Nonetheless, to avoid impacts to water quality, surface waters will be buffered to avoid depositing rodenticide into Lihue MU water bodies. Surface waters in Lihue MU will be buffered by 50 feet and rodenticide will not be aerially broadcast within these buffer areas. Some hand application within stream buffer areas may occur in key areas with care taken to avoid water. It is unlikely that aquatic organisms will be affected by the Proposed Action.

5.6.2.2 No Action Alternative

Impacts to fauna from continuing the present rat control practices without aerial rodenticide application would be moderate, long-term and negative. Using the present control means, rat populations have not been adequately limited and ‘elepaio populations have not stabilized. Continuation of the existing management activities under the No Action Alternative is anticipated to result in fewer individuals of the target species to be managed. As a result, the long-term impacts would be the continued degeneration and eventual extirpation (i.e., local extinction) of endangered species populations within Lihue MU, and further deterioration of the native forest.

5.7 Cultural, Historical, and Archaeological Resources

The evaluation of impacts on historic and archaeological resources were based on identifying cultural resources within Lihue MU and determining the direct and indirect impacts that may affect these resources. Impacts to historical and archaeological resources are considered significant if 1) prehistoric or historic resources that are listed or potentially eligible for listing on the National Register of Historic Places are disturbed or destroyed; 2) Native Hawaiian resources are physically desecrated or destroyed; or 3) access to traditional areas is affected.

5.7.1 Proposed Action

Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470f) and (36 CFR 800.3(a)(1)), the USAG-HI has determined this project has no potential to cause effects to historic or other cultural resources; therefore, the USAG-HI has determined it has fulfilled its responsibilities under Section 106 of the National Historic Preservation Act.

Based on literature reviews and surveys previously conducted, known cultural resources are present within the Lihue MU. However, there is no potential to impact these cultural, archaeological or historic resources by implementing the Proposed Action. Cultural resources staff will follow the USAG-HI reporting and documentation protocol in the event of any inadvertent discoveries.

5.7.2 No Action Alternative

No significant impacts to cultural, archaeological, or historic resources are anticipated from the No Action Alternative.

5.8 Land Use and Recreational Resources

Impacts on land use were assessed based on whether or not the proposed activities were consistent with the site-specific and surrounding land uses. The evaluation of potential impacts on land use was based on the project's consistency with the following: 1) existing and planned land uses; and 2) unique characteristics of the geographical area.

5.8.1 Proposed Action

Lihue MU is within federally-owned land designated for conservation. Hunting is not permitted within Lihue MU and the unit is closed to all entry. Impacts to land use and recreational resources from the Proposed Action would be negligible. Ungulates are excluded from Lihue MU by ungulate-proof fencelines. It is unlikely that a wild pig would discover a way to enter Lihue MU, consume a quantity of bait equivalent to the worst case observed in lab and field research experiments, and then discover a way to enter a hunting area. Even if this extremely unlikely case were to occur, and the pig was harvested, a 55 kg person would have to eat over half their body weight of pig meat (28.49 kg) in a single day to reach the lowest detectable clotting effects. This exposure is far less than the therapeutic dose administered to people when diphacinone was used as a heart medication. If a 55 kg person ate the same pig meat over multiple days they would have to eat 8.77 kg (over 19 pounds) per day before the toxicants could build up to levels causing measurable effects (Eisemann and Swift 2006). Game birds found in the area would be at some risk of being affected by the Proposed Action and that risk will vary with their relative abundance and distribution, in combination with their diet and body size. The diet of these birds is comprised primarily of vegetation (e.g., seeds and fruits) and animal matter (e.g., insects and snails), which puts them at risk of both primary and secondary poisoning. However, game bird foraging behavior favors open areas. It is unlikely a game bird would forage so intently within the forested treatment area over multiple days to ingest acute levels of diphacinone. Furthermore, it is unlikely that the range of game birds within Lihue MU would extend to areas open to game bird hunting. Additionally, D-50 pellets are dyed green which has been shown to make pellets less attractive to some birds and reptiles (Pank 1976, Tershy et al. 1992, Tershy and Breese 1994). A recent NRWC study in nearby Kahanahāiki reports no game birds were observed consuming the green colored bait (via regular observations or motion cameras), and no game bird liver samples contained measurable residue levels (Shiels 2017).

5.8.2 No Action Alternative

No significant impacts to land use are anticipated from the No Action Alternative. Existing land use would not change under the No Action Alternative.

5.9 Socioeconomic Environment

Factors considered in determining whether an alternative would have a significant impact on socioeconomics include the extent or degree to which its implementation would change the following: 1) population; 2) employment; 3) demand for housing; or 4) demand on public services.

5.9.1 Proposed Action

No significant impacts to socioeconomics are anticipated from the Proposed Action. The Proposed Action is not expected to affect job opportunities, population structure, housing availability, or the use of public facilities. No impacts to the social or economic welfare of nearby communities are anticipated from the Proposed Action.

5.9.2 No Action Alternative

No significant impacts to socioeconomics are anticipated from the No Action Alternative. Although training opportunities within Oʻahu Training Areas could be affected if the requirements of the 2003 BO are not met, it is unlikely subsequent adjustments to training or natural resources management practices would affect the socioeconomic environment.

5.10 Visual and Aesthetic Resources

Preserving open space and scenic beauty is a priority for projects that may affect mountainous areas. The General Plan for the City and County of Honolulu states that scenic resources and the open space character of the area should be preserved and protected for future generations.

5.10.1 Proposed Action

Lihue MU is located in a remote area and potential impacts from the Proposed Action would consist of a helicopter flying over the area for a short period of time. No significant impacts are anticipated to the visual quality or aesthetics of Lihue MU. The operation would likely not be visible from populated areas. The localized visual impact would be very temporary lasting for only small parts of two to four days and would not constitute an impact to visual/aesthetic resources.

5.10.2 No Action Alternative

No significant impacts are anticipated. No changes to existing visual resources would occur.

5.11 Environmental Justice and Protection of Children

Factors considered in determining whether an alternative would have a significant impact on environmental justice and protection of children included the extent or degree to which its implementation would result in the following: 1) change in any social, economic, physical, environmental, or health conditions so as to disproportionately affect any particular low-income or minority group; or 2) disproportionately endanger children.

5.11.1 Proposed Action

No significant impacts to environmental justice are anticipated from the Proposed Action. The activities associated with this Proposed Action would be located away from residential communities. Disproportionately high and adverse human health or environmental impacts on minority and low-income populations and children are not anticipated.

5.11.2 No Action Alternative

No significant impacts to environmental justice are anticipated from the No Action Alternative. No changes to social, economic, or health conditions are anticipated and disproportional impacts to low-income or minority groups and children would not occur.

6 CONSISTENCY WITH FEDERAL, STATE, AND LOCAL PLANS, POLICIES, AND APPROVALS

The approach of this project is consistent with the objectives of many entities. It is in accord with USFWS policy for the management of natural communities using an "ecosystem approach" and with the Hawaiʻi Natural Area Reserve Law, which states a system of reserves be established to "…preserve in perpetuity specific land and water areas which support communities, as unmodified

as possible, of the natural flora and fauna…" (Chapter 195D, Hawaiʻi Revised Statutes). Protection and enhancement of endangered species is mandated by both federal and state Endangered Species Acts (16 USC 1531-1543, as amended; Chapter 195, Hawaiʻi Revised Statues). It is also in alliance with the State of Hawaiʻi's long-term environmental policies, goals and guidelines outlined in Hawaiʻi Revised Statutes, Chapter 344. This project is consistent with a designated land use of the "P" subzone: "preserving natural ecosystems of native plants, fish and wildlife, particularly those which are endangered" (HAR, 13-5-11-4).

The Proposed Action is consistent with the CZMA and the Hawaiʻi CZM Program to the maximum extent practicable. The treatment area is located in central Oʻahu far from the coastline. The project would have no effect on coastal ecosystems or the marine environment.

The project also strives toward the provisions of the City and County of Honolulu General Plan Objectives and Policies, Chapter III, Objective A, Policies 1-11, by "protect[ing] and preserv[ing] the natural environment (Objective A)" as well as the "plants, birds, and other animals that are unique to the State of Hawaiʻi and the Island of Oʻahu (Policy 8)."

7 CUMULATIVE IMPACTS

Cumulative impacts were analyzed for each resource category by examining effects of the Proposed Action when added to effects of other past, present, and reasonably foreseeable future actions. Anticipated cumulative impacts of the Proposed Action to the affected environment are discussed below.

7.1 Topography and Soils

Implementation of past and reasonably foreseeable future actions include fencing activities for ungulate control in other areas in the Waiʻanae and Koʻolau Ranges that would occur as part of the OIP, state, county, or private actions. Reasonably foreseeable future actions would also include minor vegetation removal for reintroduction/augmentation of rare plant species as part of the OIP. No aerial application of rodenticide actions are anticipated in other management areas within the vicinity of Lihue MU. The potential impacts of these future actions would resemble those from the Proposed Action, resulting in a net positive effect on the immediate and surrounding habitat within the fences. As a result, the cumulative effects of the Proposed Action would provide a positive impact both alone and in combination with past, present, and reasonably foreseeable future actions.

7.2 Water Resources

Reasonably foreseeable future projects such as additional fence lines or endangered species collections work by other agencies may occur in nearby locations. Additionally, the chemical control of alien plants or animals within other management units is not anticipated to be of sufficient volume to have a significant effect on water resources. The USFWS has begun to evaluate broadscale rodenticide applications in a larger programmatic context, but there are no proposals to conduct similar treatments on Oʻahu; there is no information about where future treatments may occur should a proposal be put forward; and it is understood that additional NEPA analyses would have to be conducted on any future broadscale rodenticide proposals once that information became known. As a result, the proposed project would not significantly affect water resources individually, nor would it contribute to the cumulative impacts of other past, present, and reasonably foreseeable future actions.

7.3 Climate/Air Quality

Increase in emissions generated during proposed helicopter operations in Lihue MU would be temporary and short in duration. Reasonably foreseeable future projects such as additional fence lines or endangered species collections work for the OIP or by other agencies may occur in nearby locations, however additional impacts to climate or air quality are not anticipated. The proposed project would not significantly affect climate and air quality individually, nor would it contribute to the cumulative impacts of other past, present, and reasonably foreseeable future actions.

7.4 Noise Environment

Increase in noise generated during proposed helicopter operations in Lihue MU would be temporary and short in duration. Reasonably foreseeable future projects such as additional fence lines or endangered species collections work for the OIP or by other agencies may occur in nearby locations, however additional impacts to the noise environment are not anticipated. The proposed project would not significantly affect the noise environment individually, nor would it contribute to the cumulative impacts of other past, present, and reasonably foreseeable future actions.

7.5 Biological Resources

Potential negative impacts from the Proposed Action to biological resources and specifically endangered species would be minimized by avoiding sensitive areas and implementing BMPs. Significant adverse impacts are not anticipated. Reasonably foreseeable future projects such as additional fencelines or endangered species collections work conducted by other agencies may occur in nearby locations. However, it is expected that future projects would utilize similar mitigation actions. Consequently, the proposed project would not adversely affect ecosystems and biological resources individually, nor would it contribute to the cumulative effects of past, present, or reasonably foreseeable future actions. Instead, the Proposed Action and reasonably foreseeable future actions are expected to provide a net positive effect at the ecosystem and species levels.

The USFWS has begun to evaluate broadscale rodenticide application in a larger programmatic context, but there are no proposals to conduct similar treatments on Oʻahu; there is no information about where future treatments may occur should a proposal be put forward; and it is understood that additional NEPA analysis would have to be conducted once that information became known.

7.6 Cultural, Historical, and Archaeological Resources

USAG-HI has determined the Proposed Action has no potential to cause effects to archaeological, historical or other cultural resources. Other management activities are designed to avoid all archaeological sites. The cumulative effects of the Proposed Action would not be significant either alone or in combination with other past, present, or reasonably foreseeable future actions.

7.7 Land Use and Recreational Resources

Impacts to land use and recreation resources would be negligible and short in duration. Reasonably foreseeable future projects such as additional fence lines or endangered species collections work for the OIP or by other agencies may occur in nearby locations, however additional impacts to land use and recreational resources are not anticipated. The cumulative effects of the Proposed Action would not be significant either alone or in combination with other past, present, or reasonably foreseeable future actions.

7.8 Visual and Aesthetic Resources

Lihue MU is located in a remote area and potential visual impacts within the unit from helicopter overflight would be short in duration. If visible from other vantage points, the impact of air operations would also be short in duration. Other past, present, and reasonably foreseeable actions that could contribute to visual impacts of the Proposed Action include OIP-related construction, and ungulate exclusion fences in the Waiʻanae mountains undertaken by other agencies or landowners. These projects are separated geographically, and are not expected to have significant impacts. The cumulative effects of the Proposed Action to the visual quality or aesthetics of Lihue MU would not be significant either alone or in combination with other past, present, or reasonably foreseeable future actions.

8 OTHER REQUIRED NEPA ANALYSES

In addition to the analyses discussed above, NEPA requires additional evaluation of the project's impacts with regard to the relationship between local short-term uses of the environment and long-term productivity, and any irreversible or irretrievable commitment of resources.

8.1 Relationship Between Short-term Uses of the Environment and Long-term Productivity

Short-term impacts to the environment from the Proposed Action would be limited. They include potential impacts to the noise environment and air quality from helicopter operations, and potential short-term impacts to surface water from rodenticide application. No significant impacts were identified. Long-term productivity would be enhanced by improving the quality of native Hawaiian habitat for endangered and threatened species.

8.2 Irreversible and Irretrievable Commitment of Resources

NEPA requires an analysis of the extent to which the Proposed Action's primary and secondary effects would commit nonrenewable resources to uses that would be irretrievable to future generations. Implementation of the Proposed Action would commit nonrenewable energy and material resources in the form of:

- fuel for helicopters and equipment used to transport personnel and materials
- materials used to formulate and dispense rodenticide
- resources needed to monitor results of the Proposed Action such as equipment, supplies, and fuel for vehicles.

9 FINDINGS AND REASONS SUPPORTING THE ANTICIPATED DETERMINATION

The objective of the Proposed Action is to reduce rat populations on a management unit scale and improve survival rates for endangered Oʻahu ʻelepaio populations within Lihue MU. Other native plant and animal species will also benefit from reduced rodent predation. Military training opportunities will be sustained by increased protection and enhancement of native Hawaiian ecosystems and the protection and stabilization of native plant and animal species potentially affected by military training in other areas. The Army may implement the Proposed Action after successfully completing the NEPA process, completing agency consultations, and obtaining all necessary permits and approvals.

No significant impacts are anticipated as a result of the No Action Alternative or the Proposed Action proposed in this SEA. Table 2 (p. 28) provides a summary of anticipated impacts to each resource area analyzed. Impacts are largely anticipated to be minimized through avoidance and through the implementation of BMPs and label requirements. Avoidance results from selecting a treatment area already closed to entry and enclosed by ungulate-proof fencing, and by maintaining an application buffer around surface waters. BMPs would include scheduling the application to avoid heavy precipitation events, closely monitoring the application rate, and using licensed applicators with close manager oversight. No new mitigation measures are anticipated to be required. Monitoring efforts will include monitoring the bait application rate, the bate availability period, bait condition, water quality, impacts to nontarget species, and the effectiveness of this rodent control effort.

The Proposed Action is the only alternative that can satisfy the purpose and need. All adverse effects would be less than significant, and the project would result in substantial beneficial effects for endangered Oʻahu ʻelepaio populations in Lihue MU as well as for other native and endemic species within the management unit. The Army will determine whether it is appropriate to proceed with the Proposed Action once the environmental review process is completed. The anticipated Finding of No Significant Impact is based on a thorough evaluation of applicable research reports addressing rodenticide toxicology and environmental fate; the results of similar aerial application of rodenticide actions reported by other agencies; direct manager experience with Oʻahu endangered species population maintenance and recovery; and in particular, the relevant resource issues and concerns of Lihue Management Unit.

The long-term benefits of alien rodent control far outweigh the minor and less than significant short-term negative effects of this management action.

Potential temporary and less than significant negative impacts include: short-term localized impacts to air quality and the noise environment associated with aerial rodenticide application activities; and a potential for short-term impacts to treatment area soils and surface water from the rodenticide product. There is no intention to adversely impact nontarget species within Lihue MU, but there is potential for unintentional insignificant impacts to individual nontarget birds within Lihue MU. There is also the potential that individual nontarget birds could benefit from reduced predatory pressure from rodents.

The possibility for introduction of new weed species as a result of this activity is very low. Attempts have been made to germinate plants from the grain-based diphacinone pellets without success. Prior to initiating the operation all equipment and materials will be inspected to ensure

they are clean and free of weed seeds. During ongoing and subsequent rat monitoring activities, natural resource management staff will follow protocols to prevent weed distribution involving their personal gear and movements. This protocol will be strictly enforced.

Based upon the available information, this SEA has concluded that the Proposed Action will not have any unmitigable significant direct, indirect, or cumulative adverse impacts on the natural or human environment. As such, the Proposed Action does not require the completion of an Environmental Impact Statement, as defined by the Council of Environmental Quality regulations (40 CFR 1500-1508) and Army Regulation (32 CFR Part 651). A draft FNSI has been prepared and an opportunity for public comment will be published in both the Honolulu Star-Advertiser newspaper and the State of Hawai‘i Office of Environmental Quality Control (OEQC) Environmental Notice bulletin.

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APPENDIX A
Introduction to Rodenticides and Rodenticide Hazard Analysis, with Special Reference to Birds

(adapted from "Final Supplemental Environmental Assessment Lehua Island Ecosystem Restoration Project," October 2008)

Diphacinone is a chronic rodenticide, meaning that the onset of symptoms only begins sometime after the lethal dosage has been ingested. If a rat does not experience symptoms until long after ingesting a lethal dose of the rodenticide, it cannot associate the symptoms with the new food item, causing the rats to continue eating the bait until or even long after a lethal dose has been ingested.

Diphacinone is an anticoagulant which acts by disrupting the normal blood-clotting mechanisms of vertebrates by competing with vitamin-K, a chemical necessary for clotting of blood, for receptor sites in the liver. Death in animals receiving a lethal dose of an anticoagulant rodenticide typically occurs from shock due to excessive blood loss through internal and sometimes external hemorrhaging eventually causing severe anemia. Prior to dying, between the time of ingestion and actual death (latent period), poisoned animals may exhibit increasing weakness and behavioral changes such as acting sluggish, changes in activity time, and reduced predator avoidance ability. This behavior can make target rodents more susceptible to predation (Cox and Smith 1990, Newton et al. 1990, Innes and Barker 1999, as cited in USFWS and DOFAW 2008).

Anticoagulant rodenticides are divided into two chemical groups, the indandiones, such as diphacinone and the coumarins; which includes brodifacoum. More informally, anticoagulant rodenticides are also described either as "first generation" or "second generation" rodenticides, simply referring to the time period during which they were developed. Diphacinone is a first generation and brodifacoum a second generation rodenticide. Second generation compounds were specifically designed to overcome resistance to warfarin (an early "first generation" compound) and are therefore generally more toxic than the first generation rodenticides. The coumarins in general, but especially brodifacoum, are characterized by an increased potential for accumulation and persistence in body tissues. This is due primarily to their greater affinity to bind to receptors in the liver and the long latent period during which rodents continue to feed on the toxicant (Eason and Wickstrom 2001, Fisher et al. 2003).

Diphacinone Characteristics

Diphacinone, because it is less toxic and more rapidly metabolized and excreted, accumulates in body tissues less readily and in lower concentrations, than second generation rodenticides, such as brodifacoum (Erickson and Urban 2004).

Products containing diphacinone were first registered for rodent control in 1960 at active ingredient concentrations of 0.005% to 0.01 % (50 to 100 ppm). Diphacinone (0.005% active ingredient) is currently registered for use for conservation purposes in the United States.

Many laboratory studies of the LD_{50} for vertebrate species have been conducted on a variety of test species (both target and nontarget species) using a range of methods (Swift 1998, Fisher 2005). In general, the median oral lethal dosage of diphacinone for rats is about 3.0 mg/kg, while for brodifacoum it is roughly 0.3 mg/kg. Brodifacoum is about ten times more toxic on a weight/weight basis to rats than diphacinone. However, as previously mentioned, there is a similar latent period between time of ingestion and death between the two toxicants. Many factors influence this delay,

but in general the latent period is about seven days and ranges from three to 14 days for both of these rodenticides (Eason and Wickstrom 2001, Erickson and Urban 2004).

A rodenticide that is rapidly metabolized and/or excreted from the primary consumer (the animal directly ingesting the rodenticide) poses fewer hazards to secondary consumers than one that is readily retained in tissues and therefore accumulates in the bodies of animals over time. Sublethal exposure to anticoagulants can produce significant blood clotting abnormalities and internal and external hemorrhaging. Such chronic hemorrhaging might be especially detrimental if combined with other factors such as adverse weather, food shortages, pregnancy or predation stressors, and could predispose an animal to death from other sources, such as bruising, food stress, and reduced potential for recovery from wounds and accidents.

Most rodents will continue eating for several days or more after ingesting a lethal dose of an anticoagulant rodenticide. A laboratory study found that rats ate over twelve LD_{50} doses of a diphacinone bait formulation resulting in liver residues of 4.7 mg/g. For comparison, D-50 is 0.005% a.i. or 5 mg/g (Fisher et al. 2004). Therefore, the livers of these rats actually contained slightly less than the active ingredient concentration of the actual bait formulation.

Generally, repeated exposures to small doses of anticoagulants over several days pose a greater hazard than larger single doses. Anticoagulants bind to receptors in the liver and other tissues, including the kidneys, pancreas, lungs, brain, fat and muscles and are eliminated from the liver last. The length of time a rodenticide is retained in tissues or how quickly it is eliminated (half-life) greatly influences accumulation of rodenticides in tissues and, therefore, nontarget hazards.

Elimination of anticoagulant rodenticides from tissues is biphasic, with a proportion of the toxicant excreted within a shorter time and the remainder bound in the tissues and excreted over a much longer period of time (Parmer et al. 1987, cited in Fisher et al. 2003). During the first phase of diphacinone excretion from tissues, 70% of a single dose may be excreted in about 8 days. In a laboratory test, , 0.8 mg/kg of diphacinone was administered to rats, resulting in mean liver residue concentrations of 0.08 mg/kg at one week and below the detectable limit at six weeks. Further trials of diphacinone resulted in the estimated liver elimination half-life 3 days (Fisher et al. 2003). In addition, the range of whole carcass residues reported by the EPA in primary consumers was 0.48 to 3.4 ppm for diphacinone.

Efficacy Studies of Brodifacoum and Diphacinone

The following information is compiled from Erickson and Urban (2004) and the New Zealand Pesticide Toxicology Manual (New Zealand Department of Conservation 2001).

Brodifacoum has been used for most rat eradication projects worldwide because its far greater toxicity is perceived to impart a greater probability of success. However, it is important to remember that toxicity and efficacy are not synonymous terms. Efficacy is a complex interaction of many factors, including bait acceptance, application rate, application method, toxicity, and timing of application when rodent populations, reproduction and alternate foods are lowest to ensure eradication. The eradication of rodents on islands has been successfully implemented using the generally less toxic anticoagulant rodenticides warfarin, pindone, diphacinone and bromadiolone (Witmer et al. 2001, Donlan et al. 2002, Dunlevy and Scharf 2008) and some eradication efforts have failed during operations using brodifacoum (Tyrrell et al. 2000, Clout and Russell 2006, Howald et al. 2006).

An increasing number of experts in island rodent eradication and control have recommended using less toxic rodenticides such as diphacinone, and decreasing the use of more persistent and toxic rodenticides such as brodifacoum on future projects because of the greater risk to nontarget species associated with brodifacoum, including both primary hazards (when nontarget species feed directly on the bait) and secondary hazards (when nontarget species feed on rodenticide-exposed animals with rodenticide residues in their tissues) (Tobin 1994, Eason et al. 1999, Fisher et al. 2003). Fisher et al. (2004) recommend conducting additional field studies using diphacinone to further determine efficacy and validate estimates of lower risk for secondary poisoning of nontarget species.

A number of laboratory and field studies in the United States have evaluated the effectiveness of various application methods and the efficacy of diphacinone for control of rat populations, especially in Hawai‘i:

- Laboratory trials using Sprague-Dawley strain laboratory rats found that 100% of 20 laboratory-bred brown rats died after consuming an average of 42 grams of bait (0.21 g of the a.i. diphacinone), 7 g per day per animal over an average of six days (Svircev 1992).
- Laboratory trials found that 100% of 20 Hawaiian wild-caught Polynesian rats died over two to ten days after consuming an average of 19.7 grams of bait (0.099 g of 0.005% diphacinone) per animal and 95% of 20 wild-caught black rats died over four to 17 days after consuming an average of 21.2 grams of bait (0.106 g of diphacinone) per animal. These trials indicated that a minimum average exposure time of 7 days with 37.5 g of bait is needed for effective control of black rats, and 6 days and 30 g are needed for effective control of Polynesian rats (Swift 1998).
- A broadcast application rate study using a nontoxic formulation of Ramik® Green and a biomarker determined the optimal application rate, 22.5 kg/ha or 20 lb/ac, which exposed 100% of Polynesian rats and 94.4% of black rats over a 14-day period (Dunlevy et al. 2000), even though immigration could not be eliminated. Bait disappearance was most rapid at the 22.5 kg/ha application rate with 50% of the bait disappearing by day 6 and 80% disappearing by day 12.
- An exposure using remote cameras found that 98.98% of vertebrates photographed at broadcast rodenticide pellets were the target species, rats and mice (Dunlevy and Campbell 2002).
- A broadcast trial, also using Ramik® Green bait containing 0.005% (50 ppm) diphacinone, resulted in 100% control of radio-collared Polynesian, black, and brown rats in two 4-ha study areas in Hawai‘i (Lindsey and Forbes 2000). Follow-up broadcasts in the same study areas were also highly effective in controlling subsequent rat immigration.
- A trial of Ramik® Green broadcast into a 45.5 ha forested area in Hawai‘i also achieved 100% mortality of 21 radio-collared rats within one week of application. Three weeks after bait application, based on trapping and chew blocks, rat abundance was still reduced by 99% relative to reference areas (Spurr et al. 2003a and 2003b) despite the immigration issues of this main island study site.
- In the Bay of Islands, Adak, Alaska, a three-year study evaluated Ramik® Green and various application methods on several small islands (Dunlevy and Scharf 2008).

These successful laboratory trials and field studies strongly suggest that well planned rat eradication projects utilizing diphacinone have a very high probability of eradicating rats on islands if used appropriately.

Rodenticide Hazard Analysis

The U.S. Environmental Protection Agency (EPA) evaluates the hazards associated with the use of rodenticides. Standard evaluation tests of hazard include a toxicity assessment of rodenticides from a single ingestion (acute toxicity) as well as with repeat ingestion over time (chronic toxicity), mortality of nontarget species, retention time of rodenticide residues in primary consumers (animals that eat the bait directly) and indirect exposure of predators and scavengers that eat exposed primary consumers. Because of these concerns, EPA requires standardized studies for determining the toxicity of compounds and their impacts on fish, birds and mammals prior to registration of a particular rodenticide formulation under FIFRA. EPA has two recent documents outlining study methodologies, overall results of studies, and resultant hazards of various rodenticides, including brodifacoum and diphacinone (Reregistration Eligibility Decision (EPA 1998) and Potential Risks of Nine Rodenticides to Birds and Nontarget Mammals: A Comparative Approach (Erickson and Urban 2004)). The following summary of study approaches and terms is primarily from Erickson and Urban (2004), which summarizes the findings of studies regarding diphacinone and brodifacoum, as well as other rodenticides.

The EPA limits their definition of nontarget hazard to a product of toxicity and exposure. The level of exposure is determined by the amount of active ingredient (a.i.) ingested.

Hazard can be characterized and assessed by many measures, including:

- Acute oral toxicity or LD_{50}– A single dose that is lethal to 50% of the test subjects in the population or study group under consideration, expressed as milligram(s) of active ingredient per kilogram of test subject body weight;
- Dietary toxicity or LC_{50}– The concentration of rodenticide in the diet (multiple feedings) that is lethal to 50% of test subjects in the population or study group under consideration, expressed as parts per million of the daily diet.
- Lowest observed effects level or LOEL– The lowest dosage at which measurable effects, such as increased blood-clotting times, are documented. This is not a mortality threshold and no negative impacts are necessarily derived at this hazard level. Diphacinone has LOELs calculated; brodifacoum does not because of its substantially higher toxicity.
- The dietary risk quotient (RQ) was developed by the EPA to compare hazards among different rodenticides. The ratio of the concentration of any rodenticide (ppm of active ingredient) to the dietary toxicity (LC_{50}) of the rodenticide provides a relative index of hazard. This allows for the comparison of the hazards among various rodenticides. The Level of Concern (LOC) is an RQ threshold used by the EPA to determine if unacceptable risk exists for a particular species. The index allows for comparisons among risks for different species. Risk is presumed for non-endangered species if the RQ is $\geq$0.5 and for an endangered species if the RQ >0.1.
- Half life - The length of time that rodenticide residues persist in tissues is calculated in terms of the time that half the original concentration of residue still persists in tissue or blood.

- Total daily food intake for a particular species compared to the animals weight can be used to gauge the possibility that an animal is physically capable of eating the amount of rodenticide (at any particular concentration of the active ingredient) required to deliver an LD_{50} dosage.

To describe the range of potential hazard to nontarget species from rodenticide application, this analysis discusses the acute oral toxicity of both diphacinone and brodifacoum for the species of concern. From the LD_{50} we can determine the amounts of bait and/or rodenticide residue in tissues of prey that an individual of a nontarget species would be required to eat to obtain this dosage. Using this information we can assess the potential for this level of exposure based on knowledge of the biology of the nontarget species, such as behavior and daily food intake. Another very useful way of evaluating the potential hazards associated with rodenticide use is to describe the lowest dosage which results in any measurable effect and assess the potential for this level of exposure. Using laboratory and field data accepted by the EPA, quantitative characterizations of rodenticide nontarget hazards can be made and assessed in conjunction with the known biology of the species of concern.

Standardized laboratory studies are used to determine the acute oral and dietary toxicity of vertebrate pesticides for some standard test subjects, such as brown rats, and sometimes for other species. These studies produce a range of values, sometimes with considerable variation. The details and assessments by the EPA of these studies are discussed in the Reregistration Eligibility Decision (EPA 1998) and Erickson and Urban (2004).

The determinations of the EPA in these documents are utilized in the analyses presented here. For untested mammals, a theoretical LD_{50} can be calculated, based on the weight of the animal, using the laboratory documented LD_{50}, accepted by the EPA, for a brown rat for any particular compound. For a brown rat, the LD_{50} of diphacinone is 2.3 mg/kg; for brodifacoum it is 0.4 mg/kg, indicating the substantially greater relative toxicity for brodifacoum. A 100 kg mammal would, therefore, require 230 mg of diphacinone, or 40 mg of brodifacoum to ingest the projected LD_{50} dosage.

EPA calculates hazards for nontarget bird species the same way, using a known laboratory-derived LD_{50} from representative birds: the northern bobwhite quail (*Colinus virginianus*) and mallard duck (*Anas platyrhynchos*). Some studies have also documented, in the laboratory, LD_{50} and LC_{50} values for some other species besides the standard species consistently used by EPA in toxicity studies.

Methodology Used in This Document to Analyze Rodenticide Impacts to Birds

The analyses of the direct and indirect impacts of diphacinone and brodifacoum on nontarget birds are based on the known laboratory LD_{50} and LC_{50} information documented by the U.S. Environmental Protection Agency (EPA 1998, Erickson and Urban 2004).

Broadcast applications of diphacinone bait at the maximum rate of 22.5 kg/ha (20 lb/ac); result in approximately one 2.25-gram pellet distributed about every square meter. The maximum broadcast rate of brodifacoum bait is 18 kg/ha (16 pounds bait/acre), resulting in a density of approximately one 2-gram pellet per square meter (see Section 2.1.3 for label requirements).

The analyses of the primary hazards of brodifacoum and diphacinone use a computed LD_{50}-equivalent dose. This is based on laboratory studies in species such as the rat, a surrogate for other mammals, and bobwhite or mallard for other avian species. The average weight of an adult female

animal of concern and the established LD_{50} of the surrogate species studied are used to calculate the amount of each rodenticide that would need to be ingested to reach the LD_{50}-equivalent dosage. This is compared to the area over which that amount would be distributed during an aerial application and the likelihood of an animal eating every bait pellet within that area. If it is highly unlikely that the animal would directly eat bait pellets based on its dietary habits, the calculated results are evaluated in that context.

The analyses of the secondary impacts of brodifacoum and diphacinone assume that the adult female animal of average weight feeds exclusively in an area massively contaminated to the extent documented at the spill site in New Zealand and exclusively on the most contaminated samples collected during the monitoring of the incident: mussels and fish liver. One day after the accident, mussels contained brodifacoum residues of 0.41 ppm and a butterfish sampled nine days after the spill had brodifacoum liver residues of 0.04 ppm. This is then used to calculate amounts of these prey items secondary nontarget species would need to eat in order to ingest the computed LD_{50} for the species of concern. This is then compared to either the animal's average daily food intake or body weight to determine if eating such a quantity is probable or even possible.

For the most conservative assessment of secondary hazard, it is assumed that nontarget species of concern would be exposed to prey items that have themselves been exposed to rodenticides and contain residues and that these residues are similar to the maximum residue levels of either potential prey items documented in Primus et al. (2005) during a massive point-source spill of rodenticide, laboratory exposure to a toxicant only, and/or collected from the site of an actual rodenticide operation.

The evaluation and comparison of LD_{50} values and risk quotients provides a good description of the upper end of the hazard spectrum associated with rodenticide use. However, because anticoagulants are far more toxic when administered on multiple days with smaller exposures, to fully characterize the range of possible hazard the lower end of the hazard potential needs to be assessed. To do this we will examine the Lowest Observed Effect Level (LOEL) for all nontarget species that we know are at the highest risk of exposure. Assessing the LOEL will illustrate the minimum amount of exposure necessary to produce a measurable effect, such as increased blood-clotting time. This is not a mortality threshold and no negative impacts are necessarily derived at this hazard level.

In a laboratory study using golden eagles fed diphacinone-laced sheep muscle (2.7 ppm) Savarie et al. (1979) established the LOEL for golden eagles at 0.11 mg/kg/day in a 7-day exposure study. The EPA reports the LOEL of diphacinone for rats in a 14-day subchronic lab study as 0.085 mg/kg/day (EPA 1998).

The LOELs of brodifacoum are not as well documented as those of diphacinone. No LOEL of brodifacoum for birds has been established because effects have been observed for all doses administered in all tests. The EPA reports the LOEL of brodifacoum for rabbits in a developmental lab study as 0.005 mg/kg/day (EPA 1998). Using these available figures to extrapolate the LOELs for each of the species of concern the lower limit of potential hazard can be assessed.

Effects on Birds from Ingestion of Rodenticides by Eating Bait (Direct Effect)

Standard EPA studies of the acute oral toxicity of diphacinone and brodifacoum have been conducted for two avian species. For diphacinone, the LD_{50} for the mallard duck is 3,158 mg/kg and for the northern bobwhite 400 mg/kg $<LD_{50}<$ 2000 mg/kg. For brodifacoum, the LD_{50} for the

mallard is 0.26 mg/kg (no documentation for the bobwhite) (Erickson and Urban 2004). The dietary (chronic) toxicity studies of diphacinone for mallard (*Anas* platyrhynchos) and bobwhite quail (*Colinus virginianus*) documented LC_{50} values of 906 ppm for the mallard and >5,000 ppm for the bobwhite quail. For brodifacoum, the LC_{50} reported for the mallard is 2.0 ppm and for the northern bobwhite it is 0.8 ppm, many orders of magnitude higher than the LC_{50} for diphacinone (Erickson and Urban 2004).

Primary and secondary hazard calculations of diphacinone acute oral toxicity for nongame birds weighing ≤0.22 pounds (≤3.5 ounces) were made for the equivalent of Hawaiian passerine birds. In order to consume sufficient diphacinone bait to reach a dose equivalent to the LD_{50} for the northern bobwhite, a passerine bird would have to eat 0.53 pounds of bait or 5,027 pounds of invertebrates in one day. Neither of these amounts is even physically possible. While to obtain the LC_{50} for diphacinone, the bird would have to consume 0.36 g of bait or 3.59 g of invertebrates per day over several days. However, hazard calculations for sublethal exposure show that a 30 g bird would only need to eat 0.07 g (a 100^{th} of a bait pellet, or 0.2% of its body weight) or 0.65 g of invertebrates per day for multiple day to ingest a dose that resulted in measurable blood clotting effects in golden eagles. Therefore, small passerine birds could be vulnerable to sublethal or possibly lethal effects through both primary and secondary exposure if they forage on diphacinone bait or contaminated invertebrates over time (Eisemann and Swift 2006).

Birds that are most at risk from feeding directly on rodenticides are those that are naturally inquisitive, which are terrestrial ground-feeders, and that have a diet that includes grains and seeds. The risk of secondary poisoning is greatest for predatory and scavenging birds, especially those that feed directly on the target rodent species, such as owls. Brodifacoum has a far greater potential for primary and secondary poisoning of nontarget bird species than diphacinone because of its much higher toxicity, longer retention time in tissues, and higher rate of bioaccumulation (Erickson and Urban 2004, Eason and Wickstrom 2001, Fisher et al. 2003, Fisher et al. 2004). Combined with an extremely long half-life of residues in tissues, the general characteristic of anticoagulants for delayed symptoms and mortality after exposure results in target animals ingesting many lethal doses before death (Erickson and Urban 2004).

Erickson and Urban (2004) provide this useful discussion of potential effects of diphacinone on avian nontarget species found during field operations:

> Hegdal (1985) conducted a field study in Washington to examine the risk to game birds from the broadcast application of 0.005% diphacinone bait applied for vole control in orchards. Most orchards were treated twice, with 20 to 30 days between treatments; at an average rate of 12.9 kg/ha (11.5 pounds/acre). Telemetry was used to monitor the fate of 52 ring-necked pheasants, 18 California quail, and 30 chukar potentially exposed to the bait. About half of the quail and all chukar were pen-raised and had been released into the orchards. Dead game birds and other animals found were necropsied and any available tissue collected for residue analysis. Eight of 30 pheasants, 9 of 15 quail and one of ten chukar collected by the researchers or shot by hunters contained diphacinone residue in the liver but no mortalities were attributed to diphacinone. Bait made up as much as 90% of crop contents of some birds. No residue was detected in four passerines collected 31 to 73 days after treatment. The author concluded that risk to game birds in orchards appeared to be low but emphasized that substantial quantities of bait were eaten and longer-term behavioral and physiological effects, such as susceptibility to predation, need to be

considered along with direct mortality in order to evaluate potential hazards from exposure.

During field studies using diphacinone, searches for nontarget carcasses after baiting found one dove and two roadrunners (*Geococcyx californicus*); however there was no evidence that these birds were exposed to the rodenticide (Baroch 1994 and 1996). No avian nontarget mortality was observed during rodent eradication operations using a diphacinone rodenticide conducted on Buck Island in the Virgin Islands (Witmer et al. 2001) or Canna Island in Scotland (Elizabeth Bell, pers. comm., February 2006). Throughout two years of studies using a diphacinone rodenticide in the Aleutian Islands only one bird carcass was documented, though two ravens shot during this work also contained diphacinone residues and winter wrens, song sparrows and ptarmigan were also documented to eat the bait (Dunlevy and Scharf 2008). Two studies evaluated diphacinone residues in game birds captured from sites in Hawai‘i that had been treated by hand or aerial broadcasting 0.005% diphacinone bait. The first study utilized hand broadcast techniques on a 10-acre treatment area (Spurr et al. 2003a). Five Kalij pheasants (*Lophura leucomelana*) were collected within the treatment area between 2 and 6 weeks after treatment. Of the five, only one contained detectable diphacinone residues. The liver of this bird contained 0.09 ppm diphacinone. The second study was an aerial broadcast trial of Ramik Green (Spurr et al. 2003b). Two Kalij pheasants were collected within the 112 acre treatment area one month after treatment. Diphacinone residues of 0.12 and 0.18 ppm were found in the livers of these birds. Though extensive carcass searches were conducted during both studies no avian mortality due to diphacinone was found.

Effects on Birds from Rodenticide Ingestion by Eating Prey (Indirect Effect)

Incident reports submitted to EPA indicate that nontarget birds and mammals are being secondarily exposed to rodenticides, especially brodifacoum, in the field. Brodifacoum is widely used for control of rodents in protective stations around buildings and human habitation; diphacinone products are less used for this purpose. Diphacinone products are also registered for some field uses, such as in the agriculture industry. In 264 reported incidents, 20 animals had diphacinone residues and 244 animals had brodifacoum residues. The birds most commonly exposed to brodifacoum include great horned owls and red-tailed hawks, but multiple incidents are reported for bald and golden eagles, crows, barn owls, screech owls, hawks, falcons, kestrels and vultures.

Three laboratory studies report the secondary toxicity of diphacinone to birds. Test species were barn owls, great horned owls (*Bubo virginianus*), saw-whet owls (*Aegolius acadicus*), golden eagles (*Aquila chrysaetos* and American crows (*Corvus brachyrhynchos*). A total of 34 individuals were exposed to diphacinone-poisoned prey during these studies and three (9%) birds died, including two of three great horned owls and the only saw-whet owl tested. Symptoms of anticoagulant poisoning were noted in 13 (42%) of the survivors, indicating that raptors can recover from sublethal doses. The highest dosage administered to an eagle was 0.23 mg/kg/day for 10 consecutive days and the LOEL was determined to be 0.11 mg/kg/day. If it is assumed that the great horned owls ate equal quantities of treated mice each day, they would have consumed a maximum dose of 0.78 mg/kg/day for 5 days. Using the same methods, it can be calculated that the saw-whet owl consumed a dose of 11.1 mg/kg/day (Erickson and Urban 2004).

Hazard calculations for the short-eared owl (*Asio flammeus*, pueo) from eating contaminated rats were calculated for the secondary effects of diphacinone as there is an extremely low probability that an owl would feed directly on bait pellets. A 0.77 pound bird would have to consume at least 90.5 pounds of rodents containing 3.4 ppm diphacinone (the highest whole-carcass residue found

in a rat) in one day to ingest a dose equivalent to the LD_{50} for the northern bobwhite. Hazard calculations for sublethal exposure show that an owl would only need to eat 11 g of rodent tissue containing 3.4 ppm diphacinone per day for multiple days to ingest a LOEL dose. This amount is less than one rodent per day (Eisemann and Swift 2006). The assessments in Eisemann and Swift (2006) are based on very conservative assumptions and are assumed to overestimate the actual hazard of aerial broadcast of diphacinone.

Conclusion on Rodenticide Toxicity to Birds

The EPA (1998) states that brodifacoum is "very highly toxic" to both bobwhite quail and mallard duck for both acute and dietary exposure. Diphacinone is "moderately toxic" in acute tests of bobwhite quail, "practically nontoxic" to quail in dietary tests, and "moderately toxic" to mallard in dietary tests. Brodifacoum toxicity in birds is two orders of magnitude more toxic than required for the category "very highly toxic." The EPA declares a potential primary hazard to nontarget birds when their dietary risk quotient equals or exceeds 0.5 for non-endangered species and 0.1 for endangered species. Brodifacoum exceeds this level of concern for non-endangered species by 126-fold using the northern bobwhite LC_{50} and 50-fold using the mallard LC_{50}. For endangered species, the level of concern is exceeded by 630 times and 250 times, respectively. Diphacinone does not exceed these levels of concern for either endangered or non-endangered species using the mallard LC_{50}. Using the northern bobwhite $LC_{50,}$ diphacinone is considered "practically nontoxic" to birds by the EPA. The LOEL of brodifacoum for birds has not been determined; where efforts to establish this have been made, all dosages administered produced measurable effects; therefore a dosage where no observed effects (NOEL) have been measured has not been documented. A dosage of no observed effects is necessary to establish the lowest observable effects level.

Although individuals of avian nontarget species can die during eradication operations, especially associated with the use of brodifacoum, if the nontarget population is not extirpated and is healthy and viable it usually recovers. However, if the population is an endangered species or a small isolated island population, it may be driven too low to recover or experience negative population-level genetic effects. In most cases the long-term ecosystem benefits probably outweigh the initial nontarget mortality caused by rodenticides during eradication operations (Taylor and Thomas 1993, Eason and Spurr 1995, Dowding et al. 1999). Stephenson et al. (1999) found that passerine populations can recover naturally from a 30% decrease in populations within one to two breeding seasons following a rodenticide operation because passerine species typically have several clutches per year and successfully fledge several young per clutch. Populations of owls, because they live longer and typically fledge less than one chick per year, may recover more slowly, taking two to three seasons (also Murphy et al. 1998). The relative resilience of a species to recover after large population declines depends on the species capacity to compensate for density independent perturbations in abundance, such as the broadscale application of rodenticides. Species with a high intrinsic rate of increase and strong-density dependent links between their demographics and factors that regulate their abundance will typically be more resilient than species without these population dynamics. Species for which there is clear evidence of a high intrinsic capacity for increase and strong density-dependence in their dynamics should be able to sustain higher levels of reduction from poisoning without any undue threat to their long-term viability (Choquenot and Ruscoe 1999).

Erickson and Urban (2004) conclude that potential primary risks are higher for second generation rodenticides, including brodifacoum, than for first generation rodenticides, including diphacinone.

A small bird finding and eating just a small pellet or two of brodifacoum is likely to ingest a lethal dose, and a few small pellets could provide a lethal dose to larger birds. In contrast, it seems highly unlikely that any small bird could eat 100 to 1000 pellets of diphacinone in a single feeding which would be needed to provide an LD_{50} dose from a first-generation anticoagulant. Eason et al. (1999) and Eason and Wickstrom (2001) state: “the recorded mortality of birds after some control operations, coupled with the detection of brodifacoum residues in a range of wildlife including native birds and feral game animals raises serious concerns about the long-term effects of the targeted field use of brodifacoum…where wildlife might encounter poisoned carcasses.” New Zealand is recommending reducing the field use of brodifacoum because of the high risk of poisoning nontarget species, especially secondary poisoning (Eason and Wickstrom 2001, Eason and Murphy 2001, Hoare and Hare 2006).

APPENDIX B

Diphacinone-50 Product Label

ENVIRONMENTAL HAZARDS

This product is toxic to mammals and birds. Predatory and scavenging mammals and birds might be poisoned if they feed upon animals that have eaten bait.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store only in original closed container in a cool, dry place inaccessible to children and pets. Store separately from fertilizer and away from products with strong odors which may contaminate the bait and reduce acceptability. Spillage should be carefully swept up and collected for disposal.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

PLASTIC CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after use. Offer for recycling, if available. Otherwise, puncture and dispose of in a sanitary landfill, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL: Read this entire label and follow all use directions and use precautions.

IMPORTANT: Do not expose children or pets to this product. Take all appropriate steps to limit exposure to and impacts on nontarget species, especially those for which special conservation efforts are planned or ongoing. To help to prevent accidents:

1. Store product not in use in a location out of reach of children and pets.
2. Apply bait only as specified on this label and in strict accordance with the "USE **RESTRICTIONS**" and "**APPLICATION DIRECTIONS**". For applications involving bait stations, the bait stations must be tamper-resistant. The bait stations must deny access to bait compartments by children, pets, and other non-target species larger in body size than the type(s) of rats or mice being targeted by the bait program. Lock and secure bait stations, as necessary, to exclude such nontarget species. In locations where captive or feral livestock occur, either remove and exclude such animals from the application site prior to treatment or make sure that the bait stations used are capable of denying them access to bait compartments, and
3. Dispose of product container, and unused, spoiled and unconsumed bait as specified on this label.

USE RESTRICTIONS: This product may be used only to control or eradicate Norway rats (Rattus norvegicus), roof rats (Rattus rattus), Polynesian rats (Rattus exulans), house mice (Mus musculus) or other types of invasive rodents for conservation purposes on islands, grounded vessels or vessels in peril of grounding. This product may be applied only using bait stations, burrow baiting, canopy baiting or aerial and ground broadcast application techniques.

This product is to be used for the protection of State or Federally-listed Threatened or Endangered Species or other species determined to require special protection.

Do not apply this product to food or feed.

Treated areas must be posted with warning signs appropriate to the current rodent control project.

(DIRECTIONS FOR USE continued on right panel of this label)

STATE OF HAWAII
Department of Agriculture
ACCEPTED
LICENSE NO.
8600.1

RESTRICTED USE PESTICIDE
DUE TO HAZARDS TO NON-TARGET SPECIES

For retail sale only to: USDA Animal and Plant Health Inspection Service Wildlife Services, U.S. Fish and Wildlife Service, and the U.S. National Park Service to be used only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicators certification.

Diphacinone-50: Pelleted Rodenticide Bait for Conservation Purposes

Fish Flavored, Weather-resistant Rodenticide for Control or Eradication of Invasive Rodents on Islands or Vessels for Conservation Purposes

ACTIVE INGREDIENT:
Diphacinone: (2-Diphenylacetyl-1,3-Indandione)..0.005%
INERT INGREDIENTS:..99.995%
TOTAL..100.000%

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS

HAZARD TO HUMANS AND DOMESTIC ANIMALS

Caution: Keep away from humans, domestic animals and pets. If swallowed, this material may reduce the clotting ability of the blood and cause bleeding. Wear protective gloves when applying or loading bait. With a detergent and hot water, wash all implements used for applying bait. Do not use these implements for mixing, holding or transferring food or feed.

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	• Call a poison control center, doctor, or 1-800-222-1222 immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call a poison control center, doctor, or 1-800-222-1222 immediately for treatment advice.

• **Note to Physician**: If ingested, administer Vitamin K_1, intramuscularly or orally as indicated in bishydroxycoumarin overdose. Repeat as necessary based on monitoring of prothrombin times.

For a medical emergency involving this product, call 1-800-222-1222.

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
4700 River Road, Unit 149
Riverdale, MD 20737-1237
EPA Reg. No 56228-35
EPA Est. No. (61282-WI-1) or (056228-GU-1)

Net Contents: _______________

Batch Code No.: _______________

DIRECTIONS FOR USE
(continued from left panel)

APPLICATION DIRECTIONS:

Bait Stations: Tamper-resistant bait stations must be used when applying this product on grounded vessels or vessels in peril of grounding or when used in areas of human habitation. See Item 2) under "**IMPORTANT**:" regarding the performance characteristics needed for tamper-resistant bait stations. To bait rats: Apply 4 to 16 ounces (113 to 454 grams) of bait per placement. Space placements at intervals of 5 to 50 meters. Placements should be made in a grid over the area for which rodent control is desired. To bait mice: Apply 0.25 to 0.5 ounces (7 to 14 grams) of bait per placement. Space placements at intervals of 2 to 4 meters. Placements should be made in a grid over the area for which rodent control is desired. Larger placements (up to 2 ounces) may be needed at points of very high mouse activity. For both rat and mouse baiting: Maintain an uninterrupted supply of fresh bait for at least 15 days or until signs of rodent activity cease. Where a continuous source of infestation is present, permanent bait stations may be established and bait replenished as needed.

Burrow-baiting: Place bait in burrows only if this can be done in a way that minimizes potential for ejection of bait and exposure of bait to seed-eating birds and other non-target species. To bait rats: place 3 to 4 ounces (85 to 113 g) of bait inside each burrow entrance. Baits used in burrows may be applied in piles or in cloth or resealable plastic bags. The bags should be knotted or otherwise sealed to avoid spillage and holes should be made in plastic bags to allow the bait odor to escape. To bait mice: place approximately 0.25 ounces (7 grams) of bait in each active burrow. For both rat and mouse baiting: place one such bag or placement in each active burrow opening and push bag into burrow far enough so that its presence can barely be seen. Do not plug burrows. Flag treated burrows and inspect them frequently, daily if possible. Maintain an uninterrupted supply of bait for at least 15 days or until rodent activity ceases. Remove bait from burrows if there is evidence that bags are ejected.

Canopy Baiting (bait placement in the canopy of trees and shrubs): In areas where sufficient food and cover are available to harbor populations of rodents in canopies of trees and shrubs, canopy baiting should be included in the baiting strategy. Approximately 4 to 7 ounces (113 g to 200 g) of bait should be placed in a cloth or resealable plastic bag. The bags should be knotted or otherwise sealed to avoid spillage and holes should be made in plastic bags to allow the bait odor to escape. Using long poles (or other devices) or by hand, bait filled bags should be placed in the canopy of trees or shrubs. Baits should be placed in the canopy at intervals of 50 meters or less, depending upon the level of rodent infestation in these habitats. In some vegetation types, bait stations may need to be used to ensure bait will stay in the canopy.

Aerial and Ground Broadcast: Broadcast applications are prohibited on vessels or in areas of human habitation. Broadcast bait pellets by helicopter or manually at a rate of 10 to 12.5 lbs. of bait per acre (11.1 to 13.8 kg/ha) per treatment. Make a second broadcast application typically 5 to 7 days after the first application, depending upon local weather conditions, at a rate no higher than 12.5 lbs. (13.8 g/ha) of bait per acre. In situations where weather or logistics only allow one bait application, a single application may be made at a rate no higher than 20.0 lbs. bait per acre (22.5 kg/ha).

Aerial (helicopter) applications may not be made in winds higher than 35 mph (30 knots). Pilot in command has final authority for determining safe flying conditions. However, aerial applications will be terminated when the following conditions are met:

- Windspeed in excess of 25 knots with an evaluation of the terrain and impact of the wind conditions and not to exceed a steady wind velocity of 30 knots.

If rat activity persists after broadcast application, set up and maintain tamper-resistant bait stations or apply bait directly to rodent burrows in areas where rodents remain active. If terrain does not permit use of bait station or burrow baiting, continue with broadcast baiting, limiting such treatments to areas where active signs of rats are seen. Maintain treatments for as long as rodent activity is evident in the area and rodents appear to be accepting bait.

For all methods of baiting, monitor the baited area periodically and, using gloves, collect and dispose of any dead animals and spilled bait properly. Dead animals and spilled bait may be buried on site if the depth of burial makes excavation by nontarget animals extremely unlikely.

USDA APHIS revised 11/23/2009

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APPENDIX C

Section 7, Endangered Species Act USFWS Consultation Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2017-I-0264

Colonel Stephen E. Dawson
Office of the Garrison Commander
U.S. Army Installation Management Command, Pacific Region
Headquarters, United States Army Garrison, Hawaii
745 Wright Avenue, Building 107, Wheeler Army Airfield
Schofield Barracks, Hawaii 96857-5000

Subject: Informal Consultation for the Proposed Use of Aerial Rodenticide at the U.S. Army Schofield Barracks, Oahu

Dear Colonel Dawson:

The U.S. Fish and Wildlife Service (Service) received your letter, dated May 16, 2017, requesting our concurrence with your determination that the proposed pilot aerial application of diphacinone rodenticide within the Lihue Management Unit of the Schofield Barracks, Oahu may affect, but is not likely to adversely affect the following federally listed species: the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), the endangered Oahu elepaio (*Chasiempis ibidis*), the endangered Oahu tree snail (*Achatinella mustelina*), and the endangered Hawaiian picture-wing fly (*Drosophila obatai*); also included are the following endangered plants: *Alectryon micrococcus*, *Asplenium dielfalcatum*, *Chrysodracon forbessii*, *Cyanea calycina*, *Cyanea grimesiana obatae*, *Delissea waianaeensis*, *Flueggea neowawraea*, *Gardenia mannii*, *Hesperomannia oahuensis*, *Labordia cyrtandrae*, *Lepidium arbuscular*, *Neraudia angulate*, *Nothocestrum latifolium*, *Phyllostegia mollis*, *Platydesma cornuta decurrens*, *Pteralyxia macrocarpa*, *Schiedea hookeri*, *Schiedea kaalae*, and *Sicyos lanceoloidea*. In addition, this consultation serves as a conference on iiwi (*Vestiaria coccinea*), a species currently proposed for listing.

The findings and recommendations in this consultation are based on (1) your letter and enclosure received on May 16, 2017; and (2) other information available to us in our database and records, including data provided by the Hawaii Biodiversity and Mapping Program. A complete administrative record is on file in our office. This response is in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*).

Project Description
The Army proposes to conduct an aerial application of diphacinone rodenticide within the Lihue Management Unit (MU) on the Schofield Barracks property located on Oahu. The fenced Lihue MU encompasses 1,764 acres (ac) and protects the above mentioned endangered species from pig and goat predation. Many of the above endangered species are also threatened by rat predation. Currently, only mechanical rat control using traditional snap traps and New Zealand automatic traps is conducted in the Lihue MU. Restricted access to the MU due to training activities and limited control options hinders rat

control efforts. The aerial application of the rodenticide will provide an additional rat control option for the Lihue MU, which is an extensive area within the fenced management unit. The rat control will provide positive impacts for listed species through reduced predation on animals and plants within the Lihue MU. The rodenticide diphacinone will be applied in November or December 2017 to 1,063 ac of the Lihue MU, all of which is heavily forested. As part of the proposed rodenticide application, the Army will:

- conduct regular visual inspections of the area while monitoring rat tracking tunnels; and
- actively search for carcasses of rats and other species to measure success of the project and determine if non target species are affected by the rodenticide.

Avoidance and Minimization Measures
The following measures identified in your letter will be implemented at the project site to avoid and minimize effects to the Hawaiian hoary bat. These avoidance and minimization measures are considered part of the project description.

- Application of rodenticide will be restricted to forested areas; application of rodenticide to grassy areas will be avoided since Hawaiian hoary bats are known to utilize these areas to forage.

Conclusion
The proposed project is not likely to affect Hawaiian hoary bats since it is unlikely that bats will consume enough insects that have come in contact with the diphacinone rodenticide to cause lethal or sublethal effects (USFWS 2014). The avoidance of application of the rodenticide in grassy areas minimizes the probability for the bats to ingest insects that have come in contact with the diphacinone. Therefore, the Service has determined that any effects are insignificant and discountable, and therefore not likely to adversely affect the Hawaiian hoary bat.

The proposed project is not likely to adversely affect elepaio since it is not likely that forest birds will consume enough insects that have come in contact with the diphacinone rodenticide to cause lethal or sublethal effects (USFWS 2014). Therefore, the Service has determined that any effects are insignificant and therefore not likely to adversely affect the elepaio.

Primary or secondary poisoning from diphacinone is not likely to occur for the Oahu tree snail since it primarily forages on fungus that grows on trees. Oahu tree snails primarily forage in trees and it is not likely it will come into contact with the rodenticide on the ground. Therefore, the Service has determined that any effects are discountable and therefore not likely to adversely affect the Oahu tree snail.

Primary or secondary poisoning from diphacinone is not likely to occur for the Hawaiian picture-wing fly since it primarily forages on decaying plant matter. Therefore, the Service has determined that any effects are discountable and therefore not likely to adversely affect the Hawaiian picture-wing fly.

Primary or secondary poisoning from diphacinone is not likely to occur for the iiwi since it is a nectar foraging species. Therefore, the Service has determined that any effects are discountable and not likely to adversely affect the iiwi.

The proposed project is unlikely to affect the following listed plants in the vicinity of the project: *Alectryon micrococcus*, *Asplenium dielfalcatum*, *Chrysodracon forbessii*, *Cyanea calycina*, *Cyanea grimesiana obatae*, *Delissea waianaeensis*, *Flueggea neowawraea*, *Gardenia mannii*, *Hesperomannia*

Colonel Stephen E. Dawson 3

oahuensis, *Labordia cyrtandrae*, *Lepidium arbuscular*, *Neraudia angulate*, *Nothocestrum latifolium*, *Phyllostegia mollis*, *Platydesma cornuta decurrens*, *Pteralyxia macrocarpa*, *Schiedea hookeri*, *Schiedea kaalae*, and *Sicyos lanceoloidea*. Diphacinone is non-toxic to plants and baiting programs are approved by the Service to ensure potential adverse impacts will be avoided (USFWS 2014). Control of rodents would reduce rodent predation on listed plants and their seeds. Project implementation will be wholly beneficial to listed plants in the Lihue MU.

Based on the above, we concur that the proposed project may affect, but is not likely to adversely affect, the following federally listed species: the Hawaiian hoary bat, the Oahu elepaio, the Oahu tree snail, and the Hawaiian picture-wing fly; also included are the following endangered plants: *Alectryon micrococcus*, *Asplenium dielfalcatum*, *Chrysodracon forbessii*, *Cyanea calycina*, *Cyanea grimesiana obatae*, *Delissea waianaeensis*, *Flueggea neowawraea*, *Gardenia mannii*, *Hesperomannia oahuensis*, *Labordia cyrtandrae*, *Lepidium arbuscular*, *Neraudia angulate*, *Nothocestrum latifolium*, *Phyllostegia mollis*, *Platydesma cornuta decurrens*, *Pteralyxia macrocarpa*, *Schiedea hookeri*, *Schiedea kaalae*, and *Sicyos lanceoloidea*. In addition, the proposed project is not likely to adversely affect the iiwi, a species currently proposed for listing.

Unless the project description changes, or new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary. If additional information becomes available, or it is determined that the proposed project may affect federally listed species, we recommend you coordinate with our office early in the planning process so that we may further assist you with ESA compliance.

We thank you for your efforts to conserve listed species and native habitats. Please contact Stacey Lowe, Fish and Wildlife Biologist (phone: 808-792-9400, email: stacey_lowe@fws.gov) should you have any questions pertaining to this response or require further guidance. When referring to this project, please include this reference number: 01EPIF00-2017-I-0264.

Sincerely,

Aaron Nadig
Island Team Manager
Oahu, Kauai, Northwestern
Hawaiian Islands, and American Samoa

cc: U.S. Army Garrison Hawaii, Directorate of Public Works, Environmental Division, Natural Resource Section

Literature Cited

U.S. Fish and Wildlife Service. Informal consultation for the renewals of EPA special local needs registrations for use of Ramik Mini Bars and mouse killer, and Rozol Mini Blocks and Pellets, Hawaii. Pacific Islands Field Office, Honolulu, HI. 4 April 2014.

APPENDIX D

Waiʻanae Mountain Views and Photos of Lihue Management Unit

Typical Viewplane, Waiʻanae Mountains

View of SBMR West Range and Central Plateau, from Mt. Kaʻala Summit, Waiʻanae Mountains

View toward SBMR West Range Impact Area from Firebreak Road below Lihue MU

Typical Setting, Lihue Management Unit Rodenticide Treatment Area

ʻElepaio molt all their feathers at the end of each breeding season and must manage without a tail before growing back a new one.

UXO, Lihue Management Unit Rodenticide Treatment Area

Rat Tracking Tunnel, Lihue Management Unit Rodenticide Treatment Area

Tracking Tunnel and Ink Card with Rat Tracks

Typical View of Fenceline

Typical View of Ungulate Fenceline

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