Kawailoa Wind Power

Draft Habitat Conservation Plan Amendment

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Table of Contents

1.0 Introduction and Project Overview 1
1.1 Summary 1
1.1.1 Hawaiian Hoary Bat 1
1.1.2 Hawaiian Petrel 4
1.2 Applicant Background 4
1.3 Regulatory Context 4
1.4 Project Description 5
1.4.1 Project History 5
1.4.2 Project Design and Components 5
1.4.3 Purpose and Need for Kawailoa Wind Project 5
1.5 List of Preparers 6
2.0 DESCRIPTION OF HABITAT CONSERVATION PLAN 7
2.1 Purpose of this HCP 7
2.2 Scope and Term 7
2.3 Surveys and Resources 7
3.0 ENVIRONMENTAL SETTING 9
3.1 Location, Vicinity, and Climate 9
3.2 Topography and Geology 9
3.3 Soils 9
3.4 Hydrology, Drainage and Water Resources 9
3.5 Environmental Contaminants 9
3.6 Land Use Designations 9
3.7 Flora 9
3.8 Wildlife 9
3.8.1 Surveys Conducted 9
3.8.2 Non-Listed Wildlife Species 10
3.8.3 Wildlife at Off-site Microwave Facility Locations 10
3.8.4 Listed Wildlife Species 10
4.0 BIOLOGICAL GOALS AND OBJECTIVES 21
5.0 ALTERNATIVES 23
5.1 Full Nighttime Curtailment 23
5.2 Curtailment with Cut-in Speeds of 5.5 Meters Per Second or Above 23
5.3 Avoidance and Minimization Measures 25
5.3.1 USFWS Guidelines 25

6.0 POTENTIAL IMPACTS 26
6.1 Impacts to Birds 26
6.2 Impacts to Bats 26
6.3 Estimating Project-related Impacts 26
6.3.1 Take Levels 26
6.3.2 Monitoring of Take Levels 26
6.3.3 Estimating Indirect Take 26
6.3.4 Seabirds 26
6.3.5 Hawaiian Waterbirds 28
6.3.6 Hawaiian Short-eared Owl 28
6.3.7 Hawaiian Hoary Bat 28
6.4 Cumulative Impacts to Listed Species 35
6.4.1 Seabirds 37
6.4.2 Waterbirds (Hawaiian Duck, Hawaiian Stilt, Hawaiian Coot, Hawaiian Moorhen) 38
6.4.3 Hawaiian Short-eared Owl 38
6.4.4 Hawaiian Hoary Bat 38
6B.0 AVOIDANCE AND MINIMIZATION MEASURES 43
6B.1 Operational Minimization Measures Implemented for the Hawaiian Hoary Bat 43
6B.2 Avoidance and Minimization Measures for the Hawaiian Petrel 46
6B.3 USFWS Guidelines 46
7.0 MITIGATION MEASURES 47
7.1 Selection of Mitigation Measures 47
7.2 General Measures 47
7.3 Seabirds (Newell's Shearwater and Hawaiian Petrel) 47
7.3.1 Newell's Shearwater 48
7.3.2 Hawaiian Petrel 48
7.4 Waterbirds (Hawaiian Duck, Hawaiian Stilt, Hawaiian Coot, and Hawaiian Moorhen) 53
7.5 Hawaiian Short-eared Owl 53
7.6 Hawaiian Hoary Bat 53
7.6.1 Mitigation for Tier 1 Take 54
7.6.2 Mitigation for Tier 2 and Tier 3 Take 54
7.6.3 Mitigation for Tier 4 Take 56
7.6.4 Mitigation for Tier 5 and Tier 6 Take 62
7.7 Immediate Revegetation to Control Soil Erosion 71
7.8 Managing Invasive Species 71
7.9 Replanting of Native Trees 71

8.0 IMPLEMENTATION 72
8.1 HCP Administration 72
8.2 Monitoring and Reporting 72
8.2.1 Take Monitoring 72
8.2.2 Reporting 74
8.3 Adaptive Management Program 75
8.3.1 Future Minimization Measure Triggers and Actions 75
8.4 Funding Assurances 77
8.5 Changed Circumstances Provided for in the HCP 79
8.5.1 Listing of New Species or Delisting of a Covered Species 79
8.5.2 Designation of Critical Habitat 79
8.5.3 Catastrophic Events 79
8.5.4 Invasive Species 80
8.5.5 Disease Outbreaks in a Covered Species 80
8.5.6 Changes in Known Risks to or Distribution of Currently Listed Species 80
8.5.7 Global Climate Change Alters Status of the Covered Species 80
8.6 Changed Circumstances Not Provided for in the HCP 81
8.7 Unforeseen Circumstances and "No Surprises" Policy 81
8.8 Notice of Unforeseen Circumstances 81
8.9 Permit Duration 81
8.10 Amendment Procedure 81
8.11 Renewal and Extension 81
8.12 Suspension/Revocation 81
8.13 Other Measures 81
8.14 Permit Transfer 81
9.0 CONCLUSION 82
10.0 LITERATURE CITED 83

List of Figures

Figure 1-1. Kawailoa Wind Location and Site Layout 3
Figure 3-1. Documented Acoustic Bat Detections on O‘ahu in Relation to Land Cover. 16
Figure 3-2. Documented Fatalities by Turbine at the Project. 18
Figure 6-1. Hawaiian Hoary Bat Annual Survival Estimates by Age Group for the Matrix Population Model (a) and Estimated Portion of the Population by Age (b). 31
Figure 6-2. Generalized Theoretical Model of Population Growth Over Time. 33
Figure 6-3. Estimates of Population Trend After 10 Years from Generalized Growth Rate Estimate. ...40

Figure 6B-6-1. Percentage of Time that Wind Speeds Are in the Range of Curtailment at 5.0 m/s 44
Figure 6B-6-2. Average Wind Speed at the Project.....45
Figure 7-1. Location of the HWA.....59
Figure 7-2. Land Use and Land Cover within the HWA. 60

List of Tables

Table 1-1. Existing Wind Energy Facilities with Approved or Draft HCPs in Hawaiʻi 6
Table 6-1. Estimates of Take and Total Take Requests for Each Tier 30
Table 6-2. Best Available Information on Life History Parameters Used to Estimate Growth Rate of the Hawaiian Hoary Bat.....31
Table 6-3. Current and Pending Take Authorizations for the Covered Species Requested in this Amendment 36
Table 7-1. Mitigation Measures for Requested Take of Hawaiian Petrel and Hawaiian Hoary Bat under the HCP Amendment. 47
Table 7-2. Projections of Hawaiian Petrel Burrow Monitoring and Number of Chicks Fledged in 2020 .50
Table 7-3. Reproductive Success at Hanakāpīʻai and Hanakoa by Year of Monitoring 53
Table 7-4. Triggers for Planning for Future Tiers of Mitigation 63

List of Appendices

Appendix 1a, b. Biological Resources Surveys

Appendix 2. Jurisdictional Wetland Determination Study

Appendix 3a, b. Radar and Visual Studies of Seabirds

Appendix 4. Kawailoa Wind Wildlife Monitoring Report and Fatality Estimates for Waterbirds and Bats

Appendix 5. Life History Information on Covered Species

Appendix 6. Wildlife Education and Observation Program

Appendix 7. Wildlife Casualty Monitoring Protocol

Appendix 8. Funding Matrix

Appendix 9. Calculating Direct Take

Appendix 10. Off-site Microwave Towers Biological Resources Survey

Appendix 11. Take Reporting Form

Appendix 12. Mollusk Survey for the Kawailoa Wind Farm Project, Mount Kaʻala Microwave Communication Facilities, Mount Kaʻala, Kamananui, Waialua, Oʻahu

Appendix 13. Mitigation Timeline and Reporting Requirements

Appendix 14. Letter from Bat Expert Dr. Mike O’Farrell on the Effectiveness of Wetland and Forest Restoration for Improving Bat Foraging Habitat

Appendix 15. Goodnature Automatic Cat Trap Development Project Timeline

Appendix 16 (Amendment only). Estimating Hawaiian Hoary Bat and Hawaiian Petrel Fatalities at Kawailoa Wind

Appendix 17 (Amendment only). Kawailoa Wind Long-term Monitoring Protocol

Appendix 18 (Amendment only). Estimated Funding for the HCP Amendment

Appendix 19 (Amendment only). Tier 4 Hawaiian Hoary Bat Mitigation Plan

Acronyms and Abbreviations

APLIC	Avian Power Line Interaction Committee
CARE	Carcass removal
CUA	core use area
DLNR	Hawaiʻi Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife
EoA	Evidence of Absence
ESA	Endangered Species Act
ESRC	Endangered Species Recovery Committee
HCP	Habitat Conservation Plan
HECO	Hawaiian Electric Company
HRS	Hawaiʻi Revised Statutes
HWA	Helemano Wilderness Area
ITL	incidental take license
ITP	incidental take permit
Kawailoa Wind	Kawailoa Wind, LLC
KESRP	Kauaʻi Endangered Seabird Recovery Project
KWP I	Kaheawa Wind Power I
KWP II	Kaheawa Wind Power II
LOC	letter of credit
LWSC	low wind speed curtailment
m/s	meters per second
MW	megawatt
NFWF	National Fish and Wildlife Foundation
PCMM	Post-construction Mortality Monitoring
PPA	Power Purchase Agreement
Project	Kawailoa Wind Project
SEEF	searcher efficiency
SSMIP	site-specific mitigation implementation plan
TPL	Trust for Public Land
USFWS	U.S. Fish and Wildlife Service
WEOP	Wildlife Education and Observation Program

1.0 INTRODUCTION AND PROJECT OVERVIEW

1.1 Summary

Kawailoa Wind, LLC (Kawailoa Wind) was issued an incidental take permit (ITP) from the U.S. Fish and Wildlife Service (USFWS) and an incidental take license (ITL) from the Hawaii Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) for the Kawailoa Wind Project (Project) on December 8, 2011 and January 6, 2012, respectively. The 69-megawatt (MW) Project, which began commercial operation in November 2012, is in the northern portion of Oʻahu Island, Hawaii. The Project consists of 30, 2.3-MW wind turbine generators. Ancillary facilities include an underground electrical collection system, an operations and maintenance facility, and an approximately 4-mile above-ground transmission line (Figure 1-1).

The ITP/ITL and associated Habitat Conservation Plan (HCP; SWCA 2011) provide coverage for incidental take of seven species listed under the federal Endangered Species Act (ESA) and State of Hawaii endangered species statute, Hawaii Revised Statutes (HRS) Chapter 195D, that have the potential to be impacted by the Project. These species are: the Hawaiian stilt or aeʻo (*Himantopus mexicanus knudseni*), Hawaiian coot or ʻalae keʻokeʻo (*Fulica alai*), Hawaiian duck or koloa maoli (*Anas wyvilliana*), Hawaiian moorhen or ʻalae ʻula (*Gallinula chloropus sandvicensis*), Newell's shearwater or ʻaʻo (*Puffinus newelli*), Hawaiian hoary bat or ʻopeʻapeʻa (*Lasiurus cinereus semotus*), and the Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*). Collectively, these are referred to as Covered Species. The ITP and ITL each have a term of 20 years, of which there are 14 years remaining.

The purpose of this HCP Amendment is to 1) support a request to increase the amount of take for the Hawaiian hoary bat beyond the take authorized under the current ITP/ITL, and 2) add the endangered Hawaiian petrel or ʻuaʻu (*Pterodroma sandwichensis*) as a Covered Species. The HCP Amendment also describes how Kawailoa Wind will minimize and mitigate these additional impacts to the Hawaiian hoary bat and Hawaiian petrel to the maximum extent practicable, including appropriate adaptive management plans and a long-term post-construction monitoring plan. This amendment does not propose to change the original 20-year permit term of the ITP/ITL, nor does it consider expansion of the existing facility.

For ease of use, this amendment document utilizes the same organization and Table of Contents as the approved HCP. As noted throughout this document, not all sections of the approved HCP require revision, and unrevised sections are noted throughout the document. Where new sections in support of this amendment would require changing section numbers from the approved HCP, letters were added to retain section numbers from the approved HCP and facilitate comparison to that document.

1.1.1 Hawaiian Hoary Bat

The approved HCP authorizes take of 60 Hawaiian hoary bats, an estimate that was based on the best available information at the time the approved HCP was developed. However, Hawaiian hoary bat take has been higher than anticipated since the start of Project operations in November 2012. Take of Hawaiian hoary bats at the Project has been higher than anticipated under the approved HCP, in part because risk to bats associated with wind energy development in Hawaiʻi was largely unknown at the time, and because advancements have been made in the ability to statistically model future fatality rates. When the approved HCP was prepared, post-construction mortality monitoring data from Hawaiʻi wind farms were scant, and estimates of take were based on the best available surrogate information consisting of pre-construction acoustic data which is now recognized as a poor predictor of post-construction fatality rates (Hein et al. 2013). This resulted in an underestimate in the number of bat fatalities expected to occur as a result of Project operation. In addition, since the development of the approved HCP, the USFWS and DOFAW have adopted a more conservative standard for estimating bat take (e.g., Evidence of Absence statistical software; see Section 6.3), which is also now used to evaluate HCP compliance. Thus, the initial estimate of take and subsequent estimates of take for evaluating permit compliance (incorporating actual fatality data) were based on different methodologies.

Fatality estimates indicate that the Project has exceeded the currently authorized bat take limit, even with the implementation of additional avoidance and minimization measures, such as increasing the period of low wind speed curtailment (LWSC). In the approved HCP, Kawailoa Wind committed to implementing LWSC from sunset and sunrise from March to November, based on pre-construction data that showed relatively higher bat activity during these periods.

Incremental extensions to the LWSC period have been made as an adaptive management response to the occurrence of bat fatalities outside the initial LWSC period. In 2012, LWSC was extended to December 15. The starting date for LWSC was subsequently moved up to February 10 in 2013, then February 6 in 2015. After a bat fatality in late December 2016, LWSC was further extended to December 31 for 2017. Because take continued to occur at levels higher than anticipated, Kawailoa Wind has engaged in ongoing consultation with the USFWS and DOFAW starting in November 2015 to discuss the need for, and to develop, an HCP Amendment.

The total take requested under this amendment is 220 bats for the 20-year ITP/ITL permit term. This includes 60 bats authorized under the approved HCP as part of Tiers 1-3, and an additional 160 bats requested for authorization under Tiers 4-6 of the HCP Amendment. This request is based on site-specific post-construction mortality monitoring data and very conservative statistical tools, and represents the maximum projected take under conservative assumptions about the effectiveness of minimization measures (see Section 6B).

Specific to the Hawaiian hoary bat, this amendment presents the following information:

- Current information regarding Hawaiian hoary bat biology, distribution, threats, and occurrence in the Project area (Section 3.8.4);
- A revised estimate of total Project-related Hawaiian hoary bat take over the remainder of the permit term, based on an analysis of Project-specific post-construction mortality monitoring data, and a request for additional take authorization (Section 6 and Appendix 16);
- Additional measures to minimize impacts to the Hawaiian hoary bat (Section 6B);
- An adaptive management strategy for responding to future take rates that are higher or lower than anticipated and actions that can be taken to ensure the plan is achieving its goals (Section 8.3); and
- Associated compensatory mitigation (Section 7).

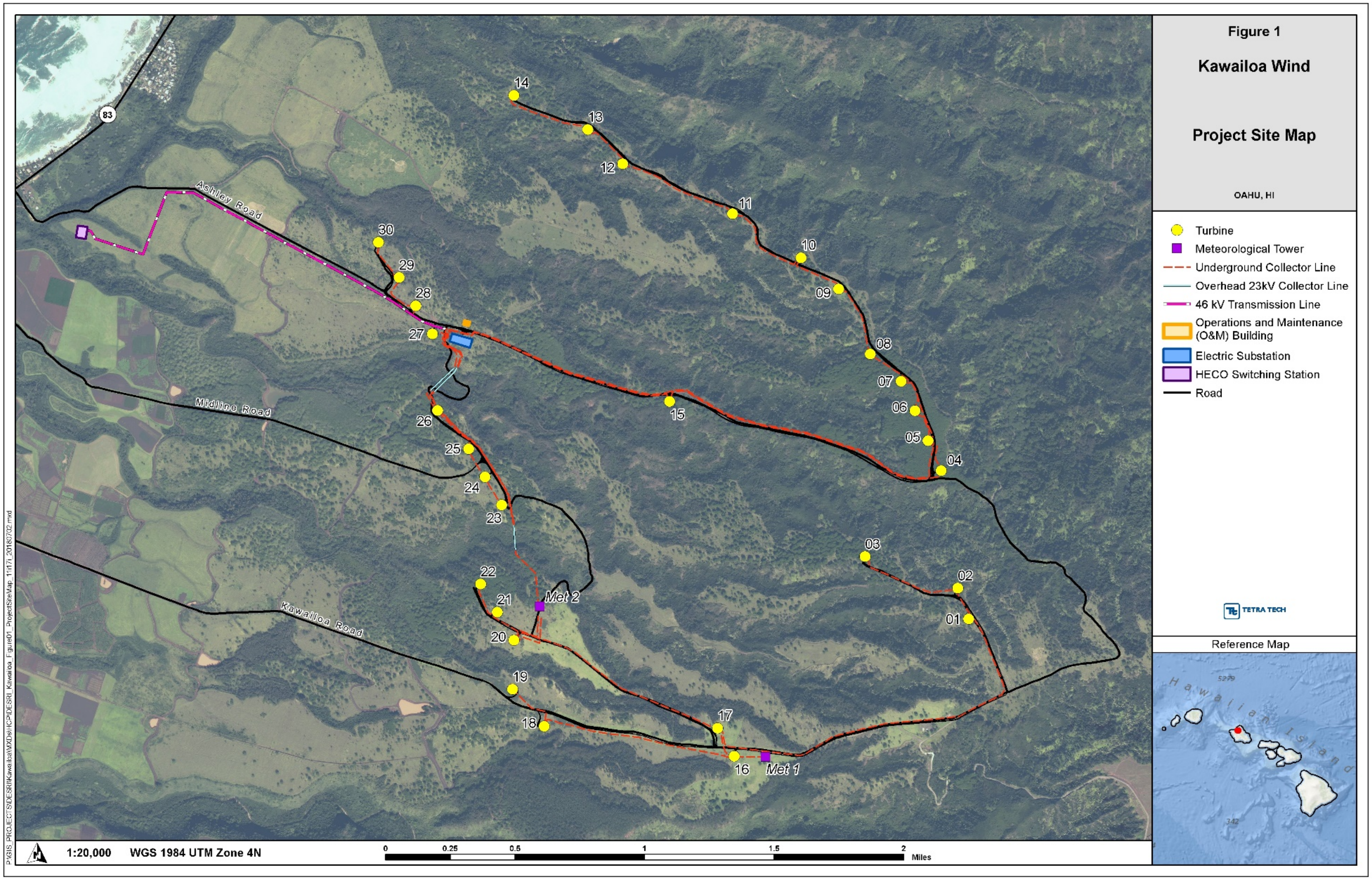


Figure 1-1. Kawailoa Wind Location and Site Layout

1.1.2 Hawaiian Petrel

The Hawaiian petrel was not originally included as a Covered Species in the HCP and ITP/ITL. When the approved HCP was developed, the Hawaiian petrel was not known to occur regularly on Oʻahu. Very few individuals have been recorded on the island in the last several decades, and when found, were often grounded and assumed to have been disoriented vagrants from other islands (Young et al. 2019). The most recent evidence of a population on Oʻahu was limited to sub-fossil remains primarily on the ʻEwa plains, which precede European contact (Pyle and Pyle 2009). The species was considered very unlikely to transit the Project area, and therefore, take was thought to be highly unlikely. The decision to exclude the Hawaiian petrel from the approved HCP and ITP/ITL was consistent with technical advice received from USFWS and DOFAW.

On July 21, 2017, a single mid-sized seabird (procellarid) carcass was observed incidentally within the Project area, and later identified through genetic analysis as a Hawaiian petrel. Furthermore, a recent study by Young et al. (2019) documented that Hawaiian petrels may occur on portions of Oʻahu more than previously expected; however, surveys to date have not provided evidence that breeding colonies are present on the island (USFWS 2017; Young et al. 2019).

Based on the observed fatality at the Project and recent surveys documenting Hawaiian petrel occurrence on Oʻahu, Kawailoa Wind is requesting that this HCP Amendment include authorization for incidental take of the Hawaiian petrel.

Specific to the Hawaiian petrel, this amendment presents the following information:

- A description of Hawaiian petrel biology, distribution, threats, and occurrence on Oʻahu (Section 3.8);
- An estimate of total Project-related Hawaiian petrel take for the permit term and a take authorization request of 19 adults and 5 chicks (Section 6 and Appendix 16); and
- Associated compensatory mitigation (Section 7.3).

1.2 Applicant Background

The Project was developed and constructed by Kawailoa Wind. The Project is a wholly-owned subsidiary of DESRI IV, LLC, which is an investment fund managed by D.E. Shaw Renewable Investments, LLC.

1.3 Regulatory Context

[This section requires no edits for the HCP Amendment, except for subsection 1.3.3 due to a change in USFWS policy since the HCP was approved.]

The bird species addressed in this amended HCP are also protected under the Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC 703-712). The MBTA prohibits the take of migratory birds. A list of birds protected under MBTA implementing regulations is provided at 50 CFR §10.13. Unless permitted by regulations, under the MBTA it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product. The USFWS does not currently have a comprehensive program under the MBTA to permit the take of migratory birds by otherwise lawful activities. On December 22, 2017, the Department of the Interior Office of the Solicitor issued a memorandum opinion concluding that the MBTA does not prohibit incidental take of migratory birds.

To avoid and minimize impacts to migratory birds, the approved HCP incorporated design and operational features based on application of the USFWS Interim Guidance on Avoiding and Minimizing Impacts to Wildlife from Wind Turbines (issued May 13, 2003). These guidelines contain materials to assist in evaluating possible wind power sites, wind turbine design and location, and pre- and post-construction research to identify and/or assess potential impacts to wildlife. Specific measures adopted by Kawailoa Wind to avoid and minimize the potential for adverse impacts to migratory birds are detailed in Section 5.3 of the approved HCP. The approved HCP also specifies that any migratory bird collisions or other impacts that occur with implementation of covered activities will be documented and reported to the USFWS.

1.4 Project Description

A detailed description of the Project is provided in Section 1.4 of the approved HCP. No additional Project development or operational changes are proposed under this amendment, except operational minimization measures to minimize risk to the Hawaiian hoary bat, as described in Section 6B. There was a minor change in the site layout after the HCP was approved. The original location of turbine 15 (adjacent to turbine 16) was too close to the parcel boundary, and was therefore moved to the location shown in Figure 1-1.

Consistent with the approved HCP, this amendment addresses tax map keys (TMKs) 61007001, 62011001, and 61006001. The geographic area is outlined in Section 1.4 of the approved HCP, and detailed in Figure 1-1, in accordance with the requirements for HCPs listed in HRS 195D-21.

1.4.1 Project History

[This section requires no edits for the HCP Amendment.]

1.4.2 Project Design and Components

[This section requires no edits for the HCP Amendment.]

1.4.3 Purpose and Need for Kawailoa Wind Project

The purpose and need for the Project is described in the approved HCP. In summary, the need for the Project is based on Hawaiʻi’s Renewable Portfolio Standard (RPS; HRS Chapter 269-92), the Hawaiʻi Clean Energy Initiative, and other similar regulations and initiatives. These regulations and initiatives reflect the State’s commitment to move away from petroleum-based energy generation and expand its portfolio of locally generated renewable energy projects, thus establishing an overwhelming need for the development and implementation of renewable energy projects throughout the State. The Project was constructed and continues to operate to help move toward the State’s renewable energy goals.

Table 1-1. Existing Wind Energy Facilities with Approved or Draft HCPs in Hawaiʻi

Facility Name	Operator	Energy Generated	Island
Lalamilo Wind (Repowering)[1]	Lalamilo Wind Company, LLC	3.3 MW	Hawaiʻi
Pakini Nui[1]	Tawhiri Power, LLC	20.5 MW	Hawaiʻi
Auwahi	Auwahi Wind Energy, LLC	21 MW	Maui
Kaheawa Wind Power I (KWP I)	Kaheawa Wind Power, LLC	30 MW	Maui
Kaheawa Wind Power II (KWP II)	Kaheawa Wind Power II, LLC	22 MW	Maui
Kahuku Wind Power	Kahuku Wind Power, LLC	30 MW	Oʻahu
Kawailoa Wind	Kawailoa Wind, LLC	69 MW	Oʻahu
Na Pua Makani[2]	Na Pua Makani Power Partners, LLC	25 MW	Oʻahu
1. Operational facility currently seeking an ITP/ITL 2. Permitted, but not yet operational.			

1.5 List of Preparers

The HCP Amendment was prepared by Tetra Tech, Inc. Review and preparation support was provided by Kawailoa Wind. Input and guidance provided by DOFAW and USFWS is gratefully acknowledged.

2.0 DESCRIPTION OF HABITAT CONSERVATION PLAN

2.1 Purpose of this HCP

The purpose of the HCP Amendment is to 1) support a request to increase the amount of authorized take of the Hawaiian hoary bat beyond that authorized under the approved ITP/ITL, and 2) add the Hawaiian petrel as a Covered Species under the ITP/ITL. The Hawaiian hoary bat and Hawaiian petrel are protected under the ESA and HRS Chapter 195D. The HCP Amendment requests authorization of additional incidental take for these two species and identifies associated appropriate minimization measures, mitigation, and monitoring requirements.

Despite increasing the period of LWSC (see Section 1.1, Section 6B), Hawaiian hoary bat take since the start of Project operations in November 2012 has been higher than anticipated. Fatality estimates indicate that the Project has exceeded the currently authorized take limit, per the approved HCP. As described in Section 1.1.2, the Hawaiian petrel was not originally included as a Covered Species in the HCP and ITP/ITL because when the approved HCP was developed, Hawaiian petrels were considered highly unlikely to transit the Project area. Given the observed incidental fatality at the Project and recent studies documenting Hawaiian petrels on Oʻahu, Kawailoa Wind is requesting an amendment to the HCP to authorize incidental take of the Hawaiian petrel.

To support the increased take authorization of the Hawaiian hoary bat and the request for take of the Hawaiian petrel, the HCP Amendment:

- Utilizes current fatality modeling methods to provide defensible estimates of take associated with on-going operation of the wind energy facility, and the impact that will likely result from such taking;
- Provides appropriate measures to minimize and mitigate the potential impacts to these species to the maximum extent practicable;
- Discusses alternatives to authorizing increased take of the Hawaiian hoary bat and take for the Hawaiian petrel;
- Ensures funding for the fulfillment of these obligations; and
- Provides for adaptive management of these measures as determined appropriate during implementation of the HCP.

2.2 Scope and Term

The HCP Amendment does not propose a change in the extent of the Project area, nor the scope of activities associated with construction and operation of the Project which have the potential to affect the Covered Species. Additionally, the HCP Amendment does not propose to change the original 20-year permit term of the ITP/ITL, which expires in 2032.

2.3 Surveys and Resources

The following additional sources of information were used in preparation of the HCP Amendment:

- Post-construction mortality monitoring data for the Project (Kawailoa Wind Power, LLC 2013, 2014, 2015; Tetra Tech 2016, 2017a);
- Evidence of Absence (EoA) analysis tool (Dalthorp et al. 2017);
- Updated information on the distribution of Hawaiian hoary bats in the north Koʻolau Mountains and their behavior within the Project area (Gorresen et al. 2015);

- New research on the potential for operational measures to minimize bat collision risk, such as acoustic deterrents and LWSC (Arnett et al. 2011, Arnett et al. 2013a, Hein and Schirmacher 2013, Tidhar et al. 2013, Hein et al. 2014, Schirmacher et al. 2018);
- USFWS guidance for calculation of Hawaiian hoary bat indirect take (USFWS 2016a);
- Endangered Species Recovery Committee (ESRC) Hawaiian Hoary Bat Guidance Document (DLNR 2015);
- Historic observations and results of acoustic surveys for Hawaiian petrel on Oʻahu (Pyle and Pyle 2017, Conservation Metrics, Inc. 2017, Young et al. 2019); and
- Verbal and written guidance from USFWS and DOFAW regarding Hawaiian hoary bat take estimation, mitigation, adaptive management, and monitoring (provided after the issuance of the DLNR Bat Guidance in 2015, and through July 2018).

3.0 ENVIRONMENTAL SETTING

3.1 Location, Vicinity, and Climate

[This section requires no edits for the HCP Amendment.]

3.2 Topography and Geology

[This section requires no edits for the HCP Amendment.]

3.3 Soils

[This section requires no edits for the HCP Amendment.]

3.4 Hydrology, Drainage and Water Resources

As described in the approved HCP, various surface water features (e.g., streams, reservoirs, agricultural ditches, and wetland features) have been identified in the Project area and the vicinity. Hawaiian hoary bats use water for drinking, as well as a foraging substrate for night-flying insects. They have been observed foraging over open water, streams, and artificial water sources, such as reservoirs (Uyehara and Wiles 2009, Todd 2012). Some studies have shown increased Hawaiian hoary bat activity near water sources relative to surrounding habitats (SWCA 2011).

Many of the features (ponds and irrigation ditches) identified by the National Wetlands Inventory in the vicinity of the Project were based on older aerial imagery. These features were surveyed as part of the Project's wetlands and waters survey in 2010 (see Appendix 2 in the approved HCP, particularly Figure 1). Many of the old irrigation ditches and ponds that formerly conveyed irrigation water throughout the Kawailoa property were dry during the 2010 survey. Additionally, since the 2010 survey, the irrigation system has changed, resulting in most of the reservoirs currently being dry, and the former ditches have been piped or abandoned. In particular, the pond approximately 0.25-miles west of turbines 18 and 19 was visited in December 2018; no surface water was observed in the former reservoir, and the area is overgrown with upland vegetation. Thus, the amount of surface water shown by the National Wetlands Inventory near the Project is not accurate. No active open ditches, reservoirs, or other surface water features occur in the vicinity of the turbines; however, low lying areas may occasionally hold or convey surface water after heavy rains.

3.5 Environmental Contaminants

[This section requires no edits for the HCP Amendment.]

3.6 Land Use Designations

[This section requires no edits for the HCP Amendment.]

3.7 Flora

[This section requires no edits for the HCP Amendment.]

3.8 Wildlife

3.8.1 Surveys Conducted

[This section requires no edits for the HCP Amendment.]

3.8.2 Non-Listed Wildlife Species

[This section requires no edits for the HCP Amendment.]

3.8.3 Wildlife at Off-site Microwave Facility Locations

[This section requires no edits for the HCP Amendment.]

3.8.4 Listed Wildlife Species

[This section requires no edits for the HCP Amendment, except for subsections 3.8.4.1 and 3.8.4.4 of the approved HCP.]

3.8.4.1 Newell's Shearwater and Hawaiian Petrel

[The Hawaiian petrel subsection below follows the original text for HCP Section 3.8.4.1, Newell’s Shearwater.]

Hawaiian Petrel

Population, Biology, and Distribution of the Hawaiian Petrel

The endemic Hawaiian petrel is one of the larger species in the Pterodroma genus that formerly nested in large numbers on all the main Hawaiian Islands, except Niʻihau. Currently, Hawaiian petrels are known to nest at high elevations on Maui, Kauaʻi, Hawaiʻi, and Lanaʻi. Small breeding colonies may also occur on Molokaʻi and Kahoʻolawe (Pyle and Pyle 2017). A recent study by Young et al. documented that Hawaiian petrels occur on Oʻahu; however, surveys to date have not provided evidence that breeding colonies are present on Oʻahu (Pyle and Pyle 2017; USFWS 2017; Young et al. 2019).

Hawaiian petrel populations have declined significantly in Hawaiʻi since the 1990s (Day et al. 2003; Duffy 2010; Raine et al. 2017). Recent population estimates for the species vary depending on methodology and years sampled. Estimates based on pelagic observations between 1980 and 1994 estimated 19,000 birds (3,750 to 4,500 breeding pairs) occurred throughout the Hawaiian Islands (Spear et al. 1995). Joyce (2013) estimated the total population of Hawaiian petrels to be roughly 52,000 individuals, including juveniles and subadults, using at-sea sightings. More recently, Pyle and Pyle (2017) estimated about 6,000 breeding pairs based on observations at colony sites. It is difficult to estimate the breeding population for Hawaiian petrel given the steep terrain of breeding areas and the nocturnal nature of the species.

Much of the life of a petrel is spent at sea, and birds rarely return to land outside of the breeding season. During the non-breeding season, Hawaiian petrels are found far offshore, primarily in equatorial waters of the eastern tropical Pacific. The Hawaiian petrel has been observed from 42 degrees north to 5 degrees north and from 148 degrees west to 158 degrees west (King 1967, 1970, Pitman 1982). The Maui Nui Seabird Recovery Project reports locations of petrels from Alaska to Peru, encompassing much of the central Pacific (MNSBRP 2018).

Adult Hawaiian petrels return to their natal colony to breed each year between March and April. They return to the same nesting site over many years (Cruz and Cruz 1990; Podolsky and Kress 1992). Breeding season trips can last up to 21 days (Simons 1985). Nesting colonies are typically on steep slopes at high elevation, xeric habitats or wet, dense forests. Nests may be in burrows, crevices, or cracks in lava tubes in both sparsely vegetated areas and areas with dense vegetation (e.g., uluhe fern [*Dicranopteris linearis*]). In a breeding colony on Maui, nests occur in more densely vegetated areas of shrub cover (Simons and Hodges 1998).

Both adults are active throughout the breeding season. One egg is laid by the female, which is incubated alternately by both parents for approximately 55 days. The egg is not replaced if it is lost to predation. When eggs hatch in July or August, both adults make nocturnal flights out to sea to bring food back to the nestlings. Hawaiian petrels feed their young mostly at night and most movements take place during crepuscular periods. On Kauaʻi, Hawaiian petrels traveled primarily inland in the evening, seaward in the morning, and in both directions during the night (Day and Cooper 1995). In October and November, the fledged young depart for the open ocean.

Several factors can influence the breeding activity of Hawaiian petrels. Adult Hawaiian petrels are long lived (up to 30 years) and do not breed until age 6. Although a petrel may not breed every year, they return to the colony to socialize (USFWS 1983; Mitchell et al. 2005). During their pre-breeding years, petrels may "wander" or "prospect," visiting several potential breeding sites (established colonies, former breeding sites, and uncolonized sites). Simons (1984) reports that about 30 percent of the active burrows at a large colony on Maui were occupied by pre-breeding birds. Factors such as availability of mates, food abundance, the presence of predators and conspecifics could all be important for deciding where to breed (Podolsky and Kress 1992).

Current Threats to the Hawaiian Petrel

A variety of threats have been documented for the Hawaiian petrel but the primary limiting factors include habitat degradation at breeding colonies and disturbance or predation by introduced animals during the breeding season (USFWS 1983; Carlile et al. 2003; Mitchell et al. 2005; Duffy and Capece 2014, Raine et al. 2017). Introduced ungulates (e.g., feral goats, pigs, axis deer, and cattle) browse on native vegetation and groundcover within petrel colonies, and trample and collapse burrows causing nest abandonment. The soil disturbance caused by ungulates also facilitates the introduction and spread of invasive plants which further reduces habitat suitability for petrels (Reeser and Harry 2005, Duffy 2010, VanZandt et al. 2014). Ungulates also create trails in the colony that increase predators' access to active burrows. Annual monitoring of nests at Haleakalā National Park has shown that predation by cats and mongooses causes more than 60 percent of all egg and chick mortality in some years (Simons 1998 as cited in Carlile et al. 2003). Rats also prey upon adult Hawaiian petrels, but to a lesser extent. Even an individual predator, such as a barn owl (*Tyto alba*) or small Indian mongoose (*Herpestes javanicus*), can be extremely destructive to and decimate a population of colony-nesting seabirds (Hodges and Nagata 2001, Raine et al. 2017). Development of new fisheries and overfishing may indirectly harm seabird populations by eliminating predatory fish needed to drive petrel prey species closer to the surface (Ainley et al. 2014). Additionally, the effect of climate change and patterns of fisheries bycatch could negatively affect petrel populations (Raine et al. 2017).

Hawaiian petrels are also threatened by light pollution and can become disoriented and fallout (falling exhausted to the ground) or collide with structures because of light attraction (Telfer et al. 1987, Ainley et al. 1997, Cooper and Day 1998, Rodriguez et al. 2017). Juvenile birds are particularly vulnerable to light attraction, and grounded birds are vulnerable to mammalian predators or vehicle strikes.

In addition, petrels sometimes collide with power lines, fences, and other structures (Hodges 1994). Modeling for Kauaʻi Island suggests that collisions with transmission lines impact a large proportion of the population, with an estimated 600 to 1,993 annual fatalities attributed to birds striking lines (USFWS 2016b).

Hawaiian petrels have been killed due to collisions with wind turbines. In addition to the single fatality observed at the Project on Oʻahu as of December 31, 2017, eight Hawaiian petrels have been documented as wind facility-related fatalities on Maui since wind facility operations began in 2006 through the end of 2017 (Diane Sether/USFWS, pers. comm., April 2018).

Occurrence of the Hawaiian Petrel on Oʻahu and in the Project Area

Prior to construction of the Project, radar surveillance and audiovisual sampling was conducted over 10 nights at the Project area in summer and fall 2009. The purpose of the surveys was to sample representative seabird passage rates for use in estimating the risk of seabird take resulting from collisions with turbines and meteorological towers (Cooper et al. 2011). Supplementary radar surveys were conducted in June 2011 for 16 nights to measure passage rates over the northeastern-most turbine string (Cooper et al. 2011). Two new areas were sampled for 5 nights each to increase radar coverage of the Project area. Sites sampled in 2009 were also resampled for 3 nights each in 2011.

All surveys found an extremely low number of targets exhibiting flight speeds and flight patterns that fit the "shearwater-like" category. The mean movement rate across all nights and all sites for 2009 and 2011 was 0.66 shearwater-like targets/hour (Cooper et al. 2011). None of the radar targets could be visually verified during these surveys; however, Cooper et al. (2011) suggested that the individuals were more likely to have been Newell's shearwaters than Hawaiian petrels because of the timing of movements and because the available literature suggested that Newell's shearwaters rather than Hawaiian petrels occur on Oʻahu.

In 2016, Young and VanderWerf (2016) assessed seabird presence at three sites on Oʻahu – Mt. Kaʻala, Palikea, and Kalihi. No Hawaiian petrels were detected by acoustic sensors at these sites during the survey (Young and VanderWerf 2016). During the 2017 breeding season, eight acoustic sensors were deployed at 16 locations on Oʻahu to survey for Hawaiian petrels and other listed seabirds. Hawaiian petrel calls were detected at one site on the windward slope of Mt. Kaʻala at 3,600 feet of elevation, over 8 miles southwest of the Project. Calls were detected on seven nights in May and July of 2017 (Conservation Metrics, Inc. 2017). Although the detections were a first record for Oʻahu for several decades, it cannot be determined from the acoustic data alone whether the species was breeding/nesting or whether the recorded calls were from prospecting birds. The Hawaiian petrel fatality observed at the Project in July 2017 confirms Hawaiian petrels occur more frequently on portions of the island than previously expected, and may transit through the Project Area.

3.8.4.2 Waterbirds

[This section requires no edits for the HCP Amendment.]

3.8.4.3 Hawaiian Short-eared Owl

[This section requires no edits for the HCP Amendment.]

3.8.4.4 Hawaiian Hoary Bat

Population, Biology, and Distribution of the Hawaiian Hoary Bat

The Hawaiian hoary bat is the only native land mammal present in the Hawaiian archipelago; it is a sub-species of the hoary bat, which occurs across much of North and South America. Recent research indicates that Hawaiian hoary bats may consist of two distinct lineages because of multiple colonization events (Baird et al. 2015, Russell et al. 2015). Nevertheless, only one bat species is currently recognized in Hawaiʻi, and it is listed as endangered.

Recent studies and ongoing research have shown that bats have an extensive distribution across the Hawaiian Islands (Bonaccorso et al. 2015, Gorresen et al. 2013, H.T. Harvey and Associates 2019, Starcevich et al. 2019) and breeding populations are known to occur on all of the main Hawaiian Islands except Niʻihau and Kahoʻolawe (Bonaccorso et al. 2015). Numerous research studies have been conducted on the Hawaiian hoary bat in the last decade. The bat has been detected broadly across the state, and on Oʻahu specifically. Documented occurrences of the Hawaiian hoary bat from monitoring at wind farms, associated mitigation sites, and via other research show that the bat is more widespread and abundant than described in the 1998 USFWS Hawaiian hoary bat recovery plan (Auwahi Wind 2017, Kaheawa Wind Power 2017, Kaheawa Wind Power II 2017, Gorresen et al. 2013, Bonaccorso et al. 2015, H.T. Harvey and Associates 2019).

Although recent studies and ongoing research have shown that bats have a wide distribution across the Hawaiian Islands, population estimates are not available (DLNR 2015). The most recent indication of population trends come from an occupancy study on Hawaiʻi Island from 2007-2011, which found the population to be "stable to increasing" (Bonaccorso et al. 2013). The islands of Kauaʻi and Hawaiʻi are anticipated to support the largest populations (Mitchell et al. 2005, USFWS 2017). The Hawaiian hoary bat is believed to occur primarily below an elevation of 4,000 feet, but has been recorded between sea level and approximately 9,050 feet in elevation on Maui, with most records occurring at or below approximately 2,060 feet (USFWS 1998).

Hawaiian hoary bats roost in native and non-native vegetation from 3 to 29 feet above ground level. They have been observed roosting in ohia (*Metrosideros polymorpha*), hala (*Pandanus tectorius*), coconut palms (*Cocos nucifera*), kukui (*Aleurites moluccana*), kiawe (*Prosopis pallida*), avocado (*Persea americana*), mango (*Mangifera indica*), shower trees (*Cassia javanica*), pukiawe (*Leptecophylla tameiameiae*), common ironwood (*Casuarina equisetifolia*), macadamia (Macadamia spp.), and fern clumps; they are also suspected to roost in eucalyptus (*Eucalyptus* spp.) and Sugi pine (*Cyrptomeria japonica*) stands (USFWS 1998, Mitchell et al. 2005, Gorresen et al. 2013, Kawailoa Wind Power 2013). Hawaiian hoary bats have been known to use both native and non-native habitats for feeding and roosting (Gorresen et al. 2013, Mitchell et al. 2005). Bat activity has been generally detected in Hawaiʻi in essentially all habitats, including in clearings, along roads, along the edges of tree lines, in gulches, and at irrigation ponds; monitoring to date indicates that bats use these features for travelling and foraging. The species has been rarely observed using lava tubes, cracks in rocks, or man-made structures for roosting. While roosting during the day, Hawaiian hoary bats are solitary, although mothers and pups roost together (USFWS 1998).

Hawaiian hoary bat breeding is suspected to primarily occur between April and August. Lactating females have been documented from June to August, indicating that this is the period when non-volant young are most likely to be present. To be conservative, however, USFWS and DOFAW consider young to be non-volant and dependent on the female from June 1 through September 15. Breeding has been documented on the islands of Hawaiʻi, Maui, Oʻahu, and Kauaʻi (Baldwin 1950; Kepler and Scott 1990; Menard 2001, Kawailoa Wind Power 2013, Tetra Tech 2018b), but likely also occurs on Molokaʻi. It is not known whether bats observed on other islands breed locally or only visit these islands during non-breeding periods.

Seasonal changes in the abundance of Hawaiian hoary bat at different elevations indicate that altitudinal movements occur on Hawaiʻi Island. During the breeding period (April through August), Hawaiian hoary bat occurrences increase in the lowlands and decrease at high elevation habitats. In the winter, bat occurrences increase in high elevation areas (above 5,000 feet) especially from January through March (Menard 2001; Bonaccorso 2010). It is not known if similar patterns of migration occur in the Project area or on Oʻahu, but seasonal migration patterns may play a factor in risk exposure.

Hawaiian hoary bats feed on a variety of native and non-native night-flying insects, including moths, beetles, crickets, mosquitoes and termites (Whitaker and Tomich 1983). They appear to prefer moths ranging between 0.6 and 0.89 inches in size (Bellwood and Fullard 1984; Fullard 2001). Koa moths (*Scotorythra paludicola*), which are endemic to the Hawaiian Islands and use koa (*Acacia koa*) as a host plant (Haines et al. 2009), are frequently targeted as a food source (Gorresen/USGS, pers. comm.). Prey is located using echolocation. Water features and edges of habitat (e.g., coastlines and forest/pasture boundaries) appear to be important foraging areas (Grindal et al. 1999, Francl et al. 2004, Brooks and Ford 2005, Morris 2008, Menzel et al. 2002). In addition, the species is attracted to insects that congregate near lights (USFWS 1998, Mitchell et al. 2005, Belwood and Fullard 1984). Bats begin foraging either just before or after sunset depending on the time of year (USFWS 1998, Mitchell et al. 2005).

Increased bat activity is correlated to insect biomass (Gorresen et al. 2018), as well as edge, gulch, and riparian habitat (Jantzen 2012, Grindal and Brigham 1999, Lloyd et al. 2006, Law and Chidel 2002). Preferred foraging habitat for bats is dependent on insect abundance and availability, and insect abundance is related to net primary productivity (Whitaker et al. 2000, Gruner 2007). For many species of insectivorous bats that forage in relatively open habitats, bat activity has been shown to increase as the amount of open airspace above a stream channel increases, due to reduced interference from vegetative clutter on bat flight patterns (Ober and Hayes, 2008). Studies have shown that alterations to riparian vegetation likely influence bat foraging activity patterns; efforts to create diversity in shrub coverage and canopy coverage to increase open space above the stream channel facilitate foraging by bats (Ober and Hayes 2008).

The foraging range of the Hawaiian hoary bat is defined as the area traversed by an individual as it forages and moves between day roosts and nocturnal foraging areas (Bonaccorso et al.2015). A study on Hawaiʻi Island documented a foraging range of approximately 7 miles with a mean of 570.1 ± 178.7 acres (Bonaccorso et al. 2015). Foraging activity within this area was concentrated within small core use areas (CUA) with a median of 20.3 acres (DOFAW 2015, interquartile range of 16 to 58 acres) that exhibited limited individual overlap among areas. Additional studies have demonstrated that Hawaiian hoary bats can move between habitats and elevations within a single night to target optimal local foraging opportunities (Gorresen et al. 2013, Gorresen et al. 2015), with bats spending 20 to 30 minutes hunting in a feeding range before moving on to another (Bonaccorso 2010).

Current Threats to the Hawaiian Hoary Bat

Possible threats to the Hawaiian hoary bat include pesticides (either directly or by impacting prey species), fire, predation, alteration of prey availability due to the introduction of non-native insects, habitat loss, and roost disturbance (USFWS 1998). Bats are also known to collide with structures, such as barbed wire fences, wind turbines, and communications towers. Management of the Hawaiian hoary bat is limited by a lack of information on key roosting and foraging areas, food habits, seasonal movements, and reliable population estimates (USFWS 1998). Based on existing information, it is not known whether the availability of roost trees is a limiting factor because the Hawaiian hoary bat roosts in a variety of native and non-native trees (see above), many of which are abundant and some are considered invasive (such as kiawe and eucalyptus). However, loss of roosting and foraging habitat is a significant long-term threat to the Hawaiian hoary bat (USFWS 1998, Mitchel et al. 2005, DLNR 2015). The resident human population of Hawaiʻi has nearly doubled from the time the bat was listed in 1970 to 2017 (from 768,000 to 1.4 million; U.S. Census Bureau 2018), leading to increased residential development (Cassiday 2014) and subsequent removal of habitat. The NOAA Coastal Change Program (2015) estimates 0.68 percent of forests on Oʻahu were lost between 2005 and 2011. During the same period, there was a 2.65 percent increase in developed area and a 3.54 percent increase in impervious surface on Oʻahu (NOAA Coastal Change Program 2015).

In their continental United States and Canada range, hoary bats are known to be more susceptible to collision with wind turbines than most other bat species (Erickson 2003, Johnson 2005). Most mortality has been detected during the fall migration period. Hoary bats in Hawaiʻi do not migrate in the traditional sense, although as indicated, some seasonal altitudinal movements occur. Currently, it is not known if Hawaiian hoary bats are equally susceptible to turbine collisions during their altitudinal migrations as hoary bats are during their migrations in the continental United States.

Occurrence of the Hawaiian Hoary Bat on Oʻahu

A variety of studies have documented Hawaiian hoary bat occurrences on Oʻahu, as shown in Figure 3-1. The locations shown are compiled from available bat detections, captures, or observations, and are derived from two wind farms (Kawailoa Wind 2013, Kawailoa Wind 2014, Kawailoa Wind 2015, Tetra Tech 2016, Tetra Tech 2017a, Kahuku Wind Power 2012, Kahuku Wind Power 2013, Kahuku Wind Power 2014, Kahuku Wind Power 2015, Kahuku Wind Power 2016, Kahuku Wind Power 2017), associated mitigation sites (Gorresen et al. 2018, Starcevich et al. 2018), research results (Gorresen et al. 2015) and other types of observations (USFWS 1998). Note that the absence of detections in an area does not necessarily mean an absence of bats (Gorresen et al. 2017). Nonetheless, in most of the locations where efforts have been made to detect the Hawaiian hoary bat, bats have been documented. The detections on Oʻahu are predominantly associated with accessible areas; thus, as more efforts are made to detect bats, they will likely be documented in more locations across Oʻahu.

Occurrence of the Hawaiian Hoary Bat in the Project Area and Off-site Communication Towers

Occurrence of the Hawaiian hoary bat in the Project area is informed by data from ongoing monitoring in the Project area, as well as relevant research in Hawaiʻi. Information used to determine bat occurrence, and thereby inform the potential take analysis for the HCP Amendment, includes:

- Acoustic monitoring within the Project area;
- Post-construction mortality monitoring within the Project area;
- Results of a research study that investigated regional occupancy of Hawaiian hoary bats near the Project area (Gorresen et al. 2015); and
- Project investigation into behavioral and occupancy patterns within the Project area, including an analysis of potential correlations with habitat and weather patterns.

Prior to construction, Kawailoa Wind monitored bat activity from 2009 to 2011. Post-construction acoustic monitoring has occurred since November 2012, when commercial operations began. In general, and described in detail below, the acoustic monitoring effort in the Project area was highest from 2012 to 2015, with a reduced level of monitoring after 2015. Due to differences in the sensitivity of the acoustic detectors and microphones used during the pre- and post-construction time periods, the data from the two periods cannot be directly compared.

From December 2012 to December 2015, Wildlife Acoustic bat detectors (SM2BAT+) were deployed at ground level and nacelle height for each turbine within the Project area (totaling 30 detectors at ground level, 30 detectors at nacelle height and 12 additional detectors near gulches). The proportion of nights with bat detections peaked from April through October for both ground and nacelle height detectors, showing a similar seasonal trend as the bat activity data collected from 2009 to 2011 (Figure 3-5 of the approved HCP). Nacelle height detectors had approximately 50 percent fewer detector-nights than the ground detectors. From December 2012 to November 2015, Hawaiian hoary bats were detected on 4,584 of 54,010 detector-nights (8.5 percent of detector-nights). Detectors recorded bats on 11.1 percent of detector-nights near the ground at the Project WTGs, on 3.8 percent of detector-nights on WTG nacelles, and on 14.3 percent of detector-nights adjacent or in gulches near WTGs (Tetra Tech 2016).

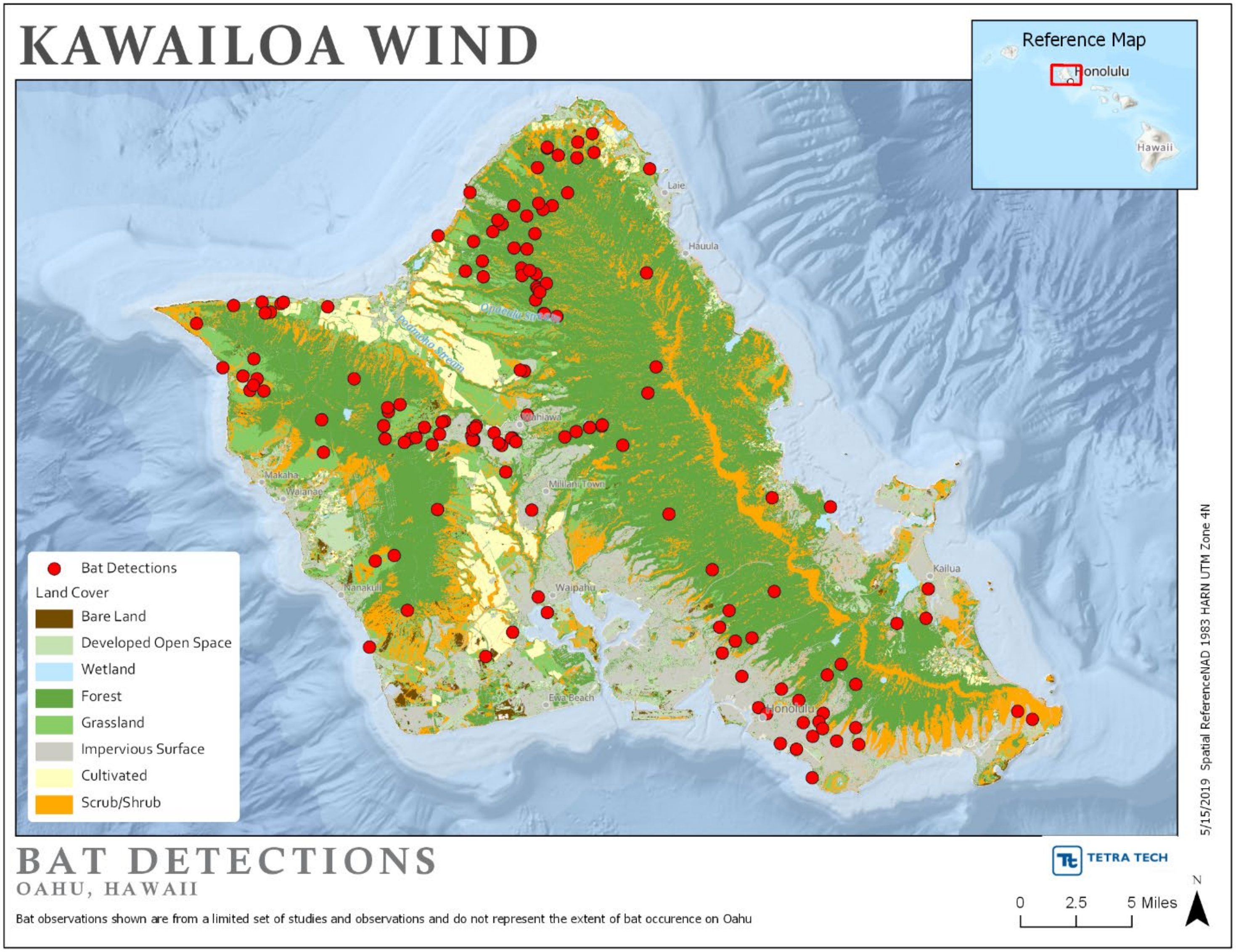


Figure 3-1. Documented Acoustic Bat Detections on O‘ahu in Relation to Land Cover.

The Project investigated behavioral and occupancy patterns of Hawaiian hoary bat fatalities and activity in the Project area utilizing data collected in 2013. This investigation looked at geographic distribution of acoustic detections and fatalities using a variety of turbine groupings from 3 to 15 turbines. Additional factors considered include: elevation, slope, aspect, direction and distance to gulches, direction and distance to forest edges, mean and maximum wind speeds, wind direction, temperature, barometric pressure, moon illumination, humidity, presence or absence of rain, and time of night. However, the results were largely inconclusive, and were unable to assist in modeling collision risk to the Hawaiian hoary bat at the Project. Several general trends were observed in 2014:

- Acoustic detections were not correlated with bat fatalities;
- Temperature was positively correlated with acoustic detections; and
- Wind speed was negatively correlated with acoustic detections.

The model with the greatest explanatory power to correlate environmental variables with acoustic detections at nacelle height included: wind speed, wind direction, temperature, humidity, pressure, moon illumination, but explained only 24 percent of the variance in the data. The follow-up analysis concluded that, based on one proposed risk model, acoustic detections at nacelle height in 2013 were greater between 7 p.m. and 8 p.m. However, calls were recorded in all hours of the night, the model did not account for the changing time from sunset, and fatalities were not correlated with increases in acoustic detections. Therefore, no changes to curtailment were proposed based on these findings.

Other factors associated with observed bat fatalities are reviewed on an ongoing basis, and findings are summarized in annual reports (Kawailoa Wind 2014). These factors include the distance and direction that fatalities are detected from turbines, wind speed, wind direction, rotor RPM, moon phase, weather patterns, and other potentially relevant factors. The number of observed fatalities per turbine is shown in Figure 3-2. One of the primary challenges in analysis of such factors is the inability of the Project to know the exact timing of a fatality. The timing of the fatality is typically estimated to within seven days, meaning a large number of prior conditions must be evaluated, which makes correlation with any factor or factors difficult.

Having identified no significant findings during the years of intensive acoustic monitoring at the Project, in 2016 Kawailoa Wind reduced the acoustic monitoring effort at the Project to four stationary ground-based units distributed throughout the Project area (Turbines 1, 10, 21, and 25). Results of acoustic monitoring since the intensive post-construction monitoring period have shown elevated activity levels in the dry season (roughly April through October) compared to the remainder of the year, which is relatively similar to previous years (Tetra Tech 2017a). In Fiscal Years 2017 and 2018 (based on State of Hawaiʻi Fiscal Year periods also used for project reporting), Hawaiian hoary bats were detected at the four detectors on 12.6 and 19.4 percent of detector-nights, respectively. Spatially, the majority of bat activity occurred at Turbine 25 compared to the other three locations (Tetra Tech 2018b).

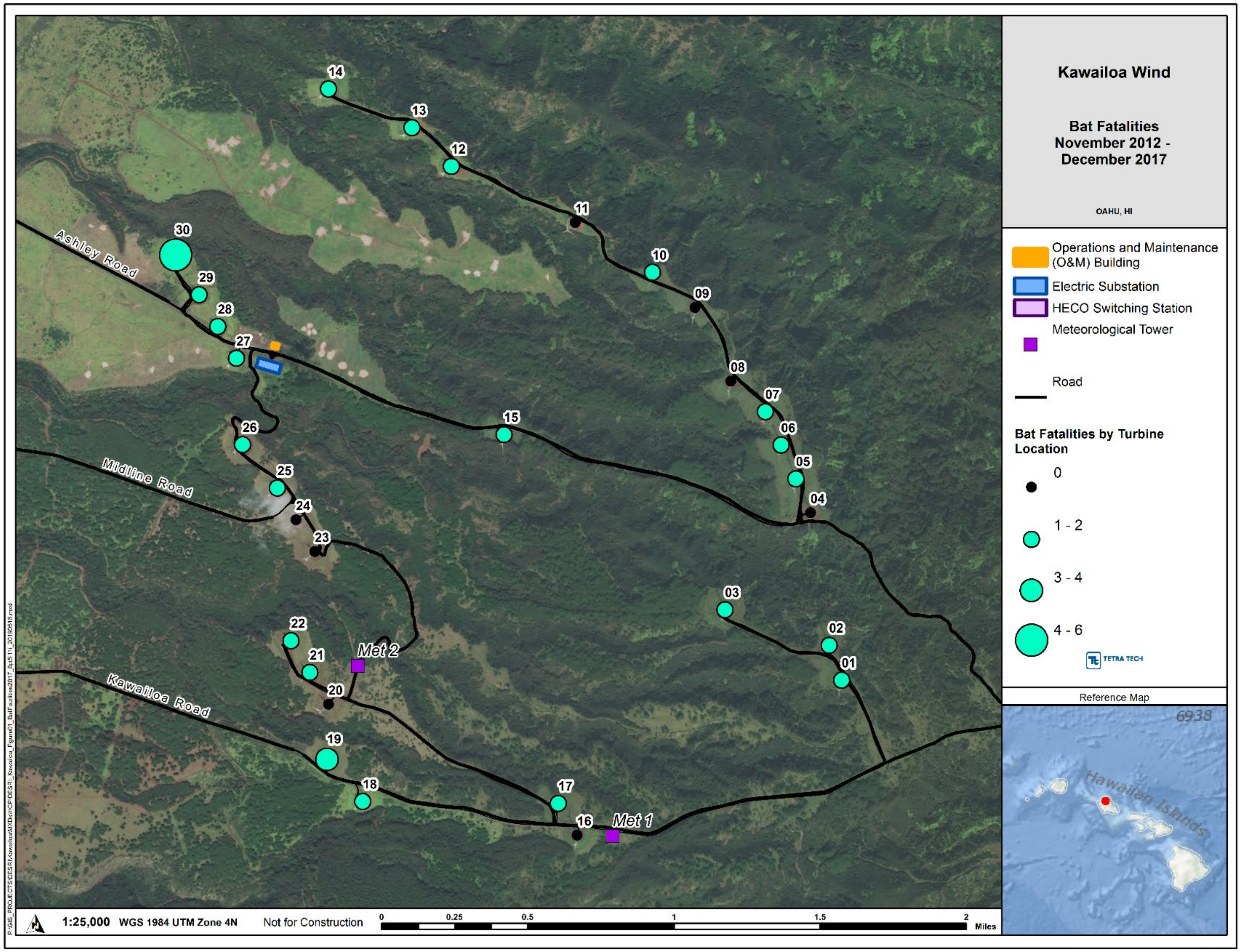


Figure 3-2. Documented Fatalities by Turbine at the Project.

In a pro-active effort to further understand patterns of bat activity at the Project, Kawailoa Wind provided site access to USGS in 2013-2014 to conduct thermal imagery surveys of bat behavior at Project turbines (Gorresen et al. 2015). Gorresen et al. (2015) simultaneously studied bat behavior at turbines within the Project area while also studying the landscape distribution of Hawaiian hoary bats in the north Koʻolau Mountains of Oʻahu. Bats frequently foraged in the airspace near turbines during the 1-year study, but appeared to be less likely to closely approach turbines than their mainland conspecifics. Results from 6 months of thermal videography conducted in this study identified several factors that correlate with higher rates of bat occurrence. These factors were nights with:

- Little rain;
- Warmer temperatures;
- Moderate wind speeds;
- Low humidity; and
- Low but rising barometric pressures indicative of fair weather and improved foraging conditions.

Gorresen et al. (2015) noted that video monitoring also demonstrated that the presence of bats near turbines was strongly correlated with insect presence; however, this correlation is likely due to the factors listed above increasing the suitability of weather conditions for insects.

Additionally, as part of the Tier 2 and 3 bat mitigation, WEST, Inc. (WEST) is conducting a multi-year study to examine the distribution and seasonal occupancy of the Hawaiian hoary bat on Oʻahu (see Section 7.6.2.2). During Year 1 (June 2017 to June 2018), WEST recorded a total of 4,808 bat detections at 83 detectors deployed across the island (Starcevich et al. 2019). The proportion of detector-nights with detections ranged from 0 to 0.33 at sites with more than one season of data. The sites with the highest proportion of detector-nights with detections were Kumaipo, Peerson, Mt Kaʻala, Pūpūkea, and Schofield Forest (Starcevich et al. 2019). Of these locations, Pūpūkea (Site-039) is the closest to the Project area. A total of 1,512 detections were recorded at Pūpūkea over 348 detector-nights in 2017 (mean = 4.34 detections/ detector-night) at Pūpūkea (Starcevich et al. 2019). Social calls were also identified at this site (Starcevich et al. 2018).

Five other monitoring sites are close to the Project area: Kawailoa Road (Site-029), Kawailoa Gate (Site-013), KAW 1 (Site-085), KAW 2 (Site-081), and Waimea Valley (Site-023). Of these monitoring locations, the two locations with the highest number of detections were Kawailoa Gate and Waimea Valley. At Waimea Valley, a total of 168 detections were recorded over 322 detector-nights (mean = 0.52 detections/ detector-night). At Kawailoa Gate, a total of 188 detections were recorded over 352 detector-nights (mean = 0.53 detections/ detector-night) (Starcevich et al. 2019). Social calls were also identified at these sites (Starcevich et al. 2018).

Studies have also indicated that bat foraging is associated with cattle grazing, potentially because bats are feeding on insects associated with cattle and cattle dung. In the United Kingdom, Downs and Sanderson (2010) found that bat call frequency was significantly correlated with the presence of cattle. Ancillotto et al. (2017) found a positive correlation between cattle herd size and bat activity in Italy. However, similar comprehensive studies have not been conducted in Hawaiʻi. Cattle grazing has occurred on the Kamehameha Schools lands on which the Project is located since prior to construction. Currently, domestic cattle are rotated periodically throughout the southwest portion of the Project, grazing under turbines 16-26. The specific locations and number of animals present throughout the year depends on several factors, including forage, water availability, and landowner operations.

Auwahi Wind (Tetra Tech 2018c) data indicates that approximately 28 percent of fatalities were observed within the grazing and 30-day post-grazing period. Finding only 28 percent of fatalities in the grazing and post-grazing period suggests either no correlation, or a negative correlation, between bat fatalities and grazing.

4.0 BIOLOGICAL GOALS AND OBJECTIVES

[This section is updated to reflect the revised HCP Handbook (USFWS and NOAA 2016) and inclusion of the Hawaiian petrel as a Covered Species for the HCP Amendment.]

The Habitat Conservation Planning and Incidental Take Permitting Processing Handbook (HCP Handbook), revised in December 2016, outlines the importance of defining biological goals which are broad, guiding principles that clarify the purpose and direction of an HCP's conservation program. Biological objectives are derived from the goals and provide the basis for determining strategies, monitoring effectiveness, and evaluating the success of actions. The objectives are more measurable than the goals and may include: species or habitat indicators, locations, actions, quantity/states, and timeframes needed to meet the objective (USFWS and NOAA 2016).

The biological goals and objectives for the approved HCP are:

- Minimize and mitigate, to the maximum extent practicable, the effects of take caused by the wind energy generation facility;
- Increase the knowledge and understanding of the Covered Species' occurrence and behavior in the Project's vicinity;
- Adhere to goals of the existing recovery plans for any of the Covered Species, considering the most recent updated information and goals; and
- Provide a net conservation benefit to each of the Covered Species.

The goals from the approved HCP (outlined above) also apply to this HCP Amendment. The goals and objectives for the Covered Species not included in this HCP Amendment (Newell's shearwater, Hawaiian duck, Hawaiian stilt, Hawaiian coot, Hawaiian moorhen, Hawaiian short-eared owl) have not changed. However, this HCP Amendment also adds additional goals and objectives for the Hawaiian hoary bat and Hawaiian petrel to incorporate updated guidance from the 2016 HCP Handbook. The goals outlined here are in accordance with HRS 195D-21, and are consistent with the recovery plan for each species.

Since the HCP amendment process was initiated in 2015, Kawailoa Wind has coordinated extensively with the USFWS and Hawaiʻi DLNR regarding the request to increase the amount of take authorized for Hawaiian hoary bat and to include the Hawaiian petrel as a Covered Species. As part of this ongoing coordination, Kawailoa Wind has identified measures to practicably minimize the potential for adverse impacts and define biological goals and objectives for the bat and petrel. Where the potential for impacts is unavoidable, the HCP Amendment seeks to minimize and mitigate adverse impacts to the listed species that may occur, and to provide a net conservation benefit. The additional goals and objectives of the HCP Amendment for the bat and petrel are species-based, rather than habitat-based. Specific measures that Kawailoa Wind will use to achieve the objectives and goals are described in Section 7.0.

The biological goals and objectives for the Hawaiian petrel and the Hawaiian hoary bat for the HCP Amendment are listed below. These goals and objectives specifically relate to the proposed mitigation for each species (see Section 7.0). Objectives for the bat are defined for each potential mitigation option; the obligation to fulfill the objectives will depend on which bat mitigation measures are implemented.

The biological goal and objective for the Hawaiian petrel for the HCP Amendment is:

- Goal: Increase survival and successful fledgling for the population of Hawaiian petrels at a known breeding colony or colonies.
    - Objective: Reduce predation and increase reproductive success at Hanakāpiʻāi and Hanakoa (or other colony), which are known endangered seabird colonies located on the northwestern side of Kauaʻi, by funding a predator control program.

The biological goal and objectives for the Hawaiian hoary bat for the HCP Amendment is:

- Goal: Maintain or increase the long-term availability of bat roosting and foraging habitat.
    - Objective (for Protection/Preservation/Acquisition-based Mitigation Option): Protect and preserve, in perpetuity, bat roosting and/or foraging habitat that would otherwise be threatened with degradation or development.
    - Objective (for Habitat Restoration/Management-based Mitigation Option): Manage or restore low-value habitat for the Hawaiian hoary bat to a condition that would promote survival and/or prevent the degradation of habitat that would otherwise decline so as to decrease or eliminate its suitability as bat habitat.

5.0 ALTERNATIVES

The HCP Handbook (USFWS and NOAA 2016) states that applicants must demonstrate in their HCPs that they considered alternatives to the taking. Kawailoa Wind considered alternatives to reduce the risk to Hawaiian hoary bats and Hawaiian petrels as part of the HCP Amendment. No petrel-specific alternatives are included here, because minimization measures already implemented for Newell's shearwater (and other birds) are also expected to minimize impacts to the Hawaiian petrel. These avoidance and minimization measures are described in Section 5.3 of the approved HCP. Each alternative considered relative to the Hawaiian hoary bat is described below, followed by the rationale for not carrying it forward for further consideration.

5.1 Full Nighttime Curtailment

This alternative would consist of feathering turbine blades year-round from 1 hour before sunset to 1 hour after sunrise at all Project turbines (full nighttime turbine shutdown) to avoid future Hawaiian hoary bat take and further reduce collision risk to the Hawaiian petrel and Newell's shearwater. The approved HCP, which identifies existing avoidance and minimization measures, mitigation measures, and monitoring commitments for Covered Species, would remain in effect. Under this alternative, an HCP amendment to increase the take authorization for the Hawaiian hoary bat to address take in exceedance of the current permit would be required. The HCP amendment would also be required to add the Hawaiian petrel as a Covered Species because nighttime curtailment is not expected to eliminate all risk to the petrel. This alternative was not carried forward for consideration by Kawailoa Wind because full nighttime curtailment would reduce power generation such that Kawailoa Wind would not be able to meet the contractual obligations under the Project's Power Purchase Agreement (PPA). Specifically, this alternative would reduce annual energy production by approximately 45 percent, resulting in an annual power generation loss on the order of 61,000 megawatt hours per year. Revenue losses under full nighttime curtailment would render the Project commercially unviable, forcing Kawailoa Wind to cease operation. As the largest wind energy generating facility in Hawai'i, this would eliminate a significant contribution to the State's Renewable Portfolio Standard and would not meet the purpose and need of the HCP.

5.2 Curtailment with Cut-in Speeds of 5.5 Meters Per Second or Above

This alternative would consist of implementing LWSC with an increased cut-in speed at 5.5 meters per second (m/s) or greater, and is based on the belief that any increase in cut-in speed above 5.0 m/s will result in significant additional reduction in bat collision risk[1]. Bat fatalities have been observed at the Project in all months. Therefore, it is assumed that curtailment at higher cut-in speeds would be implemented year-round. This alternative was not considered further for two reasons, the first being the uncertain benefits of cut-in speeds above 5.0 m/s, and second, the nature of the wind regime at the Project.

Studies conducted on the mainland to evaluate the effectiveness of LWSC on minimizing impacts to bats have provided a range of results. Overall, increasing cut-in speeds between 1.5 and 3.0 m/s above the manufacturer's cut-in speed has been shown to yield reductions in bat fatalities, ranging from 10 to 92 percent, with at least a 50 percent reduction in bat fatalities when turbine cut-in speed was increased by 1.5 m/s above the manufacturer's cut-in speed (Arnett et al. 2013b). Significant reductions in bat fatality rates have been demonstrated when cut-in speeds are raised incrementally from 3.5 to 4.5 to 5.5 m/s (Good et al. 2012), but the results of studies evaluating the additional

[1] The past minimization, and minimization from 2018 forward, for the Hawaiian hoary bat are identified in section 6B.1.

benefits of raising cut-in speeds above 5.0 m/s are ambiguous (see Section 6B.1). Additionally, some studies have shown that equally beneficial reductions in bat fatalities may be achieved by feathering blades (pitched 90° and parallel to the wind) or slowing rotor speed up to the turbine manufacturer's cut-in speed (low-speed idling approach) without LWSC (Baerwald et al. 2009; Young et al. 2011, 2012; Good et al. 2017). While there may be additional benefits to bats associated with progressively higher levels of LWSC, the effectiveness of LWSC is dependent on project-specific characteristics such as wind regime, bat species at risk, surrounding land uses, and other factors (Arnett et al. 2013a).

Arnett et al. (2009, 2010) demonstrated that bat fatalities were reduced by an average of 82 percent (95 percent confidence interval (CI): 52 to 93 percent) in 2008, and by 72 percent (95 percent CI: 44 to 86 percent) in 2009 when cut-in speed was increased to 5.0 m/s and turbine blades were feathered at lower wind speeds. In a synthesis of 10 studies, Arnett et al. (2013a) identified only one study that found increasing cut-in speeds above 5.0 m/s resulted in a statistically significant reduction in bat mortality over LWSC with cut-in speeds of 5 m/s. Although other studies from the mainland have suggested that increasing cut-in speeds to 6.0 m/s or 6.5 m/s may be more effective at reducing bat fatalities (e.g., Good et al. 2011, Hein et al. 2014), only Good et al. (2012) has shown a statistically significant reduction in bat fatalities between different LWSC cut-in speeds (bat fatalities were lower at a cut-in speed of 6.5 m/s than 5.0 m/s). Given the ambiguous results from other studies and the differences in life history characteristics between the resident Hawaiian hoary bat and migratory mainland hoary bats, the application of increased cut-in speeds beyond what is currently proposed may not be more effective in Hawaiʻi.

As noted in Section 6B, LWSC regimes are appropriate when determined on a Project-specific basis: considering the wind regime, PPA contractual obligation, financial considerations, and bat fatality patterns. Specifically, the wind regime at the Project is an important consideration driving the development of appropriate LWSC that both reduces bat collision risk while maintaining operation of a commercially viable project.

During a typical wind year, average hourly wind speeds between sunset and sunrise (when curtailment would be implemented) range from 4.6 to 5.9 m/s (average 5.4 m/s). Moreover, during 8 months of the year, the proportion of sunset to sunrise hours with hourly wind speeds below 5.5 m/s ranges from 75 to 100 percent. That is, during the period when low wind speed curtailment would be implemented, average wind speeds do not typically exceed 5.5 m/s. Therefore, implementing LWSC with a cut-in speed of 5.5 m/s or greater would result in proportionally greater periods of non-operation at the Project compared to wind energy facilities with regimes characterized by high wind speeds.

While the additional benefits to bats from raising cut-in speeds above 5.0 m/s are ambiguous, the negative impacts to energy generation are significant. Under this alternative, implementing LWSC at the Project with a cut-in speed of 5.5 m/s would reduce annual energy production by approximately 2 percent, resulting in an annual power generation loss on the order of 2,500 MW hours per year. Generation losses and costs associated with implementing cut-in speeds of 6.0 or 6.5 m/s would be substantially greater. Even under its current LWSC regime of 5.0 m/s, Kawailoa Wind does not consistently meet minimum production requirements for its PPA in individual years. Therefore, this alternative would increase the risk that Kawailoa Wind would not meet the requirements under its PPA with the Hawaiian Electric Company (HECO), jeopardizing its continued operation.

5.3 Avoidance and Minimization Measures

[This section was moved and inserted as new Section 6B.0.]

5.3.1 USFWS Guidelines

[This section was moved and inserted as new Section 6B.1 but requires no edits for the HCP Amendment.]

6.0 POTENTIAL IMPACTS

Kawailoa Wind has analyzed post-construction mortality monitoring (PCMM) data for the Project from the start of Project operations in 2012 to help assess impacts to the Hawaiian hoary bat and the Hawaiian petrel for the HCP Amendment. Information from PCMM data at the other commercial wind farm on Oʻahu (Kahuku Wind Project) also provides some perspective on potential Project impacts.

6.1 Impacts to Birds

[This section requires no edits for the HCP Amendment.]

6.2 Impacts to Bats

In Hawaiʻi, results from PCMM efforts have demonstrated that Hawaiian hoary bats are susceptible to collisions. Three operational wind facilities with HCPs that cover the take of the Hawaiian hoary bat have surpassed the requested take limits in the associated ITP/ITLs. As a result, these three wind projects are currently in the process of amending their HCPs to provide ITP/ITL coverage for additional bat take. The impacts to bats and the wind projects seeking amendment to their HCPs are covered in more detail in Section 6.4.4.

6.3 Estimating Project-related Impacts

[For the HCP Amendment, this section only requires edits to subsections 6.3.4 and 6.3.7 to provide more specific and updated information on the Hawaiian petrel and Hawaiian hoary bat, respectively. The remainder of this section was designed to generally explain take estimates and monitoring.]

6.3.1 Take Levels

[This section requires no edits for the HCP Amendment.]

6.3.2 Monitoring of Take Levels

[This section requires no edits for the HCP Amendment.]

6.3.3 Estimating Indirect Take

[This section of the approved HCP provides general information on indirect take.]

More specific information on indirect take for the Hawaiian petrel is described in Section 6.3.4.2.

In June 2016, the USFWS provided guidance for how indirect take for Hawaiian hoary bat should be estimated. USFWS recommended that proponents consider using several time periods and biological factors in their calculation of indirect take for observed and unobserved Hawaiian hoary bat fatalities. This information is summarized in Section 6.3.7 below and Appendix 16.

6.3.4 Seabirds

Seabird mortality due to collisions with human-made objects, such as power lines and wind turbines, has been documented in the Hawaiian Islands (Telfer et al. 1987; Hodges 1994; Cooper and Day 1998; Podolsky et al. 1998; USFWS 2016b). Nine Hawaiian petrel fatalities have been detected at wind energy facilities in Hawaiʻi. At the Kaheawa Pastures wind farm on Maui, seven Hawaiian petrel fatalities have been detected since operations began in June 2006 (Kaheawa Wind Power, LLC 2017, SWCA 2017). As of December 31, 2017, one Hawaiian petrel fatality has been detected at the Auwahi Wind Farm (Tetra Tech 2017b), and one Hawaiian petrel fatality was detected at the Project in July 2017. No Hawaiian petrel fatalities have been observed at the Kahuku Wind Farm, which is the other operating facility on Oʻahu. No fatalities of Newell's shearwater have been detected at wind energy facilities in Hawaiʻi.

6.3.4.1 Newell's Shearwater

[This section requires no edits for the HCP Amendment.]

6.3.4.2 Hawaiian Petrel

[New subsection for the HCP Amendment.]

The collision avoidance rate is a critical component in assessing a given species' risk of collision (Chamberlain et al. 2006). Seabird and waterfowl species have been documented detecting and avoiding turbines and other human-made structures (e.g., transmission lines) in low-light conditions (Winkelman 1995; Dirksen et al. 1998; Desholm and Kahlert 2005; Desholm et al. 2006; Tetra Tech 2008); however, recent monitoring of powerline collisions in key areas indicates that this remains one of several threats to the species, particularly at cross-island powerlines (Ainley et al.2001, USFWS 2016b). Petrels are adept at flying through forests to and from their nests during low-light and variable weather conditions, and may exhibit strong avoidance behaviors when approaching wind turbine generators or other structures. Petrels have been observed exhibiting avoidance behaviors at communication towers on Lanaʻi (Tetra Tech 2008) by adjusting flight directions away from the tower or by approaching the tower and turning away from the structure to avoid it. It is reasonable to assume that petrels have the behavioral and physical capabilities to avoid turbines, and therefore are likely to exhibit a high collision avoidance rate. However, at least one downed petrel observed is likely to have collided with a communication tower on Lanaʻi (A. Siddiqi/DOFAW, pers. comm., September 2018).

Potential sources of direct mortality of petrels at the Project include collisions with wind turbine generators, meteorological towers, and overhead generator-tie lines. On July 21, 2017, a single Hawaiian petrel carcass, confirmed through genetic analysis, was observed incidentally (not during standardized searches). The results of the standardized PCMM performed through 2017 were analyzed using the multiple years analysis module in the current EoA tool (Dalthorp et al. 2017) to calculate a conservative estimate of total direct petrel take anticipated over the remaining years of the ITP/ITL term.

Although the petrel fatality was detected outside of the search plot, it was included as a detected fatality for the purposes of take prediction to provide a conservative estimate. Using past monitoring data within the EoA software (Dalthorp et al. 2017) to estimate the direct take estimated to occur over the permit term, it can be asserted with 80 percent certainty that no more than 19 petrels are expected to be taken. An 80 percent credibility level for the take projection was selected by the USFWS and DOFAW to assess compliance with an ITP/ITL, and provides a conservative estimate, erring in favor of the Covered Species (for additional discussion of take estimation see Appendix 16). Indirect take was estimated using current agency guidance and data from the Project. Detailed calculations for cumulative indirect take can be found in Appendix 16. Indirect take based on a projected annual take rate of 0.95 (19 over 20 years), is estimated at five chicks over the remainder of the permit term (Appendix 16).

The total population of Hawaiian petrels is estimated between 19,000 and 52,000 individuals (Spear et al. 1995, Joyce 2013). The take authorization request for the Project is 19 adults and 5 chicks (Appendix 16). This level of take is between 0.126 percent and 0.046 percent of the total estimated population and should not have a population-level effect on Hawaiian petrels because stable populations can absorb low levels (i.e., less than 1 percent of current population) of additive mortality. Conclusive evidence of a breeding colony on Oʻahu has not been found, and if breeding colonies are present on Mt. Kaʻala or elsewhere, there is no evidence to indicate they are genetically distinct from colonies on all other islands. The mitigation measures that Kawailoa Wind has committed to (Section 7.3.2) will further ensure that no population-level effects will result from Project operations.

6.3.5 Hawaiian Waterbirds

[This section requires no edits for the HCP Amendment.]

6.3.6 Hawaiian Short-eared Owl

[This section requires no edits for the HCP Amendment.]

6.3.7 Hawaiian Hoary Bat

Based on pre-and post-construction acoustic surveys, the Hawaiian hoary bat occurs year-round within the Project area with higher activity recorded from April to October (Appendix 4, Section 3.8.4.4). Bats also have been documented across the slopes of northern Koʻolau Mountains (Gorresen et al. 2015). Sections 6.3.7.1 through 6.3.7.3 of the approved HCP describe the potential effects of the Project resulting from impacts to bat habitat and collision with Project components based on information available at the time. Section 6.3.7.4 describes the revised estimate of total potential Project take under the HCP Amendment and 6B identifies the minimization measures being implemented to reduce impacts to bats.

6.3.7.1 Impacts of the Facility on Bat Habitat

[This section requires no edits for the HCP Amendment.]

6.3.7.2 Calculating Direct Take for Tier 1 Through Tier 3

[This section requires no edits for the HCP Amendment. Section level heading modified for clarity.]

6.3.7.3 Calculating Indirect Take for Tier 1 Through Tier 3

[This section requires no edits for the HCP Amendment. Section level heading modified for clarity.]

6.3.7.4 Calculating Total Adjusted Take for Tier 4, Tier 5, and Tier 6

[New Section for the HCP Amendment.]

Potential impacts to the Hawaiian hoary bat evaluated for the HCP Amendment are assumed to result from collision with Project turbines. Data from PCMM at the Project allow the calculation of conservative estimates of total bat take anticipated over the remaining years of the ITP/ITL term.

As of December 31, 2017, 32 bat fatalities have been observed during systematic monitoring at the Project (direct take), as well as two incidentally detected fatalities. Using the EoA software (Dalthorp et al. 2017) to calculate adjusted take, it can be asserted with 80 percent certainty that no more than 62 bats have been taken as of December 31, 2017. An 80 percent credibility level for the take projection was selected by the USFWS and Hawaiʻi DLNR to assess compliance with an ITP/ITL, and provides a conservative estimate, erring in favor of the Covered Species (for additional discussion of take estimation see Appendix 16). Indirect take was estimated using current agency guidance (USFWS 2016a) and data from the Project. Detailed calculations for cumulative indirect take can be found in Appendix 16. Indirect take as of December 31, 2017, based on an estimated direct take of 62 bats, is estimated at 7 adult equivalents. Thus, the total cumulative take estimate through December 31, 2017 is 69 bats.

When evaluating projected future take, Kawailoa Wind assumes that technological advances will provide viable and practicable measures to minimize impacts to bats in addition to the operational measures that are currently used such as LWSC. Considerable progress has been made over the years toward a bat deterrent becoming commercially available as results from field trials for acoustic bat deterrents have been promising. In 2006, field trials for bat deterrents at ponds in the Fernow Experimental Forest in West Virginia revealed a 90 percent reduction in bat activity at all ponds (Szewczak and Arnett 2008). Initial tests of acoustic deterrents were conducted on wind turbines on the mainland in 2009 and 2010, resulting in as much as 64 percent fewer fatalities compared to when wind turbines operated without deterrents (Arnett et al. 2013a). Multiple companies are continuing to develop and test various types of deterrents on the mainland.

NRG Systems Inc. (NRG) makes acoustic deterrents that are being tested in broad-scale field trials and studies at commercial wind facilities on the mainland. In these studies, hoary bat fatalities were reduced by up to 78 percent compared to control turbines (Weaver et al. 2018). The effectiveness of the NRG acoustic deterrents presently ranges from 20 to 100 percent, with higher effectiveness shown for mainland hoary bats than other mainland bat species (NRG Systems webinar 2018). As demonstrated at Pilot Hill, Illinois in 2018 (Lillian 2019), take rates for hoary bats were reduced by 71 percent at treatment turbines, where deterrents and LWSC with cut-in speeds of 5.0 m/s were implemented, and 24 percent over LWSC alone (B. Morton/NRG, pers. comm., May 2019). Additional testing of the NRG acoustic deterrents continues to improve their effectiveness and range (B. Morton/NRG, pers. comm., 2018).

Kawailoa Wind has included implementation of deterrents as part of the baseline minimization strategy (see Section 6B.1). Acoustic bat deterrents from NRG will be installed in May and June 2019. Because there is uncertainty as to the effectiveness of deterrents at reducing bat take, conservative estimates of the variation in effectiveness is incorporated into the take estimation:

- Modeling of projected take at the Tier 5 level assumed minimization measures will realize a 50 percent reduction in the current level of take; and
- Modeling of projected take at the Tier 6 level (requested take authorization) assumed minimization measures realize a 25 percent reduction in the current level of take. This final tier is designed to be conservative to provide certainty to USFWS and DOFAW that the requested take will not be exceeded.

The Project take modelling reflects this installation of acoustic bat deterrents. Additionally, take was estimated for each scenario assuming that searcher efficiency and carcass persistence in future years will be similar to 2018 values and will remain consistent throughout the Project’s ITP/ITL permit term. For projections of future take, Project-specific data and monitoring parameters were used with the 75th percentile value of the probability distribution. The conservative assumptions used in EoA provide reasonable assurance that the take estimate at the end of the permit term will be lower than the conservative projected estimate.

The details of the modeling of direct take and the calculation of indirect take and the total take request are provided in Appendix 16, with the total take summarized in Table 6-1 below. The take in each tier represents the cumulative take attributed to the identified tier as well as all lower tiers. For example, estimated total take of 115 bats in Tier 4 includes the 60 bats authorized under the approved HCP and an additional 55 bats within Tier 4. The values of estimated take allotted to each tier is based on USFWS recommendations for tiered take at wind facilities (USFWS 2016b).

Table 6-1. Estimates of Take and Total Take Requests for Each Tier

Justification[1]	Tier	Take Request Per Tier	Total Take Request[2]	Percent of Additional Take Request
Tiers 1-3	1-3	NA	60	NA
Mitigation Offset of the Helemano Wilderness Area	4	55	115	34%
50% reduction in years 2020 – 2032 due to deterrents	5	85	200	53%
25% reduction in years 2020 – 2032 due to deterrents	6	20	220	13%

1. Kawailoa Wind assumes a bat deterrent will be commercially available, and deterrents installed by 2019 will achieve a 50 percent reduction in the current rate of bat take for Tier 5; or a 25 percent reduction in the current rate of bat take for Tier 6.
2. Total take accounts for the prior tiers; i.e., it is cumulative.

Approach for Estimating the Potential for Project Impacts

To estimate the potential impact of a given project's take, it is necessary to understand basic population parameters (e.g., population size, growth rate). Given that these parameters have not been previously estimated for the Hawaiian hoary bat, Kawailoa Wind has performed population modeling exercises to evaluate potential Project-related and cumulative impacts on the bat on Oʻahu. Specifically, a population model is used to estimate potential population growth rates and a range of population sizes using the best available information and clearly identified assumptions. The following subsections describe these associated parameters in more detail. The results of the modeling exercise are compared to estimated take rates to evaluate the risk of Project take to bats at the population level, as well as to evaluate the risk of cumulative impacts (Section 6.4.4). This analysis also meets state requirements under HRS Chapter 195D to evaluate these impacts on an island level.

The population modeling exercise is intended only to provide context for a risk analysis, and is not meant to provide a precise estimate of growth rate or population size. Despite the use of conservative estimates of density, occupancy, and annual survival, the exact numbers should be treated with caution, as the estimates may vary if the input parameters or assumptions are altered.

Estimating Population Growth Rate

Growth rate is the change in population over time, and is the sum of the reproductive rate minus the mortality rate. A growth rate (lambda [λ]) equaling 1.0 describes a stable population, a growth rate greater than 1.0 describes a growing population, and a growth rate less than 1.0 describes a declining population. The reproductive rate, mortality rate, and growth rate for the Hawaiian hoary bat can be derived or estimated from the available literature, proxies, or modeled estimates.

The reproductive rate of a species plays an important role in determining what impact the removal of individuals (i.e., mortality) has on its population. A species with a high reproductive rate is able to replace individuals quickly and recover from loss. The number of juvenile Hawaiian hoary bats surviving to adulthood per year is 27 percent of the population (P); this calculation comes from Hawaiian hoary bat life history information in the available literature (top three rows of Table 6-2), supplemented with relevant information from mainland hoary bats.

$$P * 0.5 * 1.8 * 0.3 = P * 0.27$$ = number of juvenile bats surviving to adulthood annually

Table 6-2. Best Available Information on Life History Parameters Used to Estimate Growth Rate of the Hawaiian Hoary Bat

Life History Trait	Value	Citation
Percent of female population	50%	Pinzari and Bonaccorso 2018b
Number of offspring per female	1.8 offspring	USFWS 1998
Proportion of juveniles surviving to adulthood	30%	USFWS and DOFAW 2016
Age at maturity	1 year	Kuntz and Fenton 2005
Maximum age of recapture	5 years	Bonaccorso 2010
Estimated lifespan	10 years	DLNR 2015, Kuntz and Fenton 2005.
Estimated lifespan (mainland hoary bats)	6-7 years	Tuttle 1995

All species have natural sources of mortality to be considered when assessing impacts to the population. A high reproductive rate, as identified above, would lead to exponential growth if not constrained by an external force such as competition for food, water, shelter, and space; or threats to survival such as predation, disease, or other sources of mortality. The annual mortality rate can be estimated through the use of demographic modelling, which estimates the annual survivorship (1 – mortality = survivorship). Based on the life history information from the available literature (bottom four rows of Table 6-2), an average 5-year lifespan is assumed to be reasonable.

A matrix model (which uses matrix algebra to perform a large number of calculations of births and deaths by age class) was created that assumes an average adult age of 5 years with a maximum lifespan of 10 years (Figure 6-1a[2]). Based on these two parameters, a matrix population model is used to estimate the annual adult survivorship, as shown in Figure 6-1b. The matrix population model predicts an average annual adult mortality rate of 6 percent from causes other than permitted or requested take.

(a)

Age Group by Year	Probability of Survival
1	30%
2	95%
3	95%
4	95%
5	95%
6	90%
7	80%
8	70%
9	60%
10	0%

(b)

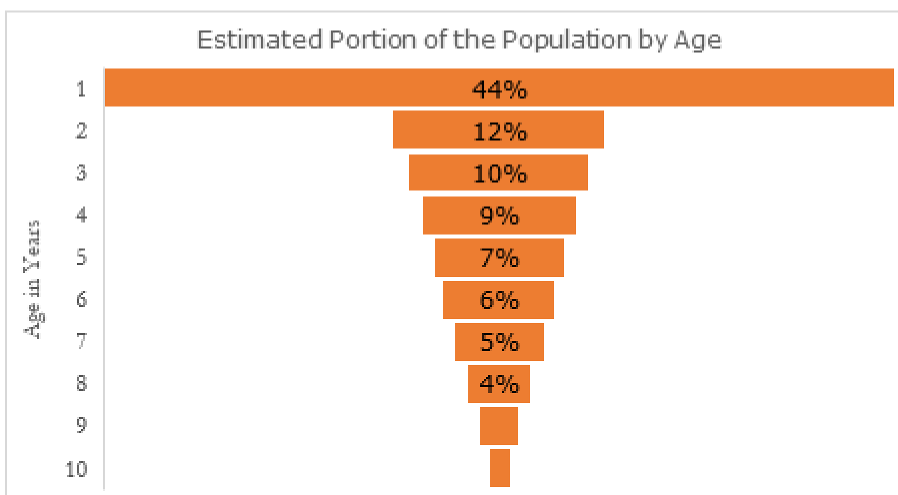


Figure 6-1. Hawaiian Hoary Bat Annual Survival Estimates by Age Group for the Matrix Population Model (a) and Estimated Portion of the Population by Age (b).

[2] The values for annual survivorship are estimates based on an assumed maximum lifespan of 10 years and an average lifespan of 5 years, and have not been empirically derived. To date, such information is not available in published literature.

The reproductive rate and mortality rates estimated above are used to estimate the growth rate. Using an estimated reproductive rate of 0.27 and subtracting a natural mortality rate of 0.06 (as modeled above) results in an estimated population growth rate of 1.21 (27% growth - 6% loss to mortality = 21% growth). In other words, based on the life history provided by USFWS and DOFAW (2016) and other sources, and the annual survivorship estimated from the matrix population model, the population is capable of growing by 21% each year (lambda = 1.21) in the absence of external factors (e.g., artificial mortality).

Growth rate of a species frequently varies in response to external factors such as the density of individuals in the population. The density dependent exertion of a force that reduces the population growth rate is commonly referred to as "carrying capacity." A population at carrying capacity would be expected to have a static population size (lambda = 1.0), due to the depression of growth rate at high densities. Figure 6-2 shows a generalized model of population growth and illustrates that peak growth rates are likely achieved well below the population size that would be estimated at stable equilibrium when the growth rate is close to 1.0. The growth rate of 1.21 estimated here is above the high end for similar bat species (Frick et al. 2017). This value likely represents peak growth, because actual growth rates of 1.21 after accounting for external factors would be rare in a natural environment. The persistence of the Hawaiian hoary bat from the time of colonization (approximately 1 million years ago) to present day in combination with a high reproductive rate is an indication that the population is in a stable equilibrium and may be at carrying capacity (Baird et al. 2017). The bat is adaptive, as it uses a variety of habitats and elevational grades, can fly long distances to utilize resources, and has no known predators (Bonaccorso et al. 2015, Gorreson et al. 2013 and 2018, Todd 2016, Speakman 1995). Further support comes from occupancy studies on Hawaii island that show a stable to increasing trend (Gorresen et al. 2013), consistent with a population at carrying capacity. Therefore, it is likely the actual growth rate is close to 1.0, but the capacity of the species for growth suggests that growth rates could be as high as 1.21 if there was a release of density-dependent forces. Such a release could occur through a decrease in population size or through an increase in a limiting environmental variable (e.g., prey availability).

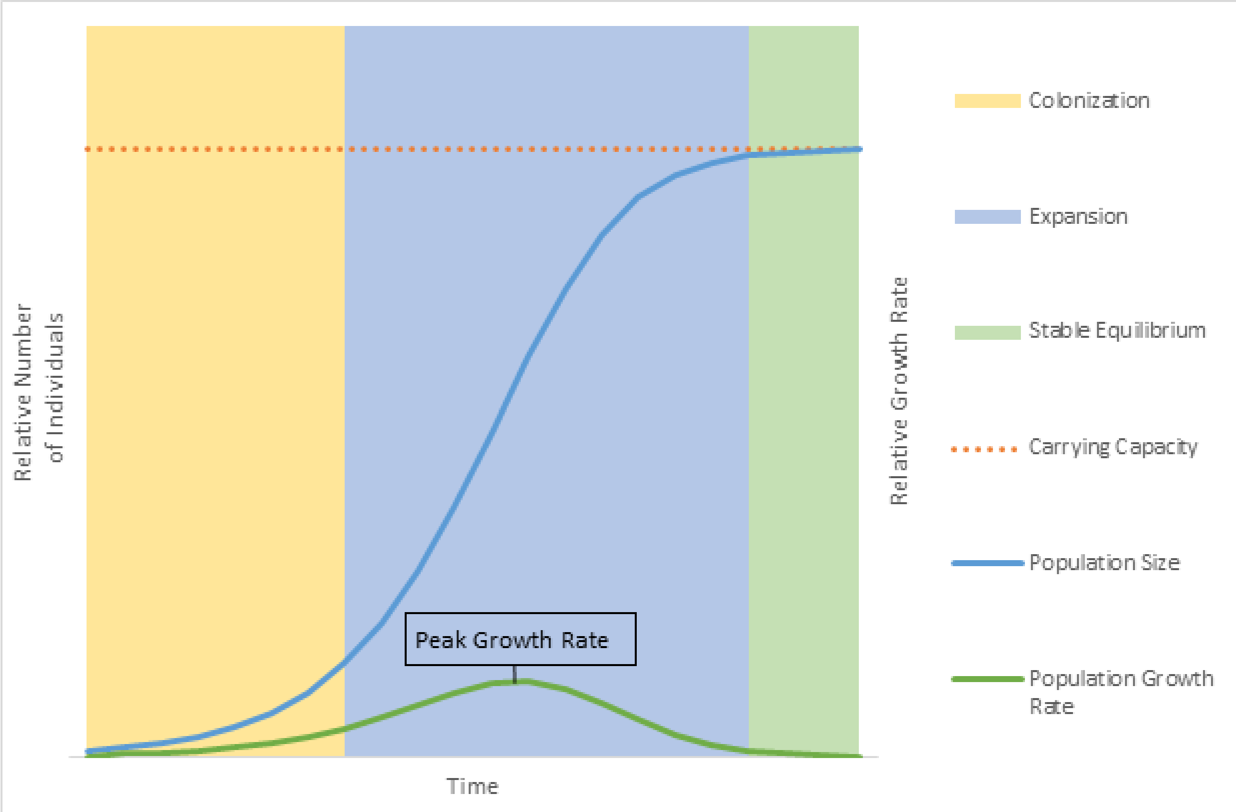


Figure 6-2. Generalized Theoretical Model of Population Growth Over Time.

Estimating a Range of Likely Population Sizes

The life history parameters of distribution and density are used as proxy metrics to provide an estimated bat population size range in the absence of metrics such as population indices or effective population sizes. Movement of bats among the Hawaiian Islands is anticipated to be rare (Baird et al. 2017); therefore, only the population on Oʻahu is of interest for this exercise to assess Project-related impacts.

As discussed earlier, Hawaiian hoary bats use a variety of habitats (i.e., widely distributed) and at varying densities. To ensure that the range of population sizes are conservative, both the estimates of distribution and density use estimates that are at or below the low end of likely data ranges resulting in lower population estimates than would be predicted by a median value. Two different methods are used to estimate the potential area available to be occupied by bats (i.e., distribution) on Oʻahu, providing additional optionality in population sizes.

The Hawaiian hoary bat has been documented in many habitats and broadly across Oʻahu (Gorresen et al. 2015, Starcevich et al. 2019, Bonaccorso et al. 2019). Approximately 23 percent of Oʻahu is developed land, or areas occupied by human structures and impervious surfaces that are assumed to provide less suitable habitat. Thus, the remaining 77 percent of Oʻahu (294,910 acres) consists of open water, forest, agriculture, or rangelands (Figure 3-1), which provide suitable habitat for the Hawaiian hoary bat to differing degrees. Of these suitable habitat types, 186,000 acres are forest (NOAA CCAP 2018).

The actual area of Oʻahu occupied by bats (i.e., distribution) is not known and therefore must be estimated for purposes of this exercise. This estimate makes the conservative assumption that only 30 percent of the area of Oʻahu is occupied by bats (383,000 acres of land on Oʻahu * 0.3 portion of the available area occupied by bats = 115,000 acres), yielding a downwardly conservative estimate of 115,000 acres of bat habitat. This value is based on the association of Hawaiian hoary bats with mature forest (Gorresen et al. 2013), the preference of bats to use day roost trees with dense canopy, and the approximate percentage (48 percent) of forest on Oʻahu. However, the estimated 115,000 acres of occupied bat habitat may incorporate habitat types other than forest, such as agriculture and rangelands.

The density of bats was estimated using the metric of CUA. Studies from Hawaiʻi Island provide estimates of CUA in acres per bat (Bonaccorso et al. 2015): the interquartile range (IQR) of the CUA is from 16 acres to 58 acres per bat. These values are used to represent a range of densities; the lower quartile CUA (16 acres per bat) is used to represent a high-end estimate for the Oʻahu density and the upper quartile CUA (58 acres per bat) to represent a low-end density. Based on these values and the assumed 115,000 acres of occupied bat habitat, Oʻahu could conservatively support 2,000 (115,000 acres/58 acres) to 7,200 (115,000 acres/16 acres) individuals.

An alternate method of calculating bat density uses occupancy data to estimate distribution. Occupancy is the proportion of an area occupied by a species, or fraction of landscape units where the species is present; occupancy rates can be used to estimate population trends (MacKenzie et al 2018). Studies from Oʻahu have reported occupancy above 50 percent (Gorresen et al. 2015). To make a conservative estimate of distribution, the developed lands are excluded from the area potentially being occupied by bats (23 percent of Oʻahu). The remaining area, which is the undeveloped land (77 percent of Oʻahu), is considered 50 percent occupied (383,000 acres of land on Oʻahu * 0.77 portion of the available area occupied by bats * 0.5 occupancy = 147,500 acres), yielding a downwardly conservative estimate of 147,500 acres of bat habitat. When the same range of densities are applied to this acreage it yields a minimum population ranging from 2,500 bats (147,500 acres/IQR of 58 acres) to 9,200 bats (147,500 acres/IQR of 16 acres) on Oʻahu.

Taking the smallest and largest values from the two ranges produces a downwardly conservative range of population sizes between 2,000 and 9,200 bats on Oʻahu. This exercise gives a sense of scale in which to interpret Project-related take, despite uncertainties in translating CUA and occupancy to a population size.

Potential Population-level Impacts

The range of population sizes estimated above are compared to estimated Project take rates to provide an assessment of the scale of potential Project-related impacts. The range of the population size is assessed relative to the take requested by the Project.

Estimated Take Rate

The authorized take rate represents an upwardly conservative maximum annual impact to the bat. The approved ITP/ITL for the Project authorized three bats per year (60 bats over 20 years). Based on predictions from PCMM data and conservative interpretation of EoA, the maximum estimated average annual rate of total take for the amendment is 11 bats per year (220 bats over 20 years) over the life of the permit term. This rate incorporates the conservative assumption that minimization measures are minimally effective at reducing take (Appendix 16). An annual take value of 11 bats represents less than 1 percent of the lowest population estimate (2,000 bats) estimated above. A loss of 1 percent of the population per year would be unlikely to affect what appears to be a stable population, particularly given a capacity for growth of as much as 21 percent per year in the absence of external factors.

Cumulative impacts for bats are reviewed in more detail below in Section 6.4.4.

Summary

The population modeling to estimate potential growth rate and population size ranges for the Hawaiian hoary bat on Oʻahu was conducted to provide context in which to interpret the impacts of the requested Project take.

- Based on the model results, the bat population has the capacity to grow by up to 21 percent each year; evidence suggests the population is at carrying capacity and the actual growth rate is likely close to zero percent unless released from density dependent factors.
- Using estimates of distribution and density, the population on Oʻahu could range from 2,000 to 9,200 bats. The average annual rate of total take is 11 bats per year, which is less than 1 percent of lowest population estimate range.
- Additionally, the take estimate incorporates an 80 percent credible level, which means there is an 80 percent certainty that the actual number of fatalities is less than or equal to the reported number.
- In addition to the low risk from Project-related impacts, additional mitigation and minimization measures will offset bat take. The mitigation described in this HCP Amendment will protect or create bat habitat in perpetuity, and based on a conservative mitigation acreage ratio, will fully offset the impact of the take (Section 7.6.3).
- Kawailoa Wind has developed an adaptive management program whereby exceedance of specific take limits and take rate thresholds will trigger additional minimization measures (Section 8.3).

Although it is difficult to assess the effect that take of Hawaiian hoary bat resulting from the Project may have on the local population of this species, population modeling using the best available information suggests the population on Oʻahu is robust to the low levels of take proposed by the Project. Therefore, in accordance with HRS 195D-21, no population level impacts would be expected for the Hawaiian hoary bat.

6.4 Cumulative Impacts to Listed Species

[Section text and Table 6-16 of the approved HCP (Table 6-3 of the HCP Amendment) updated to support analysis for the HCP Amendment.]

Take of the Covered Species has been authorized or requested through HCPs for projects occurring on Oʻahu, Maui, Hawaiʻi Island, Kauaʻi, and Lanaʻi (Table 6-3). Under the Federal ESA (16 U.S.C. 1531-1544) and State HRS 195D, HCPs are required to minimize and mitigate the effects of the incidental take to the maximum extent practicable. In addition to the above requirements, the State of Hawaiʻi requires that all HCPs and their actions authorized under the plan should be designed to result in an overall net benefit to the threatened and endangered species in Hawaiʻi being authorized for incidental take (Section 195D-21).

In addition to the take that has already been authorized, and the anticipated major HCP amendments, the proposed Na Pua Makani Wind Project on Oʻahu and pending requests for ITLs by Pakini Nui Wind Farm and Lālāmilo Wind Farm, also have the potential to result in incidental take of, and contribute to cumulative impacts to, the Covered Species (Table 6-3). Furthermore, it is anticipated that due to the

State's Renewables Portfolio Standard objectives, which requires "a renewable portfolio standard of… one hundred percent of net electricity sales by December 31, 2045" (HRS 269-92), wind energy development in Hawaiʻi will continue in the future. However, it is expected that if the HCPs or HCP amendments for any or all the potential projects are approved, the impacts and mitigation measures will resemble those discussed for Kawailoa Wind, where the mitigation measures are expected to offset the anticipated take and provide a net benefit to the species.

Table 6-3. Current and Pending Take Authorizations for the Covered Species Requested in this Amendment

Name	Permit Duration	Location	Species and Total Take Authorization for Permit Term[1]	Species and Total Take Pending Approval (Total Includes Previous Authorized Take) [2]
Tower Kauaʻi Lagoons Land, LLC	12/09/2016 – 11/09/2042	Lihuʻe, Kauaʻi	Hawaiian petrel (1)	N/A
Kauaʻi Island Utility Cooperative (Short-Term)[3]	Permit renewal for an indefinite period	Kauaʻi (Island-wide)		Hawaiian petrel (2 per year)
Kahuku Wind Farm	06/07/2010–06/06/2030	Kahuku, Oʻahu	Hawaiian petrel (12) Hawaiian hoary bat (32)	N/A
Kawailoa Wind Farm	12/08/2011–12/07/2031	Haleʻiwa, Oʻahu	Hawaiian hoary bat (60)	Hawaiian petrel (24)[4] Hawaiian hoary bat (220)
Na Pua Makani Wind Project	2019 - 2040	Kahuku, Oʻahu	Hawaiian hoary bat (51)	N/A
U.S. Army Kahuku Training Area Single Wind Turbine	05/05/2010-05/09/2030	Kahuku, Oʻahu	Hawaiian hoary bat (2 adults, 2 pups)	N/A
Auwahi Wind Farm	02/24/2012–02/23/2037	ʻUlupalakua, Maui	Hawaiian petrel (87) Hawaiian hoary bat (21)	Hawaiian hoary bat (140)
Kaheawa Wind Power I (KWP I)	04/30/2012[5]–01/29/2026	Kaheawa, Maui	Hawaiian petrel (38) Hawaiian hoary bat (50)	N/A
Kaheawa Wind Power II (KWP II)	1/03/2012–1/02/2032	Kaheawa, Maui	Hawaiian petrel (43) Hawaiian hoary bat (11)	Hawaiian hoary bat (38)
Lālāmilo Wind Farm Repowering Project	No permit	Lalamilo, Hawaiʻi		Hawaiian petrels (3) Hawaiian hoary bat (6)
Pakini Nui Wind Farm	No permit	Ka Lae (South Point), Hawaiʻi		Hawaiian petrels (3) Hawaiian hoary bat (26)
Pelekane Bay Watershed Restoration Project[6]	02/05/2010-02/04/2030	Pelekane Bay, Hawaiʻi	Hawaiian hoary bat (16)	N/A

1. Other species may also have incidental take authorizations not reported here. Only the Hawaiian hoary bat and Hawaiian petrel are included in this table. Total take authorization for Hawaiian hoary bats includes adult and juvenile bats; number of adult equivalents provided by D. Sether, USFWS, 2017.
2. Total includes previous authorized take.
3. Identified in USFWS 2018.
4. 24 individuals includes 19 adults and 5 chicks.
5. Original permit issued in 2006 and amended in 2012.
6. Take authorized under ESA Section 7 Biological Opinion.

At a broader scale, Kawailoa Wind represents one of many development projects that can be expected to occur on the islands of Oʻahu, Maui, Kauaʻi, and Hawaiʻi Island. These islands have experienced increasing human population growth and real estate development as described in Section 3.8.4.4, and those will likely continue to increase in the future. This growth may further contribute to some of the causes of decline of the Covered Species, such as mammal predation, light disorientation, pesticide use, and loss of nesting or roosting habitats. Kawailoa Wind's HCP Amendment includes minimization measures for the Hawaiian hoary bat (Section 6B.1) that are expected to result in take levels substantially less than the maximum take amount requested for authorization (Table 6-1). Additionally, the adaptive management program provides specific actions to be taken should Tier 5 assumptions be invalid about the effectiveness of the baseline minimization measures at reducing take (Section 8.3). Moreover, through mitigation, projects like Kawailoa Wind are implementing measures to offset take and provide a net benefit to the affected species. In general, it is assumed that future development projects will be conducted in compliance with all applicable local, state, and federal environmental regulations. Updated cumulative effects analysis for the Hawaiian petrel and Hawaiian hoary bat are presented in Section 6.4.1 and Section 6.4.4, respectively.

6.4.1 Seabirds

6.4.1.1 Hawaiian Petrel

Multiple factors contribute to the cumulative effects on the Hawaiian petrel including predation by introduced species, ingestion of plastics, crushing of burrows by feral ungulates such as goats, loss of suitable habitat from invasive plant species, disorientation caused by unshielded lighting, collisions with power lines and other structures, and possibly climate change. In addition to these factors, take for the Hawaiian petrel is currently authorized under ESA Section 10/HRS 195D ITPs/ITLs or ESA Section 7 incidental take statements for five projects in Hawaiʻi, and is pending for an additional three projects (see Table 6-3). Two additional HCPs that include the Hawaiian petrel as a Covered Species are in preparation (Kauaʻi Island Utility Cooperative Long-Term and Kauaʻi Seabird Habitat Conservation Program); however, the associated take requests are not publicly available at the time of this writing. Under the ESA, HCPs are required to avoid, minimize, and mitigate to the maximum extent practicable the remaining effects of incidental take.

Although take of Hawaiian petrels authorized under the Kawailoa Wind ITP/ITL amendment would contribute to the cumulative effects to this species, operation of the Project poses a very low risk to Hawaiian petrels. Petrel occurrence at the Project is considered rare and individuals that may occasionally transit the Project area are considered an unusual occurrence. The mitigation for the requested take of 19 adults and 5 chicks for this Project, described in Section 7.3, will contribute to funding Hawaiian petrel management at known breeding colonies and thereby offset the impacts from the requested take. Thus, no significant adverse impact to the population of Hawaiian petrels across the state are anticipated from this Project.

Hawaiian petrel take for many of the projects listed in Table 6-3 has been lower than estimated. As of December 31, 2017, seven petrel fatalities have been observed at KWP I, one petrel fatality has been observed at the Auwahi Wind Farm, and one petrel fatality has been observed at the Kawailoa Wind. No petrel fatalities have been recorded at the KWP II or Kahuku wind farms. Each of these projects has successfully implemented associated mitigation measures to provide a net benefit to the species (Kaheawa Wind Power, LLC 2017; Kaheawa Wind Power II, LLC 2017; Kahuku Wind Power, LLC 2017; Tetra Tech 2017b).

The most recent breeding population estimate for Hawaiian petrels is estimated to be about 6,000 breeding pairs based on observations at colony sites (Pyle and Pyle 2017). Surveys to date have not provided evidence that breeding colonies are present on Oʻahu (Pyle and Pyle 2017; USFWS 2017; Young et al. 2019). Although the total population trend is declining, the overall impacts from the

Project would be unlikely to impact the population, and the net effects including mitigation should provide a benefit to the species.

6.4.2 Waterbirds (Hawaiian Duck, Hawaiian Stilt, Hawaiian Coot, Hawaiian Moorhen)

[This section requires no edits for the HCP Amendment.]

6.4.3 Hawaiian Short-eared Owl

[This section requires no edits for the HCP Amendment.]

6.4.4 Hawaiian Hoary Bat

[This section was substantially revised for the HCP Amendment.]

Cumulative impacts are those impacts from the increased authorized take associated with the HCP Amendment considered alongside the past, present and reasonably anticipated future actions on Oʻahu and statewide. On Oʻahu, past development and other historic land use changes are presumed to have resulted in the loss of bat roosting and foraging habitat through the conversion of forest to agriculture and other uses (USFWS 1998). Residential, resort or recreational developments, farming, road construction, pesticide use, and wildfires are expected to persist into the future, and have the potential to result in habitat loss or alteration, either directly or through the introduction or spread of invasive plant and insect species; although data (NOAA 2018) suggests the annual change is small. Other direct impacts to bats associated with these activities may occur through collisions with structures, such as barbed wire fences, wind turbines, and communications towers; or disturbance at roost sites. These activities may also indirectly affect bats through the displacement or reduction in the number of prey resources.

Few direct impacts to Hawaiian hoary bats have been quantified outside of wind turbine collisions, which is the only source of mortality regularly monitored. One such impact source is collision with or snagging on barbed wire, with the statewide estimate ranging between 0.0-0.8 Hawaiian hoary bats killed per 62 miles of barbed wire (Zimpfer and Bonaccorso 2010); rates on Oʻahu are expected to be similar. Observed fatalities are uncommon because most fences are not checked regularly, and bats caught on these fences may quickly be taken by predators or scavengers. Based on the low estimates of mortality related to bat impalement on barbed-wire fences, the impact of the HCP Amendment in combination with this impact is not expected to result in significant cumulative impacts to the species on Oʻahu, or statewide. Other anthropogenic sources of take potentially include: timber harvesting, drowning, pesticides, predation or competition from introduced species, and climate change. The scale of the impacts from the identified activities is not monitored, but it is thought to be minimal (Diane Sether/ USFWS pers. comm. April 2019).

The mobility of the bat is such that all individuals on a given island likely belong to the same population; therefore, the assessment of population-level impacts caused by the Project should consider other projects on Oʻahu. As stated above, Project impacts are not anticipated to affect populations on other islands and this analysis is limited to the Hawaiian hoary bat population on Oʻahu.

In addition to the Hawaiian hoary bat take authorized under the approved HCP, the only other authorized take of the Hawaiian hoary bat on Oʻahu is from two other industrial-scale wind farms with approved HCPs: the operational Kahuku Wind (12 Clipper 2.5-MW wind turbines) and approved Na Pua Makani (wind turbines not specified) projects. These two projects are located on Oʻahu and have authorized take levels of 32 bats and 51 bats over 20-year permit terms, respectively (Kahuku Wind

Power 2011, Tetra Tech 2016). Given the remaining permit terms and current take estimates, the take for all existing Oʻahu projects is estimated at 15 bats per year.

The likelihood of additional development must also be considered in the impacts to species. HECO issued a request for proposals seeking to develop an additional 485,000 MW hours annually, of renewable energy on Oʻahu (HECO 2018). Palehua Wind has filed a PPA with HECO but has not received an ITP or ITL (Froese 2018). Without approved take permits, it cannot be assumed that this project will operate at night and pose a risk to bats, and therefore cannot be included in the analysis. The Hawaiʻi Clean Energy Initiative (HRS 196-10.5) and Renewable Portfolio Standards (HRS 269-92) specifies that the State of Hawaiʻi will establish a renewable portfolio standard of 100 percent of net electricity sales from renewable sources by 2045. New wind projects may be proposed in the future, but the timing, approval, construction, and operation of such projects is uncertain and is therefore not incorporated into the analysis of cumulative impacts.

Impacts to the Hawaiian Hoary Bat on Oʻahu

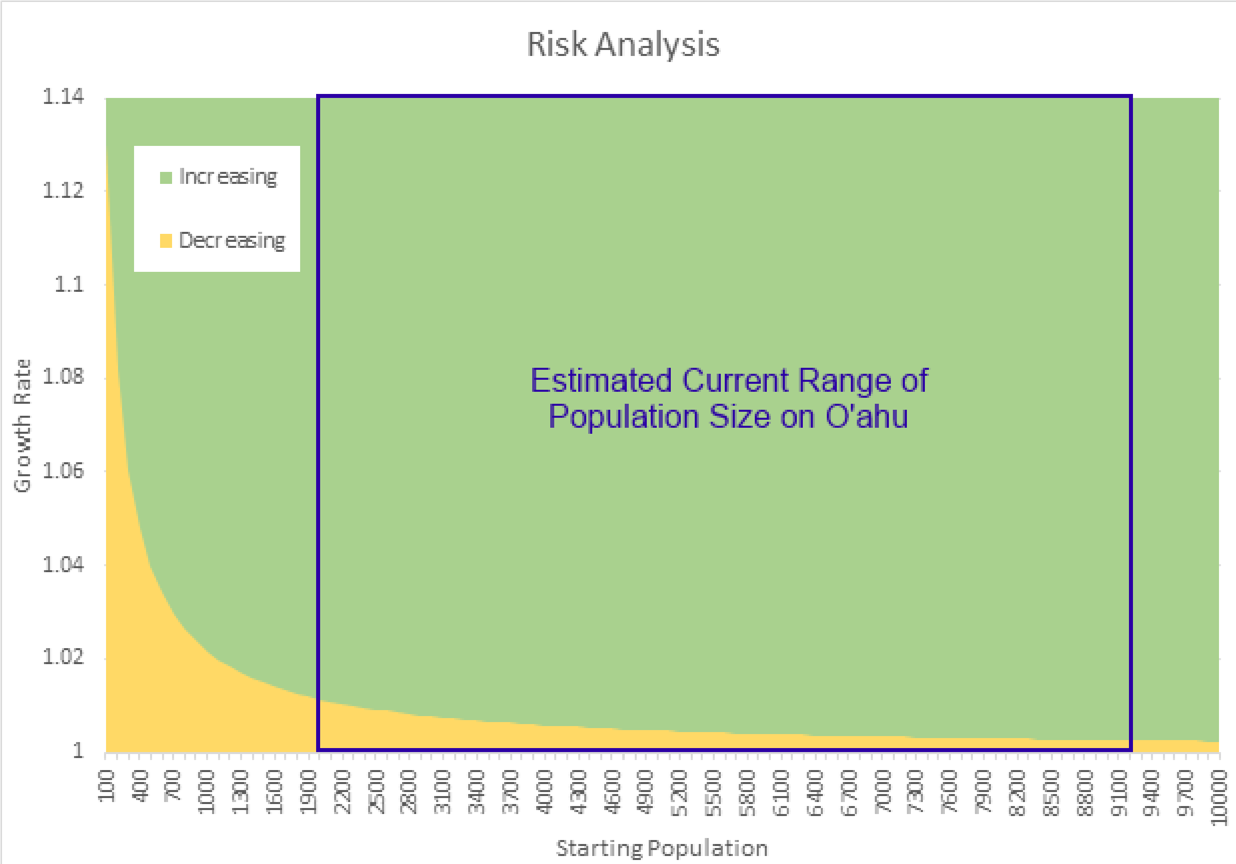
Evaluating Risk Given Estimated Population Sizes and Capacity For Growth

A range of model scenarios were evaluated to determine under what conditions a population would be at risk. The range of population sizes estimated for the bat give a reasonable range from which a conservative range of starting populations (P_{T_0}) from 100 to 10,000 were modeled. The population was modeled for 10 years (T) to approximate the impact of the remaining permit term. The population after 10 years is described by the following equation, which takes into account a generalized population growth formula ($P_{T_0} * \lambda^T$) and an approximation of the loss of 15 bats annually

($0.0619 * T^3 + 0.0267 * T^2 + 17.807 * T - 4.6922$. This equation describes 15 bats lost each year i.e. after each reproductive cycle, corresponding to the estimate of total take at all Oahu wind projects):

$$Population_T = \left(P_{T_0} * \lambda^T\right) - (0.0619 * T^3 + 0.0267 * T^2 + 17.807 * T - 4.6922)$$

The possible growth rates as estimated from the model ranged from 1.00 to 1.14 (Figure 6-3).



Note: The area shown in green indicates all scenarios for which there would be an increase in population, the area shown in yellow indicates all scenarios for which there would be a decrease in population over 10 years. The shaded blue box captures those scenarios with starting populations that fall within the previously estimated range of population sizes (2,000 – 9,200).

Figure 6-3. Estimates of Population Trend After 10 Years from Generalized Growth Rate Estimate.

From Figure 6-3, the risk to bats can be assessed relative to likely starting population sizes and growth rates. A growth rate of 1.03 or higher will lead to an increasing population in all scenarios except those scenarios with starting populations less than 600. The downwardly conservative range of population sizes modeled above suggests that a reasonable minimum population size is 2,000 bats, which would have an increasing population with a growth rate as small as 1.01. The cumulative impacts from all wind farms on Oʻahu (15 bats per year) are estimated at less than 1 percent of the population per year (0.75%; assuming the lower end of the range of population sizes). Therefore, even if growth rates are as low as 1.01 and decreased by an additional 0.0075 per year due to all authorized take on Oʻahu, the actual growth rate would be 1.0025 and the population would remain stable to increasing with a starting population as small as 2,000 (Figure 6-3). Thus, the population would be sustained even given the added mortality from the direct and indirect take from all existing wind farms.

Future Minimization

The take rates outlined for Hawaiian hoary bats are likely to decline as the risk factors associated with Hawaiian hoary bat fatalities become better understood and minimization measures for wind farms are improved. Several companies are working to develop effective ultrasonic and ultraviolet deterrents to reduce the risk of bat fatalities at wind farms. Kawailoa Wind installed acoustic bat deterrents at all Project turbines. The installation of bat deterrents at other wind farms in Hawaiʻi is anticipated in the future, and would further reduce the risk of cumulative impacts to the bat.

Impacts of Mitigation

Mitigation associated with the HCP and the HCP Amendment will provide a benefit to the bat to offset negative impacts. Kawailoa Wind's land-based mitigation at ʻUkoʻa Pond continues to be successfully implemented and should continue to provide a benefit to the Hawaiian hoary bat (Kawailoa Wind 2017). In addition, ongoing biological research being conducted for mitigation under Tiers 2 – 3 will contribute to filling in knowledge gaps that will lead to effective on-the-ground management activities for the species. Additional mitigation for all Project-related take associated with the HCP Amendment will be implemented on Oʻahu, as described in Sections 7.6.3 and 7.6.4, and will further contribute to the species' recovery. The mitigation described in Section 7.6.3 and 7.6.4 increases the chances of survival and the likelihood of recovery for the bat species by providing a net benefit to the bat. Additionally, the mitigation identifies benefits to species not covered by the HCP so as to provide a net environmental benefit and does not threaten or jeopardize the existence of any other native species and complies with HRS 195d.

Statewide Impacts to the Hawaiian hoary bat

The activities that directly impact bats on Oʻahu (identified above), also occur statewide. The direct impacts from other authorized or proposed actions that could take bats include: 1) authorized take approved for three existing wind projects on Maui (KWP II and Auwahi Wind are seeking HCP amendments to increase the amount of authorized Hawaiian hoary bat take), and 2) requested take for two existing wind projects and one restoration project on Hawaiʻi Island (refer to Table 6-3). Take authorization for these wind farms is contingent upon approved mitigation, which is expected to offset these projects' take.

In addition to mitigation offsets, conservation lands across the state protect habitat that are likely to be used by Hawaiian hoary bats. Approximately 160,000 acres of conservation lands occur on Oʻahu with over 2 million acres of conservation lands statewide. In addition to the 186,000 acres of forest on Oʻahu, an estimated 1.5 million acres of forest habitat occur across the state. These lands would be expected to provide available habitat that would enable the Hawaiian hoary bat to continue to survive and reproduce despite any anthropogenic losses.

Additionally, the Hawaiian hoary bat has been documented on Kaua'i, Molokaʻi and Lana'i. These three islands have no wind energy projects, and their bat populations would not be expected to be impacted by any of the existing wind projects. The existence of the species on these islands is a further assurance of the persistence of the Hawaiian hoary bat across its range.

Approved and pending authorized levels of bat take would be expected to be fully mitigated, with the exception of the U.S. Army Kahuku Training Area and Pelekane Bay Watershed Restoration Project, for which mitigation is a recommendation under the USFWS's ESA Section 7 Biological Opinion (USFWS 2003), but not required. The approved and pending HCPs include a combination of habitat restoration and research (see Section 7.6 for Project-specific Hawaiian hoary bat mitigation under the HCP Amendment). Habitat restoration is intended to create or improve the quality of bat foraging and roosting habitat, the loss and degradation of which has been identified as a major factor contributing to decline of the species (USFWS 1998). Restoration actions incorporated into the approved and pending HCPs include installation of ungulate fencing, the removal of non-native ungulates and invasive plant species, and/or planting of native trees and shrubs. Over time, these actions are anticipated to create high quality, sustainable native foraging and roosting habitat, benefiting bats beyond the ITP/ITL terms, and thereby resulting in a net benefit to the species. Additionally, the research component of the mitigation is critical to filling data gaps about the species and was identified as a priority recovery action in the Hawaiian hoary bat recovery plan (USFWS 1998). Research projects approved by USFWS and DOFAW are designed to gain an understanding of basic life history parameters and develop effective mitigation measures for the species (DOFAW 2015), which will ultimately guide future management and recovery efforts.

Summary

Based on the best scientific data currently available, the Project is unlikely to cause adverse impacts to the species' population on Oʻahu or statewide, or to the recovery potential of the species. Pursuant to USFWS and DLNR ITP/ITL issuance criteria, the provisions described in the HCP amendment, including the avoidance and minimization measures, mitigation, and adaptive management program, identify how any bat take will not jeopardize the survival and recovery of the species. The mitigation described in Section 7.6.3 and 7.6.4 increases the chances of survival and the likelihood of recovery for the listed species by providing a net benefit to the species.

- The process of estimating take for the HCP Amendment using EoA and PCMM data provides a high degree of certainty that actual take will be less than predicted take.
- Population modelling results indicate that reasonable scenarios of population size and growth rates are sufficient to sustain stable to increasing bat populations on Oʻahu after accounting for cumulative impacts.
- No published or reported information is available to suggest that either the Oʻahu or statewide population is decreasing.
- The discovery of a thriving population on Oʻahu represents an expansion of the known range of the species. Additionally, there are many locations across the state where no impacts are occurring, providing assurances that the species will continue to persist statewide.
- Current and pending actions of HCPs are expected to fully mitigate for their take, and provide a net benefit as required by Hawaiʻi law; thus, the cumulative impact to the Hawaiian hoary bat associated with the increased take from the HCP Amendment is expected to be none to minimal.

6B.0 AVOIDANCE AND MINIMIZATION MEASURES

[This section was moved from Section 5.3 in the approved HCP. This is a new level 1 section number occurring between Sections 6.0 and 7.0. Section 6B.0 label is used to retain the original section number headings of the approved HCP.]

Kawailoa Wind is committed to the on-going implementation of operational avoidance and minimization measures described in the approved HCP and has been evaluating other options to further reduce the risk to bats since Project operations began in 2012. Kawailoa Wind implemented multiple adaptive management steps to understand and reduce the risk to the Hawaiian hoary bat including modifying the LWSC regime, implementing innovative approaches to PCMM, and supporting development of the latest technologies that could reduce risk to bats. From initial commercial operations (i.e., original baseline minimization measures), Kawailoa Wind committed to using LWSC with a cut-in speed at 5.0 m/s as a minimization measure between sunset and sunrise from March through November. As an adaptive management response to the occurrence of bat fatalities outside the initial LWSC period, the implementation of LWSC was extended to December 15 in 2012 and the starting date for LWSC was subsequently moved up to February 10 and then February 6 in 2013 and 2015, respectively. After a bat fatality in late December 2016, LWSC was further extended to December 31 in 2017. Under the HCP Amendment, Kawailoa Wind will commit to LWSC with a cut in speed of 5.0 m/s and a 0.2 m/s hysteresis (5.2 m/s return to service), with a 20-minute rolling average time, year-round as a new baseline minimization measure.

Additionally, Kawailoa has been a pioneer in the use of trained canine search teams in PCMM to increase searcher efficiency (SEEF) and reduce uncertainty in the amount of bat take documented at the Project. Kawailoa initiated the use of trained dogs in July 2013 and continues to use canine search teams to increase the robustness of the PCMM program, remaining one of the few wind farms in the United States to do so.

Finally, Kawailoa Wind has been pro-active in funding and conducting additional research and assessments focused on deterrent technologies and operational changes that would reduce risks to bats. In 2013, Kawailoa funded research and engineering development of an ultrasonic bat deterrent through BCI and Deaton Engineering as an adaptive management effort to promote options for reducing bat fatalities (Kawailoa Wind Power, LLC. 2014). Kawailoa Wind is installing the NRG bat deterrent on all turbines in May and June 2019. Kawailoa Wind also implemented the most extensive acoustic monitoring system of any wind farm in Hawaiʻi, with more than 70 acoustic detectors deployed on the ground, in gulches, and on nacelles (Kawailoa Wind 2014, Tetra Tech 2016). Additionally, Kawailoa Wind has participated in thermal and acoustic studies to elucidate factors that correlate with Hawaiian hoary bat activity (Kawailoa Wind 2014; Gorresen et al. 2015).

The measures described in this section identify Kawailoa Wind's measures to minimize the impacts to the maximum extent practicable in accordance with the ESA and HRS 195D-21.

6B.1 Operational Minimization Measures Implemented for the Hawaiian Hoary Bat

In response to the Project's exceedance of authorized take for bats, Kawailoa Wind has proactively implemented additional measures rather than waiting for the approval of an HCP amendment. Kawailoa Wind has been investigating other potential minimization measures that could further reduce bat take. Increasing LWSC has been suggested as a minimization measure by USFWS and DLNR. One of the factors limiting the Project's flexibility in increasing the cut-in speed above 5.0 m/s (the original baseline LWSC strategy) is the wind regime at the Project. This means that even a small adjustment in the LWSC regime can result in significant power loss, jeopardizing the ability of Kawailoa Wind to meet its commitments under its PPA with HECO. Equally as important, and as described in detail in Section 5.2, the literature suggests that LWSC at cut-in speeds above 5.0 m/s results in diminishing returns in terms of decreases in bat take. Hein et al. (2014) at Pinnacle Wind (Vermont) and Arnett et al. (2011) at Casselman (Pennsylvania) found no statistically significant difference between 5.0 and 6.5 m/s cut-in speeds. Only Good et al. (2012) has shown a statistically significant reduction in bat fatalities between different LWSC cut-in speeds at Fowler Ridge (Indiana). Other studies of LWSC with higher cut-in speeds suffer from either no control treatment, or lack of sampling for comparison (Stantec 2015, Tidhar et. al 2013). Furthermore, given the differences in life history characteristics between the Hawaiian hoary bat and migratory mainland hoary bat, the application of increased cut-in speeds beyond what is currently proposed may not be more effective at decreasing take of Hawaiian hoary bat.

To facilitate the identification of further operational minimization measure options, Kawailoa Wind contracted ArcVera to conduct a wind speed/power loss analysis evaluating a number of LWSC scenarios incorporating various cut-in speeds and implementation periods. The results of this study determined that the Project is restricted in its ability to support higher LWSC (i.e., increasing the cut in speed above the current 5.0 m/s) due to wind variability at the site and the commitments required in the Project's PPA with HECO. The wind regime at the Project is consistently in the range of 5.0 m/s, as illustrated in Figures 6B-1 and 6B-2.

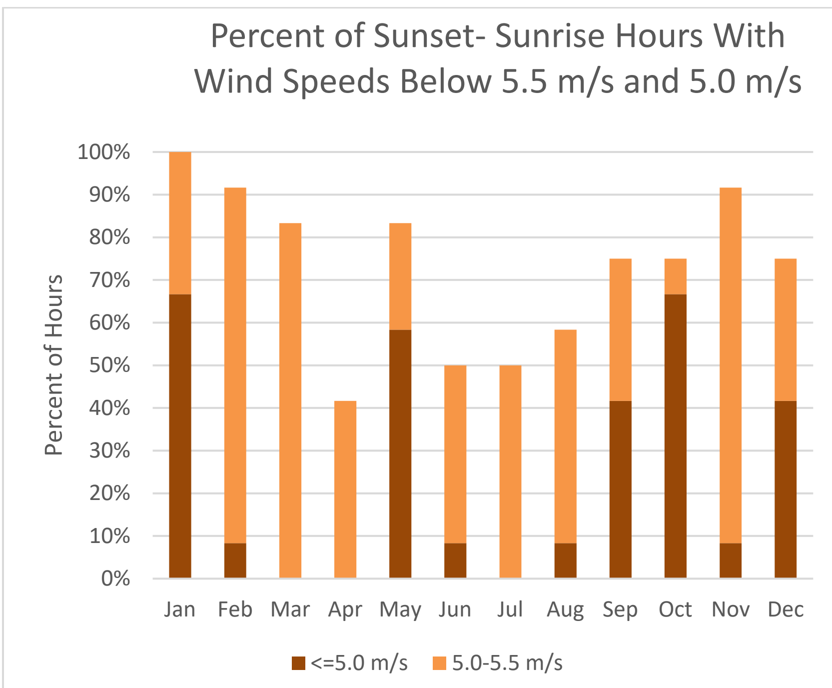


Figure 6B-6-4. Percentage of Time that Wind Speeds Are in the Range of Curtailment at 5.0 m/s

Notes: Wind data from 2017 (representative of an average wind year). 2. Sunset – Sunrise is defined as hours between 7:00 p.m. and 7:00 a.m.

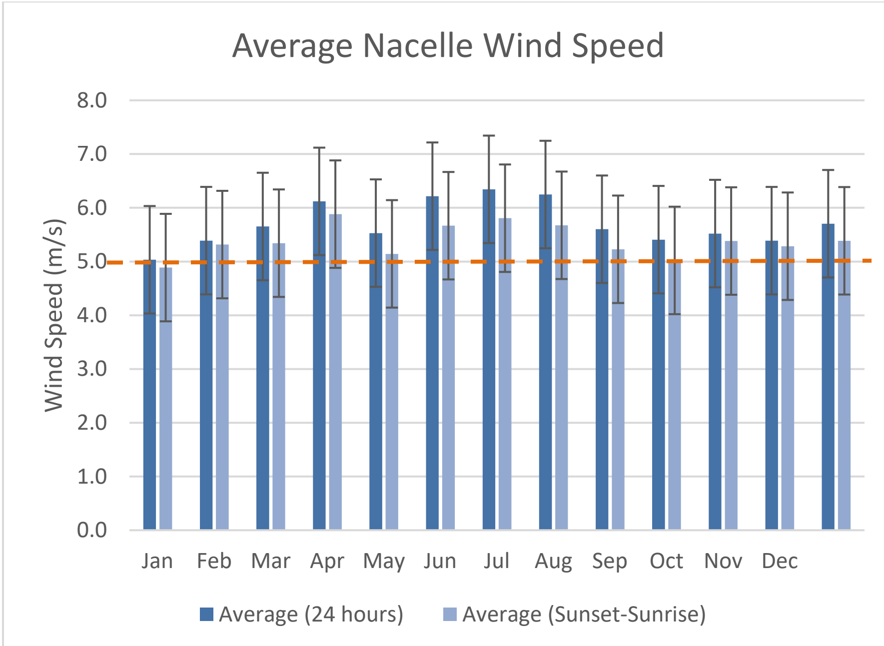


Figure 6B-6-5. Average Wind Speed at the Project

Notes: Wind data from 2017 (representative of an average wind year). 2. Sunset – Sunrise is defined as hours between 7:00 p.m. and 7:00 a.m.

Based on the Project's wind regime and recognizing the operational limitations associated with PPA requirements, Kawailoa Wind implemented the following operational minimization measures, and these actions will be the baseline minimization measures under this HCP Amendment, to minimize the risk to the Hawaiian hoary bat:

1. Extended LWSC with a cut-in speed of 5.0 m/s at all turbines to year-round from sunset to sunrise.
2. Increased LWSC cut-in speed to 5.2 m/s through a 0.2 m/s hysteresis to increase the "down time" of the wind turbines, and reduce the number of stop/start events per night by extending the rolling average time from 10 to 20 minutes. Hysteresis is a LWSC regime that offsets the "cut-out" and "cut-in" speeds such that it will take a higher average wind speed (raised cut-in speed) for the turbines to return to operation after stopping due to LWSC. LWSC at the Project results in turbines being removed from service with feathering (blades rotated to a pitch of 82 degrees due mechanical specifications), resulting in a rotor speed of 1 revolution per minute or less. All Project turbines individually monitor wind speed using turbine-mounted anemometers, and are programmed to shut off when wind speeds are 5.0 m/s or lower and to start up again when wind speeds reach 5.2 m/s, thereby increasing the cut-in speed and extending the period during which collision risk for bats is minimized.

   Observations of bat behavior have identified risk factors to bats correlating with periods of low wind speed (Arnett et al. 2013b, Welling et al. 2018). Based on an experimental test of operational minimization treatments, Shirmacher et al. (2018) found that bats may be at risk of collision during operational transitions (i.e., during turbine start-up or shut-down). This risk was demonstrated by a significant increase in the probability of finding a fatality at turbines with increased wind turbine stops. Hysteresis is a method of reducing the number of start and stop events.

3. Kawailoa Wind will install bat deterrents at all 30 Project turbines in May and June 2019. For the purposes of take estimation, Kawailoa Wind assumes deterrents will be effective beginning FY 2020 (Section 6.3.7.4; Appendix 16).

On-going PCMM will be a key component to assess the effectiveness at reducing take of Kawailoa Wind's baseline minimization approach and to assess the effectiveness at reducing take of responses to adaptive management measures, if triggered. The mortality monitoring data is also expected to provide insights to spatial and temporal patterns of bat fatalities, to help refine minimization measures. However, fatality sample sizes have been, and will likely continue to be, insufficient to draw statistically meaningful correlations between minimization actions and mortality levels. Kawailoa Wind's PCMM program to document bird and bat fatalities is described in Section 8.2.1 and in Appendix 17. Section 8.3 identifies the adaptive management strategy for minimizing risk to bats, should the current measures identified above not have the intended effect of reducing bat take.

6B.2 Avoidance and Minimization Measures for the Hawaiian Petrel

The avoidance and minimization measures previously implemented for the Newell's shearwater also minimize risk to the Hawaiian petrel. These measures are described in detail in Section 5.3 of the approved HCP, and include: minimizing on-site lighting at buildings; implementing a Wildlife Education and Observation Program (WEOP) to reduce vehicle collision risk; and following Avian Power Line Interaction Committee (APLIC) guidelines for overhead collection lines.

6B.3 USFWS Guidelines

[This section was moved from its location as Section 5.3.1 in the approved HCP, but requires no edits for the HCP Amendment.]

7.0 MITIGATION MEASURES

7.1 Selection of Mitigation Measures

Compensatory mitigation for anticipated impacts to the Covered Species includes the following components for each mitigation measure identified below, consistent with USFWS ITP issuance criteria (USFWS and NMFS 2016) and HRS 195D-21 ITL issuance criteria:

- Identifying the biological goals and objectives (incremental steps taken to achieve the goals of the HCP as defined in Section 4) to lay the foundation for the conservation strategy;
- Defining the measures of success;
- Identifying monitoring that will demonstrate mitigation effectiveness based on the defined success criteria;
- Outlining adaptive management measures in case the planned mitigation needs to be adjusted.

In addition to the above requirements, this section describes how the mitigation will result in an overall net benefit to the Covered Species as required by the State of Hawaiʻi (HRS 195D) and fully offset the impacts of taking as specified by the ESA.

A summary of mitigation measures that will be carried out by Kawailoa Wind under this HCP Amendment is identified in Table 7-1. The estimated cost for each mitigation measure is presented in Appendix 8 of the approved HCP (Tiers 1 – 3) and Appendix 18 of this amendment (Tiers 4 – 6).

Table 7-1. Mitigation Measures for Requested Take of Hawaiian Petrel and Hawaiian Hoary Bat under the HCP Amendment.

Species	Mitigation Measures	
Hawaiian Petrel	Funding predator control and burrow monitoring for the Hawaiian petrel colony at Hanakāpīʻai and Hanakoa, or another Hawaiian petrel colony (Section 7.3.2).	
Hawaiian Hoary Bat	**Tier 4**	**Tiers 5 and 6**
	Contribution of $2,750,000 to The Trust for Public Land toward the acquisition and long-term protection of the Helemano Wilderness Area (Section, 7.6.3; Appendix 19).	Implementation of one or a combination of the following two options listed in order of priority as identified by Kawailoa Wind (Section 7.6.4): 1: Protection and Preservation of Habitat/Land Acquisition: Contribute funding to acquire property that will protect bat roosting and foraging habitat in perpetuity; or 2: Habitat Restoration/Land Management: Conduct bat habitat management/restoration to improve bat foraging and/or roosting habitat at the Central Koʻolau area, Helemano Wilderness Area, Waimea Native Forest, or similar site.

7.2 General Measures

[This section requires no edits for the HCP Amendment.]

7.3 Seabirds (Newell's Shearwater and Hawaiian Petrel)

[Section level heading modified to include the Hawaiian petrel.]

7.3.1 Newell's Shearwater

[Section 7.3.1 is identified in the HCP as Section 7.3.]

7.3.2 Hawaiian Petrel

The USFWS 5-year review for Hawaiian petrels (2017) provided guidance to identify appropriate mitigation measures anticipated to benefit the petrel including: 1) efforts to reduce fallout from light attraction and disorientation, 2) protection of known breeding colonies, and 3) development of efficient predator control methods (USFWS 2017). The 5-year review also recommended expanding knowledge of the species' population trend and distribution (USFWS 2017). Although providing mitigation for this species on Oʻahu would be preferred because this is where Project-related impacts would occur, this is not the most effective approach for Hawaiian petrel recovery because breeding colonies are not known on Oʻahu, and locating any breeding populations (if any exist) would take considerable effort and time. Combined with additional threats such as fallout potential due to heavy urbanization, this makes conservation efforts on a scale that is within the scope of the Project impractical on Oʻahu. Therefore, Kawailoa Wind's Hawaiian petrel mitigation will consist of funding monitoring and predator control of known seabird breeding colonies within the Hono O Nā Pali Natural Area Reserve (NAR) on Kauaʻi.

The Hono O Nā Pali NAR is a managed 3,579-acre reserve that contains rare plants, endemic stream invertebrates, and nesting forest birds and seabirds. Hanakāpīʻai and Hanakoa are two of six sites that are managed by DOFAW and the Kauaʻi Endangered Seabird Recovery Project (KESRP) as part of the Hono O Nā Pali NAR Seabird Mitigation Project. Funding for the predator control and burrow monitoring efforts at these two colonies runs out at the end of 2019. Therefore, Kawailoa Wind will fund predator control and burrow monitoring at Hanakāpīʻai and Hanakoa in 2020. The mitigation described below will contribute to the recovery goals for this species set forth under the Hawaiian Dark-Rumped Petrel and Newell's Manx Shearwater Recovery Plan (USFWS 1983) and will result in a net benefit to the species (see Section 7.3.2.2). The seabird breeding colonies within the Hono O Nā Pali NAR also have a small population of Newell's shearwater; therefore, the mitigation described below will also benefit this species.

7.3.2.1 Biological Goal and Objective

As stated in Section 4.0, the biological goal for the Hawaiian petrel for the HCP Amendment is to increase survival and successful fledgling of Hawaiian petrels at a known breeding colony or colonies. The biological objective is to reduce predation and increase reproductive success at the Hanakāpīʻai and Hanakoa seabird breeding colonies by funding a predator control program. The goal and objective for the Hawaiian petrel is in line with the overarching biological goals of the approved Kawailoa Wind HCP (2011), which are outlined in Section 4.0 of the HCP Amendment.

7.3.2.2 Mitigation Measures

To meet the biological goal and objective, Kawailoa Wind will fund predator control and burrow monitoring at the Hanakāpīʻai and Hanakoa seabird colonies within the Hono O Nā Pali NAR in 2020. Known predators to Hawaiian petrels at both colonies include feral cats, barn owls, rats, and feral honey bees. A summary of each colony's past monitoring efforts, as well as the efforts to be funded in 2020 is provided below to support the estimated take offset (Table 7-2).

Hanakāpīʻai

Hanakāpīʻai encompasses 138 acres of mid- to high-elevation terrain in northern Kauaʻi. It is in the center of the Hono o Nā Pali NAR and bordered on the east by the Hanakāpīʻai drainage and on the north by the Pohakea management site. The presence of a very large Hawaiian petrel colony was initially confirmed at Hanakāpīʻai in 2014 based on auditory surveys. KESRP began monitoring in 2015 and subsequently, DOFAW predator control began at Hanakāpīʻai in June 2016. A more comprehensive seabird monitoring and predator control program was initiated in 2017 by DOFAW and KESRP.

Monitoring completed to date indicates the predator control program has substantially increased Hawaiian petrel reproductive success at the site. At Hanakāpīʻai in 2015, prior to implementation of the predator control program, reproductive success of petrels at the site was 51.4 percent (Raine et al. 2018a). After the predator control program was initiated in 2016, reproductive success increased to 75.9 percent in 2016 and 84.1 percent in 2017. In 2017, 177 petrel burrows were monitored and 138 burrows were confirmed breeding. At least 116 Hawaiian petrel chicks fledged in 2017 (Raine et al. 2018a).

Hanakoa

The Hanakoa colony encompasses 58 acres and is located in the western portion of the Hono o Nā Pali NAR in a drainage adjacent to the Kalalau rim. The colony is adjacent to and southwest of Hanakāpīʻai. The site was first identified in 2015 as being a potentially large seabird colony. Auditory survey trips by KESRP in 2016 confirmed the existence of a large colony of Hawaiian petrels, as well as a breeding population of Newell's shearwaters. Predator control was initiated at Hanakoa in September 2016, with minimal survey work performed prior to that time. Similar to Hanakāpīʻai, a more comprehensive seabird monitoring and predator control program was initiated in 2017 by DOFAW and KESRP (Raine et al. 2018b).

The predator control implemented in 2016 may have improved the reproductive success at Hanakoa compared to prior to implementation of predator control. However, monitoring data are unavailable prior to 2016, and the predator control implemented may have had a limited influence on reproductive success given that it began in late September only a month and a half before the birds started fledging. Therefore, the reproductive success in 2016 effectively serves as an upwardly conservative baseline from which to measure the effect of predator control at Hanakoa (A. Raine/KESRP, pers. comm., September 2018). The reproductive success of confirmed breeding burrows at Hanakoa was 59.0 percent in 2016 and increased to 76.1 percent in 2017. In 2017, 89 petrel burrows were monitored by KESRP at Hanakoa and 78 burrows were confirmed breeding. At least 60 Hawaiian petrel chicks fledged in 2017 (Raine et al. 2018b).

Mitigation

Kawailoa Wind will provide designated mitigation funds, in the amount of approximately $392,800, to DOFAW and KESRP dedicated for predator control and burrow monitoring at Hanakāpīʻai and Hanakoa to offset the requested take. The mitigation cost was provided by KESRP and DOFAW to conduct predator control and burrow monitoring costs at Hanakāpīʻai and Hanakoa in 2020 (A. Raine/KESRP, pers. comm., August 31, 2018). A breakdown of estimated mitigation costs is provided in Appendix 18. The budgets are based on the predator control and burrow monitoring costs in 2017; however, costs were increased for the 2020 budget compared to 2017 to expand predator control efforts at Hanakāpīʻai and Hanakoa by implementing full Good Nature A24 Automatic Rat Trap grids across both sites. The expansion of the predator control efforts is expected to further increase reproductive success at both colonies by protecting more burrows; however, there is insufficient information available to quantify the amount of this increase.

Table 7-2. Projections of Hawaiian Petrel Burrow Monitoring and Number of Chicks Fledged in 2020

Hawaiian Petrel Breeding Colony	Hanakāpīʻai	Hanakoa	Total
Projected Number of Breeding Burrows in 2020			
Total Number of Known Burrows in 2017	177 [1]	89 [2]	266
Percent Confirmed Breeding in 2017	79.2% [1]	87.6% [2]	n/a
Projected Number of New Burrows since 2017 (assumes 20% increase from 2017)	35	18	53
Projected Number of Known Burrows in 2020	212	107	319
Projected Number of Confirmed Breeding Burrows in 2020	168	94	262
Estimated Increase in Chicks Fledged as a Result of Predator Control			
Baseline Reproductive Success (i.e., before predator control)	51.4% [1]	59.0% [2]	n/a
Reproductive Success With Predator Control in 2017	84.1% [1]	76.1% [2]	n/a
Baseline Number of Chicks Fledged Without Predator Control Using 2020 Confirmed Breeding Burrow Numbers	86	55	141
Projected Number of Chicks Fledged With Predator Control Using 2020 Confirmed Breeding Burrow Numbers	141	71	213
Estimated Increase in Number of Chicks Fledged Over Baseline	**55**	**16**	**71**
TOTAL CHICKS	**71**		
TOTAL ADULTS (assumes 30% of chicks survive to adulthood)	**21.3**		
1. Raine et al. 2018a 2. Raine et al. 2018b			

Mitigation funding will include predator control conducted by DOFAW (or a similar entity approved by USFWS and DOFAW) and burrow monitoring conducted by KESRP (or a similar entity approved by USFWS and DOFAW) at Hanakāpīʻai and Hanakoa in 2020. Specific activities to be implemented at the site include:

- Monitoring activity of nesting seabirds in Hanakāpīʻai and Hanakoa with cameras, song meters, and on the ground surveys. Metrics recorded will include: seabird call rates, number of burrows, reproductive success, number of fledglings, and number of depredation events.
- Monitoring predator activity in Hanakāpīʻai and Hanakoa with cameras, traps, and on the ground surveys.
- Implementing focused removal of predators (rats, feral cats, and feral pigs) surrounding nest sites within Hanakāpīʻai and Hanakoa. Rodents will be controlled by deploying and maintaining automatic resetting traps (A-24, Goodnature, NZ). Cat trapping will consist of cage traps and Conibears, and pigs will be removed using a combination of targeted trapping and shooting.
- Controlling non-native barn owls opportunistically by targeted shooting as well as trapping, particularly in areas of high seabird activity.

- Responding to outbreaks of seabird depredation with increased predator trapping across the entire NAR and at major predator ingress points into the NAR. While priority will be given to Hanakāpīʻai and Hanakoa, the funds provided by Kawailoa Wind will allow for carefully prioritized predator control in other areas in order to benefit seabirds in Hanakāpīʻai and Hanakoa.

Although the funds from Kawailoa Wind are intended to be used for calendar year 2020, if issuance of the ITP/ITL is delayed beyond 2020, Kawailoa Wind will provide the funds to DOFAW within 6 months of the issuance of the ITP/ITL.

7.3.2.3 Take Offset and Net Benefit

Kawailoa Wind will fund predator control and burrow monitoring at the Hanakāpīʻai and Hanakoa seabird colonies in 2020. It is expected that more Hawaiian petrel burrows will be monitored in 2020 compared to 2017 because:

1. New burrows are detected each year of monitoring; and
2. There are many unidentified procellarid burrows, many of which are likely to be Hawaiian petrel burrows, but have not yet been confirmed.

For the purposes of calculating take offset, an estimate of a 20 percent increase in Hawaiian petrel burrows is assumed for Hanakāpīʻai and Hanakoa in 2020 compared to 2017. This value represents a conservative approximation based on the rate of new burrow detection in 2017 (i.e., new burrows made up 32 percent and 50 percent of all known burrows at Hanakāpīʻai and Hanakoa, respectively, in 2017; Raine et al. 2018a, Raine et al. 2018b). The selected value is also conservative because definitive identification of previously unidentified procellarid burrows is expected to contribute to the number of "new" burrows. A total of 132 unidentified procellarid burrows were present in 2017 (79 at Hanakāpīʻai and 53 burrows at Hanakoa; Raine et al. 2018a, Raine et al. 2018b).

Assuming that there are 20 percent more Hawaiian petrel burrows monitored in 2020 compared to 2017, it is expected there would be 35 new burrows at Hanakāpīʻai (for a total of 212 monitored burrows) and 18 new burrows at Hanakoa (for a total of 107) (Table 7-2). Based on the proportion of burrows that were confirmed breeding in 2017 at Hanakāpīʻai (79.2 percent) and Hanakoa (87.6 percent) (Table 7-2), it is expected there would be 168 and 94 confirmed breeding burrows in 2020. Assuming that reproductive success of burrows confirmed to breed in 2017 is representative of 2020, at least 141 and 71 chicks are expected to fledge from Hanakāpīʻai and Hanakoa with an implemented predator control program. Thus, as shown in Table 7-2, predator control is anticipated to result in an increase of 71 chicks fledged between both sites (55 chicks [141-86] for Hanakāpīʻai and 16 chicks [71-55] for Hanakoa). If it is assumed that 30 percent of petrel fledglings survive to adulthood (Kaheawa Wind Power LLC 2006), Kawailoa Wind's mitigation in 2020 would produce 21.3 additional Hawaiian petrel adults (equivalent to 19 adults and 8 chicks).

Thus, based on previous monitoring data and expected increases to the numbers of burrows monitored as well as increases to predator control efforts, Kawailoa Wind's mitigation is expected to offset the 19 adult petrels and five chicks that are estimated to be taken during the remainder of the permit term (see Section 6.3.4 and Appendix 16). Although predator control efforts are aimed at increasing reproductive success because most predation at the colonies affects chicks, predator control also has the potential to have a positive impact on adult survival because adult petrels are sometimes preyed upon (Hodges and Nagata 2001). The effectiveness of predator control at the two colonies has been demonstrated by monitoring data which shows that reproductive success has increased at both colonies since predator control efforts were fully implemented. The combined experience of KESRP and NARS have been proven and vetted within the seabird and conservation community. The mitigation for the Hawaiian petrel is expected to fully offset the anticipated take, and provide a net conservation benefit by producing more petrels than are authorized to be taken by the Project, contributing to recovery of the species.

7.3.2.4 Measures of Success

Hawaiian petrel mitigation measures will be considered successful and Kawailoa Wind will be deemed to have fulfilled their mitigation requirements for the species if:

- Funding for predator control and burrow monitoring at the Hanakāpīʻai and Hanakoa colonies are provided to DOFAW within 6 months of issuance of ITP/ITL; and
- Burrow monitoring efforts indicate that the predator control program results in one more fledgling than required to compensate for the requested take. Fledglings accrued will be the net increase in fledglings in 2020 (or for the year Kawailoa Wind provides mitigation funds) based on the number of confirmed breeding burrows, over the estimated baseline reproductive success under unmanaged conditions (51.4 percent for Hanakāpīʻai and 59.0 percent for Hanakoa; Table 7-2). The estimated reproductive success for Hawaiian petrels at the sites in 2020 (or for the year Kawailoa Wind provides mitigation funds) will be based on burrow monitoring being conducted by KESRP (or a similar entity). External conditions may influence reproductive success at the colony. To account for uncertainty in external conditions that influence breeding success (food availability, climate conditions, or others), Kawailoa Wind will assess a minimum percent of reproductive success if reproductive rates are below the 2017 reproductive success numbers as identified in adaptive management.

7.3.2.5 Adaptive Management

If unanticipated circumstances make funding the Hanakāpīʻai and Hanakoa mitigation project infeasible, Kawailoa Wind will select another colony on Maui or Kauaʻi to supplement current management efforts, or fund a separate management project. Mitigation measures funded by Kawailoa Wind would address one or more of the major threats to the recovery of Hawaiian petrels: 1) introduced predators which prey on adults, eggs, and fledglings; 2) feral ungulates, mainly pigs, which degrade habitat and may trample burrows; and 3) artificial lighting, which may disorient fledglings and increase their risk of collision with artificial structures (Mitchell et al. 2005; USFWS 2016b). For the selected mitigation measures, Kawailoa Wind will work with USFWS and DOFAW to develop appropriate biological measures of success, should the objective of the mitigation measure differ from the mitigation at Hanakāpīʻai and Hanakoa described above.

Should reproductive success at Hanakāpīʻai and Hanakoa not fully offset the take of 19 adults and 5 chicks, Kawailoa Wind will initiate consultation with USFWS and DOFAW to implement additional mitigation commensurate with the remaining need for offset. Kawailoa Wind will provide designated mitigation funds to the USFWS's National Fish and Wildlife Foundation (NFWF) account to offset the remaining birds. The USFWS has created an account with the NFWF where funds for Hawaiian petrel mitigation can be deposited and then used accordingly for appropriate Hawaiian petrel conservation/management efforts. The overall intent is that pooled resources can be used to fund larger management projects in support of the recovery of the Hawaiian petrel than could have been supported through smaller scale, individual project funding contributions. Funds to NFWF could be dedicated for predator control and burrow monitoring at Hanakāpīʻai and Hanakoa in 2021 (or another year) or at additional colonies, but the specific use of the funds would be decided upon in consultation with USFWS and DOFAW.

The estimated benefit from the planned mitigation is 21.3 Hawaiian petrel adult equivalents. Should the net productivity be lower than anticipated due to external environmental factors (e.g., food availability, climate conditions), Kawailoa Wind will need to make a comparison to what would be expected had predator control not been conducted. For Hanakāpīʻai, this will be calculated as the average difference in reproductive success from baseline to managed site conditions (75.9 percent in 2016 + 84.1 percent in 2017 / 2 – 51.4 percent in 2015; Table 7-3). Therefore, Kawailoa Wind would still be credited a net productivity of 28.6 reproductive success (i.e., chicks fledged) for Hanakāpīʻai as the benefit provided by funding burrow monitoring and predator control. For Hanakoa, the net productivity credited would be calculated as the difference between the 2017 and 2016 percent reproductive success at the site, or 17.1 percent (76.1 percent in 2017 – 59.0 percent in 2016; Table 7-3); however, it is important to note that true baseline data are unavailable for Hanakoa given that the months of predator control conducted in 2016 potentially obscure the benefit provided by predator control at that colony. If the number of confirmed breeding burrows is equal to 2017 values, this would provide an equivalent of 12.0 Hawaiian petrel adults at Hanakāpīʻai and 3.9 Hawaiian petrel adults at Hanakoa.

Table 7-3. Reproductive Success at Hanakāpīʻai and Hanakoa by Year of Monitoring

Year	Hanakāpīʻai		Hanakoa	
	Reproductive Success	Predator Control	Reproductive Success	Predator Control
2015	51.4%	No	-	-
2016	75.9%	Yes	59.0%	Partial[1]
2017	84.1%	Yes	76.1%	Yes

1. Predator control was initiated in September near the end of the breeding season; Raine et al. 2018b.

7.4 Waterbirds (Hawaiian Duck, Hawaiian Stilt, Hawaiian Coot, and Hawaiian Moorhen)

[This section requires no edits for the HCP Amendment.]

7.5 Hawaiian Short-eared Owl

[This section requires no edits for the HCP Amendment.]

7.6 Hawaiian Hoary Bat

USFWS and DOFAW provided guidance for what is deemed appropriate Hawaiian hoary bat mitigation because of the incomplete information known about its limiting factors as described in Section 3.8.4. In 2011, when the HCP was approved, USFWS and DOFAW required that habitat restoration be provided as compensation for bat take. This requirement was applied to wind projects that typically have a 20-year permit term. Subsequent agency guidance, as presented in the ESRC Bat Guidance (DLNR 2015), determined an investment of approximately $50,000 per bat in land acquisition, habitat restoration, or research activities. The justification for this cost is provided in the ESRC guidance, but is based in part on habitat requirements for the Hawaiian hoary bat and costs of reforestation efforts conducted as bat mitigation under previously approved mitigation plans (DLNR 2015). On May 1 and 2, 2018, USFWS and DOFAW provided verbal guidance to Kawailoa Wind to apply the $50,000 per bat equivalency only for research projects. No new research projects are proposed as mitigation for the new Tiers 4-6 in the HCP Amendment.

The mitigation measures completed for authorized take at the Tier 1 to Tier 3 levels under the approved HCP and ITP/ITL are described below in addition the mitigation measures associated with the requested take for Tiers 4 through 6 in the HCP Amendment. For all tiers, on-site monitoring during Project operations will be used to determine the tier at which Hawaiian hoary bat take is occurring. Under the HCP Amendment, planning for the next tier of mitigation will be initiated when 75 percent of the estimated take in the current tier has been reached (using the 80 percent upper credible limit). As an example, it would take more than 2 years for the Tier 4 limit to be reached after hitting the Tier 5 mitigation planning trigger (86 bats, 29 more bats to reach Tier 4 limit of 115), even at the Tier 6 annual take rate of 11 bats per year (220/20=11). Therefore, assuming timely review and approval of any required mitigation measure, the implementation of mitigation actions will begin by the time the total take estimate reaches the next tier threshold.

7.6.1 Mitigation for Tier 1 Take

The wetland restoration/management measures described in the approved HCP continues to be implemented at ʻUkoʻa Wetland for Tier 1 Hawaiian hoary bat mitigation. This effort is being adaptively managed in coordination with USFWS and DLNR and includes:

- Acoustic monitoring for bats;
- Restoration of wetland habitat through the removal of invasive vegetation to promote improved foraging areas;
- The creation of bat lanes in adjacent forest areas to improve foraging and movement corridors;
- Insect sampling;
- Construction and maintenance of an ungulate fence; and
- Predator control within the fenced area.

As of December 31, 2017, the ungulate fence and removal of invasive vegetation from the open water area have been completed. Insect surveys were conducted in 2014 and 2015. Ultrasonic bat detectors were deployed from July to October 2015 and were re-deployed in late June 2017. A total of 16 bat lanes were created in 10 separate zones throughout the management area. Predator and ungulate control, as well as fence maintenance, are on-going.

7.6.1.1 Research on Bat Habitat Utilization and Bat Interactions at Kawailoa Wind

[This section requires no edits for the HCP Amendment.]

7.6.1.2 Implementation of Management Measures

[This section requires no edits for the HCP Amendment.]

7.6.2 Mitigation for Tier 2 and Tier 3 Take

[Section level heading modified for clarity.]

7.6.2.1 Additional Research at Kawailoa Wind

[This section requires no edits for the HCP Amendment.]

7.6.2.2 Additional Bat Mitigation Measures for Tier 2 and Tier 3

[Section level heading modified for clarity.]

Three ongoing research projects, totaling $1,626,298, continue to be funded by Kawailoa Wind as part of Tier 2/3 bat mitigation. The three research projects and a summary of their objectives and status are provided below.

1. Modeling foraging habitat suitability for the Hawaiian hoary bat (USGS) - $143,542

The objective of this study was to investigate the use of multi-state occupancy modeling to quantify foraging habitat use and suitability by Hawaiian hoary bats. All field work and analysis was completed by April 2018, and the results of the work were published in PLOS One in October 2018. The primary findings reported by Gorresen et al. (2018) include: 1) elevated levels of acoustic activity by Hawaiian hoary bats were found to be related primarily to beetle biomass, and 2) video-derived observations demonstrated higher and more accurate estimates of the prevalence of high bat flight activity and feeding events than acoustic sampling methods. Gorresen et al. (2018) concluded that multi-state occupancy modeling may be useful in future bat research, such as identifying habitat quality and foraging areas.

2. Hawaiian hoary bat conservation genetics (USGS) - $377,675

The objectives of the USGS conservation genetics study are to improve the understanding of the genetic diversity of the Hawaiian hoary bat, identify bat prey items, and identify the sex of bat carcasses and any sex-specific food habits. Data on these topics will help inform conservation planning and improve host-plant selection for future habitat restoration efforts. A Hawaiʻi Cooperative Studies Unit Technical Report was published in October 2018 (Pinzari and Bonaccorso 2018a) and USGS data were released in November 2018 (Pinzari and Bonaccorso 2018b). This research determined the sex of 88 Hawaiian hoary bat tissue samples using genotyping, which allows for more reliable evaluation of the ratio of males to females affected by collisions with wind turbines. The results of which indicate that 65% of observed fatalities at wind farms are male. As part of the research, DNA will be extracted from any new tissue samples from bats (as acquired), and sex determination of additional bat carcasses will continue.

3. Hawaiian hoary bat acoustic surveys (WEST) - $1,105,081

The goal of the WEST study is to examine the distribution and seasonal occupancy of the Hawaiian hoary bat on Oʻahu. The specific objectives for Year 1 of the multi-year study are to: 1) provide information on bat occupancy, distribution, and detection probabilities for O’ahu, 2) examine seasonal changes in distribution by estimating seasonal changes in occupancy, and 3) collect data that could be used later to assess habitat use relationships. The first year of data collection is complete. During Year 1 (June 2017 to June 2018), WEST recorded a total of 4,808 bat detections at 83 detectors deployed across the island (Starcevich et al. 2019). At least one Hawaiian hoary bat detection was recorded at 51 of the 83 detectors (61% of the sites), and the derived initial occupancy rate was estimated as 0.47 (SE = 0.12, 95% CI=[0.23-0.70]). Data collection and analysis will continue in Year 2, and analysis may incorporate habitat variables such as elevation, human population density, and percent forested habitat as predictors in the occupancy analysis to assess Hawaiian hoary bat habitat selection (Starcevich et al. 2019).

In addition to these three ongoing research projects, Kawailoa Wind previously provided $20,000 to WEST to conduct an occupancy power analysis study. This brings the total funded research to $1,646,298 of the $2 million mitigation obligation ($1 million per tier).

Funding the above-listed studies leaves an outstanding obligation of $353,702 under this tier. Based on USFWS and DOFAW guidance, there are no remaining research funding gaps for joint agency sub-committee approved projects (Glenn Metzler/DOFAW, pers. comm., August 2, 2017). To fulfill the remaining uncommitted funding obligation for Tier 3, Kawailoa Wind will contribute the remaining funds towards the purchase of the 3,716-acre Waimea Native Forest. The land will be acquired through a partnership with The Trust for Public Land (TPL) and DOFAW, as well as other funding partners. This mitigation aligns with current USFWS and DOFAW guidance which identifies land acquisition as an appropriate mitigation approach for the Hawaiian hoary bat (DLNR 2015). Additional details about the Waimea Native Forest are provided in Section 7.6.4.

7.6.3 Mitigation for Tier 4 Take

[New Section for the HCP Amendment.]

Tier 4 mitigation for the Hawaiian hoary bat is responsive to recovery goals identified in the Hawaiian hoary bat recovery plan (USFWS 1998), as well as agency guidance in the ESRC Bat Guidance (DLNR 2015) outlined in Section 7.6.4.1. In response to exceeding the permitted take of the approved HCP, Kawailoa Wind initiated planning and implementation of Tier 4 mitigation in coordination with USFWS and DOFAW. Relevant information on the Tier 4 mitigation is provided here, with greater detail provided in Appendix 19.

The protection and preservation of land on Oʻahu known to be occupied by bats through land acquisition has a high likelihood of contributing to the recovery of the species. Habitat loss is likely to impact the carrying capacity for the island of Oʻahu. Development is one of the greatest sources of habitat loss, and from the time of ESA listing of the Hawaiian hoary bat, the resident population of Oʻahu has increased from 630,528 people in 1970 to 953,207 people in 2010 and is likely to continue to increase (U.S. Census 1970, 2010). In addition to development, forests are threatened with degradation through non-native weed species such as strawberry guava (*Psidium cattleyanum*) which form monotypic stands that have not been documented to be utilized by the Hawaiian hoary bat. Non-native ungulates also cause damage to mature trees and decrease or destroy the regeneration of mature forest suitable for roosting habitat for the Hawaiian hoary bat.

The available literature identifies general habitat needs for the Hawaiian hoary bat but specific habitat requirements and management actions known to benefit the bat are more limited (Gorresen et al. 2013, Bonnacorso et al. 2015). Therefore, the protection of existing habitat is the most direct means of providing a benefit to the Hawaiian hoary bat. Kawailoa Wind's bat mitigation for Tier 4 take consists of contributing to the purchase and protection of the Helemano Wilderness Area (HWA) as described below.

7.6.3.1 Biological Objective

The biological objective of the Tier 4 bat mitigation is to protect and preserve, in perpetuity, bat roosting and foraging habitat that would otherwise be threatened with degradation or developed. This objective is in line with the overarching biological goals of the approved Kawailoa Wind HCP (2011) and the HCP Amendment, which are outlined in Section 4.0.

7.6.3.2 Mitigation Measures

Kawailoa Wind contributed $2,750,000 to TPL toward the purchase of the nearly 2,900-acre HWA. The HWA encompasses four parcels located in Central Oʻahu approximately 3 miles from the Project (Figure 7-1). Funds provided by Kawailoa Wind, in combination with funding commitments from six other partners including federal and state partners provided TPL with sufficient secure funding to purchase the four HWA parcels in 2018. No other funding partners seek mitigation credit. Kawailoa Wind derives the Tier 4 mitigation from a portion of the HWA acquisition; however, the funding provided by Kawailoa Wind enables the acquisition and protection of the entire HWA.

Originally, the HWA was 3,056 acres. While in negotiation for the HCP Amendment, the acreage changed because Dole subdivided part of TMK 6-4-004:001, the remainder of which is now TMK 6-4-004:011. As a result, the current HWA is 2,882 acres, a subset of which Kawailoa Wind is counting toward mitigation credit (Section 7.6.3.3). This division demonstrates that the threat of development is real and imminent for these parcels. HWA includes significant tracts of native forest habitat within documented range of the Hawaiian hoary bat that are at risk due to the encroachment of invasive plant and animal species and potential anthropogenic activities (e.g., residential development; Figure 7-2; Appendix 19). The HWA also includes non-forested fallow agricultural areas (Appendix 19). The mix of forested lands and fallow agricultural lands is anticipated to provide both foraging and roosting habitat for the Hawaiian hoary bat.

A number of monitoring efforts have shown that there is bat activity surrounding the HWA, and it is likely the HWA area itself is occupied by hoary bats. In 2014 and 2015, bat detectors placed by the Army approximately 0.5 miles west, 0.8 miles north, and 1.1 miles south of the HWA detected measurable bat activity, as did a detector placed by Tetra Tech for 2 months in 2014 roughly 2 to 3 miles east of the HWA at the Poamoho Trail summit. In addition to detections to the immediate north, south, east, and west of the HWA, Army surveys detected bat populations about 5 miles to the west, in agricultural lands across from the HWA. Thus, the HWA is surrounded by bat activity, and there is a high likelihood that the HWA itself is occupied by Hawaiian hoary bats. Acoustic bat activity detected throughout the northern Koʻolau Mountains also provides strong support for this assumption (Gorresen et al. 2015). It is likely that the contiguous tracks of mixed forest habitat in the HWA and current lack of development in this region supports movements of bats between Central Oʻahu and the North Shore along the major forested parcels on the Koʻolau mountain range.

Following purchase of the lands by TPL in the fall of 2018, the land was transferred to DOFAW and will be managed for multiple uses, including for the benefit of the Hawaiian hoary bat. As one of the conditions of ownership, DOFAW will develop and implement a long-term management strategy to protect and maintain existing habitat and restore and improve degraded habitat. Research will be incorporated into the overall management plan for the area that will focus on identifying optimal habitat or limiting factors for the Hawaiian hoary bat. The land deed will include the requirement that HWA will be managed in perpetuity for the protection of habitat and conservation of listed endangered species including the Hawaiian hoary bat, 20 species of listed plants, and other rare species as per the funding awards. USFWS will be consulted during the development of the multi-resource management plan to ensure the forest management activities will consider impacts to listed species.

DOFAW’s management strategy has not been finalized at this time. Management activities are expected to vary among the parcels based on the objectives and management needs of each specific area, but are expected to include activities such as (Marigold Zoll/DOFAW, pers. comm., May 2018):

- Control of feral ungulates, rodents, and invasive plant species;
- Control of erosion throughout plantings and other methods;
- Confining of hiking to designated trails;
- Confining of camping to areas along designated trails;
- Limitation of forestry harvesting activities to hazardous tree mitigation; and
- Reforestation with native and non-invasive hardwood tree species.

Additional details on HWA and the proposed management are included in Appendix 19.

The Tier 4 mitigation aligns with current USFWS and DLNR guidance for land acquisition as mitigation for impacts to Hawaiian hoary bats (DLNR 2015), as described below:

1. The acquired parcels provide protection for lands threatened with development and disturbance by non-native species;
2. The acquired parcels are primarily intact habitats, but also include portions of degraded land suitable for restoration;

3. The conditions of land acquisition include management to be funded and implemented by DOFAW (described in Appendix 19);
4. Restoration efforts to be implemented in the acquired parcels are focused on restoring native habitats to provide net environmental benefits (benefits to other species through the habitat protection);
5. The acquired parcels create a single large tract and are adjacent to nearby habitat as documented through acoustic surveys;
6. The acquired parcels are protected in perpetuity; and
7. Land acquisition occurs on the same island as take occurs, but not in close proximity to the Project.

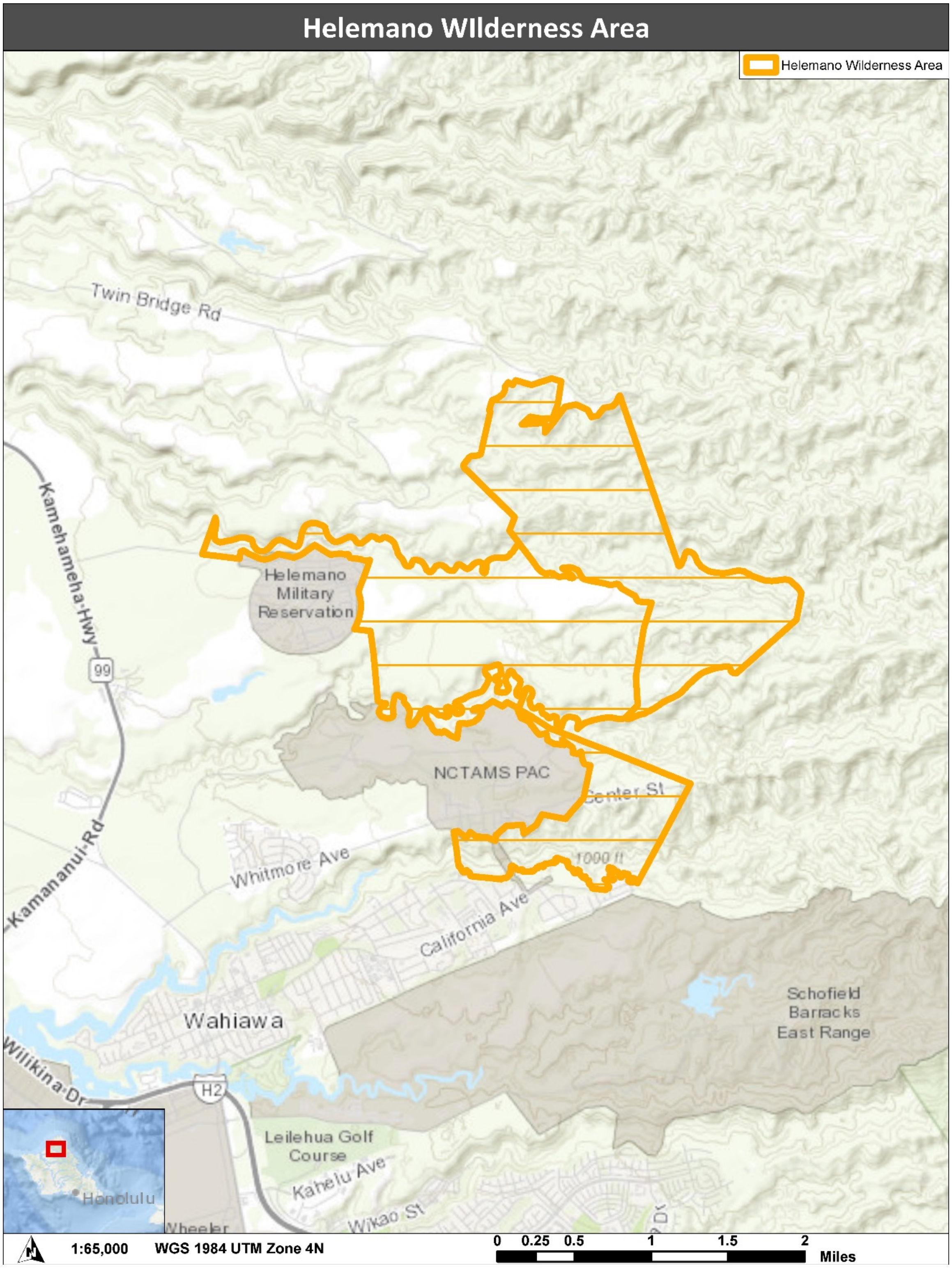


Figure 7-1. Location of the HWA

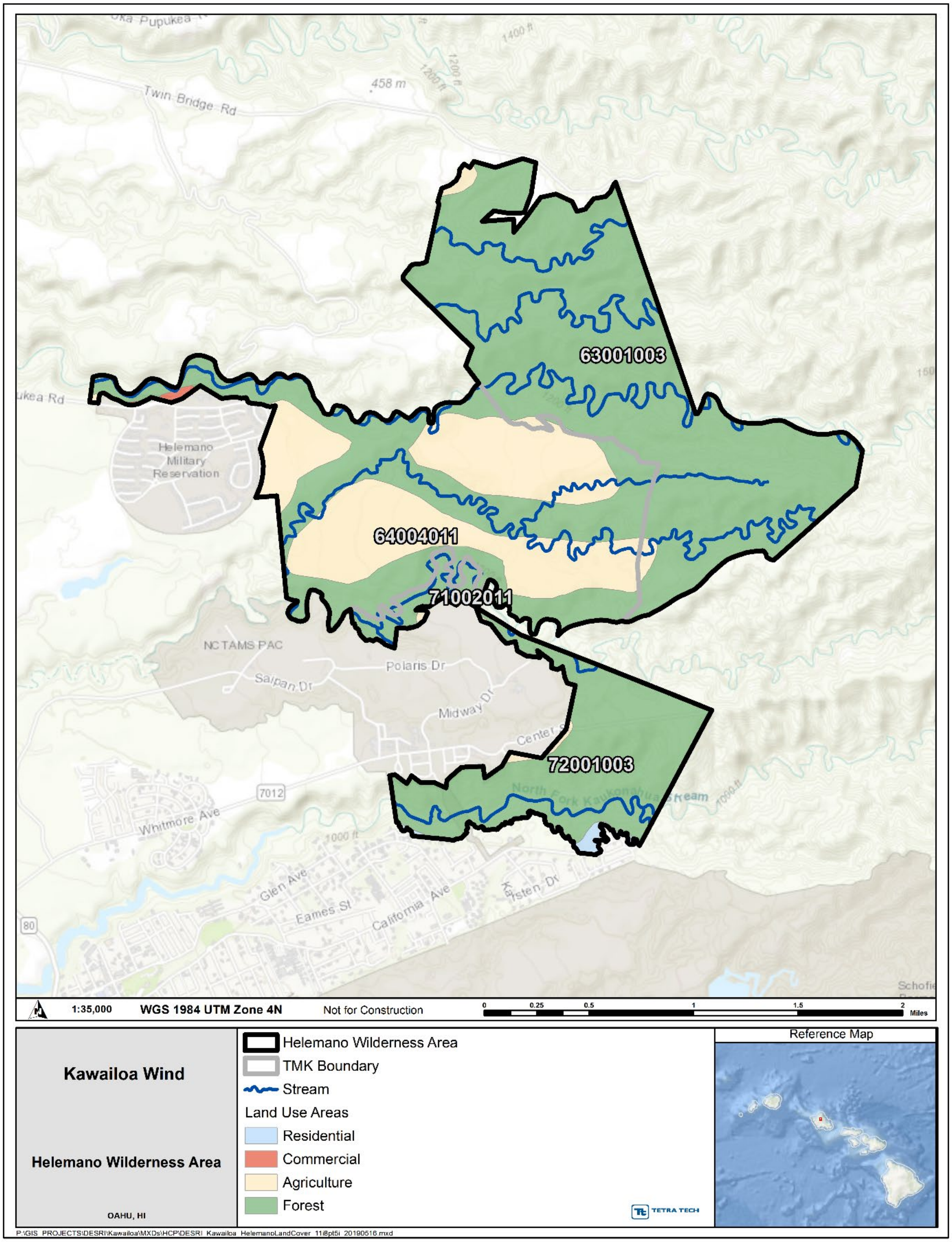


Figure 7-2. Land Use and Land Cover within the HWA.

7.6.3.3 Take Offset and Net Benefit

The mitigation will fully offset the take of Hawaiian hoary bats for Tier 4 and provide a net benefit. Kawailoa Wind proposes to derive the Tier 4 mitigation from only a portion of the HWA; however, the funding provided by Kawailoa Wind enables the acquisition and protection of the entire HWA. Conservation of the HWA ensures protection of Hawaiian hoary bat habitat from future development and meets the USFWS and DLNR long-term conservation goals including the enhancement and connectivity of important conservation areas. These actions benefit bats beyond the term of the ITP/ITL by providing native forest roosting and foraging habitat in perpetuity, thereby providing a net benefit to the species. Protection of HWA also provides DOFAW with a unique opportunity to conduct habitat management on a large scale to assess the effectiveness of various approaches in recovering bat populations.

The mitigation credit originally assessed for the HWA acquisition was based on a funding amount of $50,000 per bat, in accordance with DOFAW guidance at the time. Because of changes to USFWS and DOFAW guidance, updates were made to the HCP Amendment in 2018 to also demonstrate the biological value of the mitigation to the Hawaiian hoary bat by assessing mitigation credit on an acreage-per-bat basis. Based on the median CUA for the Hawaiian hoary bat (20.3 acres per bat [DLNR 2015]), a total of 1,116.5 acres would be required to offset the take of 55 bats (1,116.5 acres / 20.3 acres per bat = 55 bats). There are 1,614 acres of native and mixed forest land that may be used to calculate take offset this equates to a mitigation credit of at least 55 bats. The details of the applicable acreage and funding are described in Appendix 19.

Additionally, preservation of 20.3 acres per bat as mitigation is relatively conservative based on a variety of parameters and as previously identified above. The bat habitat in the mitigation area will be protected in perpetuity, for multiple generations of bats. A minimum of two generations of bats would be expected to benefit from the protection of HWA within the remainder of the permit term. Therefore, the range of mitigation offset provided by HWA could range between 55 to 150 bats over the remaining life of the permit. The impact of productivity and future generations aid in benefit assessment of the mitigation. With the addition of future generations, there is a clear net benefit to the Hawaiian hoary bat from the protection of the HWA parcels as Tier 4 mitigation.

Acquisition of the HWA ensures protection of Hawaiian hoary bat habitat from future development, meeting USFWS and DLNR long-term conservation goals described in the ESRC Bat guidance (DLNR 2015), the Hawaiian hoary bat recovery plan (USFWS 1998), and the USFWS 5-year review (USFWS 2011). Protection of HWA also enhances the connectivity of important conservation areas. These actions benefit bats beyond the term of the ITP/ITL by providing native forest roosting and foraging habitat in perpetuity, thereby providing a net benefit to the species. Protection of this area also provides a unique opportunity to conduct habitat management on a large scale to measure the effectiveness of various approaches in recovering bat populations.

Based on the above discussion, the Tier 4 mitigation fully offsets the take of the 55 bats in Tier 4 and provides a net benefit to the species as outlined in HRS 195D. Agency concurrence on the approach to determining the offset of Tier 4 mitigation, including the biological rationale, is provided in letters from USFWS and DOFAW dated 26 September 2018 and 21 September 2018, respectively. In accordance with HRS 195D-21, the mitigation provides certainty that the ecosystems and habitat types that support the Hawaiian hoary bat will be maintained for the life of the plan. Additionally, the Project impacts will last only for the permit term, while the benefits of acquiring the HWA will be in perpetuity.

7.6.3.4 Measures of Success

Measures of success for Tier 4 are derived from the protection of land that would otherwise be threatened with destruction or degradation. The benefit of the mitigation is realized upon completion of the acquisition, application of deed restrictions, and the transfer of parcel ownership to DOFAW.

The mitigation will be deemed successful if:

- Kawailoa Wind provides funding of $2,750,000 to TPL to be used towards the purchase of the HWA;
- The transfer of the parcels will include a requirement that the HWA will be managed in perpetuity for the protection of habitat and conservation of listed endangered species including the Hawaiian hoary bat; and
- TPL secures the ownership of the HWA, and transfers ownership to DOFAW or equivalent entity who will then have responsibility for management and oversight of the parcels by the time of ITP/ITL issuance.

Kawailoa Wind will work with DOFAW to obtain their annual reports on the monitoring and management efforts at HWA, and to provide a summary of these efforts within the project annual reports submitted to USFWS and DOFAW.

7.6.4 Mitigation for Tier 5 and Tier 6 Take

[New Section for the HCP Amendment.]

Mitigation for the Hawaiian hoary bat for Tiers 5 and 6 is responsive to the goals identified in the HCP Amendment, Hawaiian hoary bat recovery plan (USFWS 1998), agency guidance described in the ESRC Bat Guidance (DLNR 2015), conservation and management priorities identified by the agencies, and any information available on the species' limiting factors. Should either Tier be reached, mitigation will consist of one or both of the following: land protection/preservation of habitat (i.e., easement or acquisition) and habitat restoration/land management. Mitigation measures under Tiers 5 and 6 may occur much later in the permit term, or may never occur; therefore, while anticipated mitigation for Tiers 5 and 6 are described below, the most appropriate mitigation option will be selected in consultation with USFWS and DOFAW at the time mitigation planning is triggered. This approach allows Kawailoa Wind to describe the preferred mitigation based on current information for the purposes of this HCP Amendment, while leveraging information that will be learned from ongoing Hawaiian hoary bat research projects that address some of the existing information gaps, best available science, and current USFWS and DOFAW guidance. Adaptive management is identified as a strategy to address the uncertainty due to current information and data gaps (per the USFWS HCP handbook). A detailed site-specific mitigation implementation plan (SSMIP) will be developed at the time each tier is triggered, and the plan will be reviewed and approved by USFWS and DOFAW prior to implementation.

Kawailoa Wind will ensure adequate funding is available for the current tier of take that the Project is in and for the next tier of take before it is reached. See Appendix 18 and Section 8.4 for a discussion of funding assurances.

As identified in Section 6.3.7, consistent with USFWS guidance, planning for implementation of Tier 5 or Tier 6 mitigation will occur when 75 percent of the authorized take under the current tier is reached (USFWS 2016). Table 7-4 identifies the triggers for mitigation planning.

Table 7-4. Triggers for Planning for Future Tiers of Mitigation

Mitigation Tier	Mitigation Planning Trigger	
	Description	Cumulative Take Estimate[1]
Planning for Tier 5 Mitigation	75% of Tier 4 authorized take limit	86 bats
Planning for Tier 6 Mitigation	75% of Tier 5 authorized take limit	150 bats
1. Take represents the cumulative take including prior tiers.		

The following subsections describe the selection criteria for determining the type of Tier 5 and 6 mitigation measures that would be developed should a tier be triggered as well as biological objectives, measures of success, monitoring (as applicable), and adaptive management that would be applied to such measures. Within 6 months after reaching the tier trigger, Kawailoa Wind will submit a SSMIP to USFWS and DOFAW for the next tier of mitigation (see Adaptive Management for more details), which includes the plan area, the mitigation actions, measures of success, monitoring, how the mitigation will offset take, and cost estimates. This should provide sufficient time for comment and feedback necessary for such a plan to be approved by USFWS and DOFAW, given the anticipated 2-year lead time between triggering and exceeding the current tier take limit.

7.6.4.1 Mitigation Options and Prioritization

Kawailoa Wind will identify a mitigation project from the options identified as priorities by the USFWS and DOFAW. These options currently include the following, listed in order of priority as identified by Kawailoa Wind:

1. Habitat Restoration/Land Management: Land management actions taken to restore degraded bat habitat.
2. Protection and Preservation of Habitat: Protection and preservation of existing habitat through; acquisition, easement, or other legal conservation instrument.

Habitat Restoration/Land Management

Biological Objective

The biological objective of habitat restoration or land management as mitigation is to 1) restore habitat that is considered low quality for the Hawaiian hoary bat to a condition that would promote survival, such as increased foraging resources, and/ or to 2) prevent the degradation of habitat that would otherwise decrease or eliminate its suitability as bat habitat. This objective is in line with the overarching biological goals of the approved HCP (2011) and the HCP Amendment (see Section 4.0), as well as the bat recovery plan (USFWS 1998).

Mitigation Approach and Selection Criteria

The restoration/management of low quality habitat has the potential to increase the carrying capacity of Hawaiian hoary bats on Oʻahu. As described in the Section 3.8.4.4, the abundance of the Hawaiian hoary bat is associated with insect abundance (Gorresen et al. 2018). Habitat factors have been identified which are positively correlated with Hawaiian hoary bat utilization or occupancy. Invasive species pose a threat to forest regeneration (see above). Bats have been identified to use water features and wetlands, edge habitats, and mature forests (Tuttle et al. 2006, Kawailoa Annual Report 2017, Jantzen 2012, Gorresen et al. 2013, Bonnacorso et al. 2015). Removal of threats and creation of suitable habitat is expected to provide benefits to the Hawaiian hoary bat. Throughout Oʻahu, a wide variety of degraded habitats exist that could be restored to benefit the Hawaiian hoary bat.

Should habitat restoration/management be identified for future tiers, Kawailoa Wind will conduct or fund appropriate bat habitat restoration/management from the options identified below, listed in order of priority as identified by Kawailoa Wind. To mitigate for 85 bats in Tier 5, Kawailoa Wind would target a 1,725-acre area to fund management activities, a 406-acre area would be targeted for Tier 6. The options are prioritized to consider the level of information known about the potential mitigation parcels; however, the timing in which mitigation is triggered will impact the selection of mitigation options.

1. Central Koʻolau Riparian Restoration. This area is located in central Oʻahu within the upper portions ahupuaʻa from Waiawa to Kahauiki in the parcels managed by the Koʻolau Mountain Watershed Partnership (KMWP). The area encompasses approximately 12,000 acres, from which specific restoration areas can be selected. The elevation range of the site is between 110 feet and 1,700 feet. Major landowners within the management area include DLNR, Kamehamea Schools, and the Queen Emma Foundation. The parcel owners are currently participating partners in the Ko'olau Mountain Watershed Partnership (KMWP).

   Habitat types in the area transitions from upland dry-forest to mesic forest in the upland regions, to streams and gulches. The forest structure is highly degraded and tends to be dominated by a monotypic stand of haole koa (*Leucaena leucocephala*) with guinea grass (*Megathyrsus maximus*) understory (JC Watson/KMWP, pers. comm., April 16, 2019). Impermeable forest habitats deter bat foraging at lower altitudes (Ober and Hayes 2008). Ten main streams with numerous tributaries occur within the area. The streams vary in size from intermittent streams to regular streams with flow in all months.

   The Hawaiian hoary bat has been documented to have low levels of acoustic activity within the management area (Starcevich et al. 2019, Bonaccorso et al. 2019). Acoustic monitoring that has occurred at ʻEwa Forest, Radar Hill Road, Fort Shafter, and Tripler Medical Center have documented bat occurrence ranging from 0-6 percent of detector-nights. The low level of bat detections in this area indicates habitats of low suitability for bats.

   In evaluating pertinent management actions in this parcel to benefit bats, Kawailoa Wind looked at the habitat characteristics known to influence bat activity is known to target management actions for this area. Kawailoa Wind has identified several management actions that could be implemented to improve the habitat quality and provide suitable foraging habitat for the Hawaiian hoary bat.

   a. The existing closed canopy, monotypic non-native forest would be restored to a diverse native forest along riparian buffers.

   b. To maintain riparian habitat, ground cover, native shrubs, or native trees would be planted to create open water ways and foraging access in riparian areas.

   c. Monitoring would be implemented to determine the effects on bats, insects, and vegetation.

2. HWA. DOFAW's long-term management strategy to restore and improve degraded or low value bat habitat within portions of the 2,882-acre HWA is in development (as described in Section 7.6.3.2 and Appendix 19). Management activities expected to occur at HWA that would benefit bats include: fencing portions of the parcel; control of feral ungulates, rodents, and invasive plant species; control of erosion throughout plantings and other methods; and reforestation with native and non-invasive hardwood tree species. DOFAW has expressed interest in financial assistance to manage and restore habitat at HWA (Marigold Zoll/DOFAW, pers. comm., May 2018). Funds would be provided to DOFAW to restore habitat or prevent the

degradation of habitat. This funding would complement the Project's Tier 4 mitigation at HWA which assumed credit for acquiring only a portion of the HWA (1,116 acres of suitable bat habitat). Kawailoa Wind could mitigate for one tier, and/or a portion of both tiers but the full mitigation for both tiers would not be appropriate for the remaining lands in HWA. If mitigation were to occur at HWA, it would be distinct from credit provided for Tier 4 mitigation and contingent on agency approval.

3. Waimea Native Forest. As described in Section 7.6.2.2, Kawailoa Wind would contribute funds towards the purchase of the 3,716-acre Waimea Native Forest as part of Tier 3 mitigation. Once the acquisition is complete, DOFAW will develop a long-term management strategy to restore and improve habitat at the Waimea Native Forest. The long-term management of the Waimea Native Forest would involve a variety of measures designed to benefit the Hawaiian hoary bat, as well as many other threatened and endangered species. Management activities will vary within the parcel, but activities expected to occur at Waimea Native Forest that would benefit bats include: fencing portions of the parcel; controlling invasive species as feral ungulates, plants, and other species; and planting native trees and plants. DOFAW has expressed interest in assistance to manage and restore habitat at Waimea Native Forest (Marigold Zoll/DOFAW, pers. comm., May 2018). Funds would be provided to DOFAW to restore habitat or prevent the degradation of habitat.

4. Alternative Parcel. If conducting or funding appropriate bat habitat management/restoration at the sites identified above is not feasible, Kawailoa Wind would work with DOFAW and USFWS to identify an alternative parcel on Oʻahu to conduct or fund bat habitat management/restoration as part of Tier 5 and/or 6 mitigation. Management actions implemented at an alternative parcel would likely include activities similar to those proposed at the sites identified above, such as fencing to keep out ungulates, ungulate removal, removal of invasive plants, restoration of water features, and plantings of non-invasive vegetation for roosting or promoting insect prey for the Hawaiian hoary bat. Should this option be chosen, Kawailoa Wind would work with DOFAW and USFWS to develop a SSMIP to restore habitat for the benefit of the Hawaiian hoary bat.

If a habitat restoration or management mitigation measures for an alternate parcel is considered, selection criteria will include the following:

- The mitigation parcel is located on Oʻahu.
- The mitigation parcel avoids proximity to the Project area.
- A minimum of 20.3 acres will be used to offset one Hawaiian hoary bat, based on the median bat CUA identified from data by Bonaccorso et al. (2015) and Tier 4 USFWS and DOFAW letters (DOFAW 2018, USFWS 2018b).
- Restoration efforts will focus on restoring native habitats to provide net environmental benefits.
- Habitat management projects will also serve as research projects to understand how the management results in an increase in bat activity.

The detailed SSMIP, submitted for approval by USFWS and DOFAW within 6 months after reaching the tier trigger, will incorporate the best available science related to bat habitat requirements and will be tailored to the specific management needs of the parcel. As such, the plan may include refinements to the biological objectives, success criteria, monitoring requirements, through adaptive management. The SSMIP for the habitat restoration/management option will include the following information:

- Site-specific biological goals and objectives (if different or more detailed from the goals and objectives outlined above);
- Site-specific measures of success and a monitoring/evaluation program to determine the progress of meeting success criteria (if different or more detailed from the goals and objectives outlined above);
- Site feasibility information such as monitoring data if appropriate, to explain clearly why the site is suitable for bat habitat restoration, or necessary for bat survival and recovery, based on best available information;
- A project budget, including funding for a monitoring program; and
- Sufficient draft funding assurances to cover the mitigation plan, including funding to respond to adaptive management.

Take Offset and Net Benefit

As indicated in Section 7.6.3.3, the protection and management of a minimum of 20.3 acres will offset the take of one bat adjusted based on the suitability of the habitat and generation of bats over the permit term. Implementing habitat restoration or land management at the sites described above is anticipated to restore habitat to a condition beneficial to bats as determined by the best scientific literature and/or agency guidance. The proposed restoration actions within a 1,725-acre area (Tier 5, 85 bats *20.3 acres per bat) and 406-acre area (Tier 6, 20 bats * 20.3 acres per bat) would improve roosting and foraging habitat for bats by increasing forested areas for roosting and increasing edge habitats for foraging. Furthermore, the management proposed at the sites described above will focus on restoring native habitats to provide net environmental benefits.

The actions outlined above increase the Hawaiian hoary bat habitat on Oʻahu, thereby increasing the carrying capacity of the island and creating new CUAs which can be occupied by additional bats. This provides a net benefit to the species and is anticipated to fully offset take within Tiers 5 and 6.

Measures of Success

Measures of success for the habitat restoration mitigation option are derived from proxy measurements of population, such as habitat equivalency, as the current tools for monitoring the abundance of the Hawaiian hoary bat are limited. Acoustic monitoring is the most common tool to document occurrence of bats; however, acoustic monitoring can only record calls which indicate a local presence, but does not provide a measure of abundance (counts of individuals) or population changes. Gorresen et al. (2017) have shown that a bat may traverse acoustic detectors without calling, thereby causing underestimation of bat activity in the monitored area. The suitability of other methods for monitoring bats (thermography, radio tracking, and mark-recapture) is also limited by the behavior and biology of the Hawaiian hoary bat. Therefore, while measures of bat activity such as acoustic monitoring are useful tools, assessment of habitat is therefore the most appropriate measure for success criteria for mitigation offset through habitat equivalency. Thus, the measures of success provided below are drawn from a combination of available scientific literature and agency guidance, with these limitations in mind.

The SSMIP will include one or more measures such as:

- Verification of implementation of ungulate control and/or control of invasive plants that inhibit generation or re-generation of trees that support roosting and feeding habitat;

- Habitat improvement for bats (e.g., canopy cover, invasive vegetative species presence, or other measures) will be measured over an established baseline condition and result in an increase of bat roosting or foraging habitat;
- Verification that fencing is installed and maintained;
- Verification that ungulates are removed;
- Insect biomass, abundance, or diversity has increased to enhance food availability; and
- Acoustic monitoring documents an increase in bat activity.[3]

Monitoring

Monitoring is a critical component both for assessing compliance with success criteria and to gain valuable insight into the response of the Hawaiian hoary bat to management actions. To the extent practicable, the monitoring incorporate Before/After, Control/Impact design so that the response can be measured. Additionally, the analysis will incorporate a power analysis so that the scale of responses can be assessed.

Monitoring will be conducted to establish baseline conditions and evaluate compliance. Baseline monitoring will be conducted prior to implementation of management actions to determine the relative abundance, seasonality, and expected statistical power. Following the implementation of restoration/land management mitigation activities, effectiveness monitoring will be conducted in restored or managed habitats. Monitoring of restored/managed habitats will be specified in the SSMIP and may include, but are not limited to the following:

- Periodic acoustic monitoring throughout the duration of the mitigation project.
    - Acoustic monitoring locations will be established at the site. Baseline monitoring will be conducted to compare to post-management actions results;
    - Acoustic monitoring will occur in Year 0 (baseline), as well as Years 1, 2, 3, 5, and 10 following implementation of management actions;
- Periodic insect monitoring will be conducted to determine the response to changes in habitat and correlate biomass with bat activity;
- Measures of canopy cover are recorded by survey, or GIS analysis;
- Initial confirmation that any restoration areas were planted or managed using an appropriate species mix, spacing, site preparation, or other bat-focused management activities as determined in collaboration with USFWS and DOFAW and outlined in the mitigation plan.
- Monitoring periodically over the life of the permit such as providing a report from the land managing agency confirming that mitigation requirements are being met (i.e., trees have been planted and survived); and
- Monitoring periodically for invasive species. Should any invasive species that threaten the function of the mitigation for Hawaiian hoary bat habitat be present, maintenance would be implemented.

[3] Acoustic monitoring for bat activity has limitations and habitat alterations may improve the suitability for bats but correlate with a decrease in acoustic activity such as larger prey items, or a transition from foraging to roosting habitat. The SSMIP will detail the means which acoustic monitoring is incorporated.

Adaptive Management

At the time that Tier 5 or Tier 6 mitigation is triggered, and habitat restoration/management is the selected mitigation option, Kawailoa Wind will consider current agency guidance and new information available on Hawaiian hoary bat life history requirements and ecology. This approach will allow Kawailoa Wind to leverage available information derived from 1) ongoing Hawaiian hoary bat research projects (anticipated to be completed by 2020 or sooner) which address some of the existing information gaps and are expected to identify management actions that will improve the survival and/or productivity of the Hawaiian hoary bat, and 2) subsequent studies that may be available at the time.

For the Tiers 5 and 6 restoration/land management option, adaptive management of SSMIP development will occur if:

1. New information is obtained about the Hawaiian hoary bat. This new information may alter the following:
    a. The selection criteria may be revised to change the priorities for parcel selection.
    b. The management actions may change to remove actions identified or add new mitigation actions.
    c. The monitoring methods or evaluation may be revised to incorporate new information.
    d. The biological information suggests new information regarding the offset of Hawaiian hoary bats.
2. New information is obtained that changes the success criteria put into the SSMIP. If restoration/land management efforts fail to meet the success criteria set forth above, Kawailoa Wind, would implement adaptive management to take corrective actions, based on recommendations from USFWS and DOFAW.
3. New information suggests that the mitigation project does not achieve the intended biological objectives outlined above. If habitat restoration/land management at the sites identified would not meet the biological objectives outlined above or is deemed inappropriate at the time the tier is triggered, Kawailoa Wind would coordinate with USFWS and DOFAW to identify another appropriate parcel for habitat restoration/management.

The implementation of the SSMIP will also incorporate adaptive management. The success of land restoration and management actions are dependent on the land selected for mitigation; the management actions selected for mitigation; the intensity, frequency, and scale of the actions; as well as adaptive management responses. Therefore, the success criteria and adaptive management responses for a management action will be refined and built into the SSMIP at the time it is developed. Adaptive management for restoration/management-based mitigation will ensure that mitigation activities are working as intended and offsetting the impact of the take, based on the results of monitoring:

- Interim success criteria would be developed to ensure that the long-term success criteria are met;
- If restoration/land-management efforts fail to meet the success criteria set forth in the SSMIP, corrective actions would be taken, based on the results of monitoring, such as:
    - Increase the intensity or extent of the current management actions, such as increasing the number of trees planted;

  - Increase the diversity of management actions, such as changing canopy or understory species;
  - Alter the management actions implemented, such as moving from reforestation to other limiting factors identified by research; and
  - Other actions based on the best available science and technological advances, and/or recommendations from USFWS and DOFAW, at that time.

Protection and Preservation of Habitat (Land Acquisition)

Biological Objective

The biological objective of habitat protection and preservation as mitigation is to protect and preserve, in perpetuity, bat roosting and/ or foraging habitat that would otherwise be threatened with degradation or development. This objective is in line with the overarching biological goals of the approved HCP (2011) and the HCP Amendment (see Section 4.0), as well as the bat recovery plan (USFWS 1998).

Mitigation Approach and Selection Criteria

Should habitat protection/preservation be identified for future tiers (Tiers 5 and 6), Kawailoa Wind would continue to coordinate with TPL, USFWS, DOFAW, and others to identify key parcels that would benefit the bat. Land would be protected and preserved through acquisition, easement, or other legal conservation instrument. For this mitigation option, the following selection criteria would be used to identify a suitable mitigation parcel:

- The mitigation parcel is on the Island of Oʻahu.
- A minimum of 20.3 acres would be used to offset one Hawaiian hoary bat (based on the median bat CUA identified from data by Bonaccorso et al. 2015; see Section 7.6.3.3).
- The mitigation parcel faces a threat such as development or other threats that are not consistent with suitable or high value bat habitat (e.g., level of protection, intact versus degraded habitat, etc.). Parcels that are at risk of development, deforestation, or other degradation will have a higher priority than those not at risk.
- Larger parcels are typically preferable to smaller parcels. However, the location of a smaller parcel (e.g., adjacent to another larger area that supports bats or is being restored to support bats) could make it more attractive as a mitigation site.
- The mitigation parcel will be protected in perpetuity (i.e., fee simple, conservation easement, or other arrangement agreed upon by Kawailoa Wind and the agencies). Proposed protections and restrictions are consistent with bat roosting and/ or foraging habitat.
- Recent evidence of bat activity has been identified at the mitigation parcel or neighboring parcels that would indicate bat use of the mitigation parcel, in conjunction with suitable habitat on the mitigation parcel.

The detailed SSMIP, submitted for approval by USFWS and DOFAW within 6 months after reaching the tier trigger, will incorporate the best available science related to bat habitat requirements and will be tailored to the specific parcel. As such, the plan may include refinements to the biology of the Hawaiian hoary bat, biological objectives, and parcel selection through adaptive management. The SSMIP for the land protection option will include the following information:

- Documentation of Hawaiian hoary bat activity, indicating the parcel is currently used by the Hawaiian hoary bat;

- A description of the plan area, and the habitat within the mitigation parcel;
- Measures of success (see below);
- A description of how the parcel offsets take, including how the protection increases the bat habitat relative to the future baseline;
- A cost estimate for the parcel to be protected including adaptive management.

Take Offset and Net Benefit

The offset for Hawaiian hoary bats is based on scientific literature and agency guidance (USFWS and DOFAW letters dated September 26, 2018 and September 21, 2018). A minimum of 1,725 acres will be protected and preserved for Tier 5, and 406 acres will be protected and preserved for Tier 6. This value uses the 20.3-acre median core bat use area as an appropriate approximation of bat density, justifying a take offset of 85 and 20 bats per tier, respectively (85, or 20 * 20.3 acres per bat). The mitigation will protect and preserve current bat roosting and/ or foraging habitat to ensure that habitat that is already providing habitat for bats will continue to provide habitat in perpetuity. Protection of the land in perpetuity would benefit bats beyond the term of the ITP/ITL by providing bat habitat in perpetuity, for multiple generations of bats to ensure a net benefit for the species. This mitigation is effective because it prevents existing habitat from inevitably no longer supporting the bat population and, thus, increases bats over the expected permit term. The mitigation is expected to meet the biological goals and objectives, provide a net benefit to the Hawaiian hoary bat, and fully offset the take of 85 bats in Tier 5 and 20 bats in Tier 6.

Measures of Success

The benefit of land protection/preservation for Hawaiian hoary bats is realized at the time of acquisition or protection. Therefore, the Tier 5 or Tier 6 mitigation will be deemed successful if:

- Kawailoa Wind secures protection of a parcel, through fee simple, conservation easement or other legal instrument;
- The transfer of the parcel includes a requirement that the parcel will be managed in perpetuity for the protection of habitat and conservation of the Hawaiian hoary bat; and
- A designee is assigned to oversee the management of the mitigation parcel.

Kawailoa Wind will work with the managing entity to obtain their annual reports on the monitoring and management efforts at the mitigation parcel, and to provide a summary of these efforts within the Project annual reports submitted to USFWS and DOFAW.

Adaptive Management

At the time that Tier 5 or Tier 6 mitigation is triggered, and protection/preservation is the selected mitigation option, Kawailoa Wind will consider current agency guidance and new information available on Hawaiian hoary bat life history requirements and ecology. This approach will allow Kawailoa Wind to leverage available information derived from ongoing Hawaiian hoary bat research projects (anticipated to be completed by 2020 or sooner) which address some of the existing information gaps and are expected to identify mitigation and management actions that will improve the survival and/or productivity of the Hawaiian hoary bat.

For the Tiers 5 and 6 protection/preservation mitigation option, adaptive management may occur if, in coordination with Kawailoa Wind, the USFWS and DOFAW determine:

1. New information is obtained that informs the mitigation parcel selection criteria; and

2. New information suggests that a proposed protection/preservation parcel will not achieve the intended biological goals and objectives.

Should one of these scenarios occur, Kawailoa Wind will work with USFWS and DOFAW to refine the mitigation outlined above.

7.6.4.2 Contingency Mitigation Options

Should other, to-be-determined contingency mitigation options be deemed more appropriate than the land-based mitigation described above for Tier 5 or Tier 6, or in the event that the mitigation options identified above are not implementable at the time that mitigation planning for future tiers is triggered (Table 7-2), Kawailoa Wind will coordinate with USFWS and DOFAW to identify the most appropriate mitigation measures. Two possible contingency mitigation options are described below.

- Mitigation Banking: Mitigation banking has been identified by DOFAW as a needed addition for HCP planning. If Hawaiian hoary bat mitigation banking is established, it may provide an alternative for mitigation. Should a Hawaiian hoary bat mitigation bank(s) be established, Kawailoa Wind will consult with USFWS and DOFAW on whether such a bank(s) could be used for Tier 5 and/or 6.
- Research: The on-going research approved by the ESRC may indicate that other mitigation measures may be more effective in off-setting bat take than the land-based options and this could include future research. The USFWS and DOFAW have indicated that additional research is not anticipated to be approved given the ongoing research projects. Thus, Kawailoa Wind has only included research as an adaptive management option in the event the agencies identify that critical information is still needed, and the higher priority mitigation options are not implementable at the time mitigation planning is triggered.

Any contingency mitigation option would be subject to approval by USFWS and DOFAW.

7.7 Immediate Revegetation to Control Soil Erosion

[This section requires no edits for the HCP Amendment.]

7.8 Managing Invasive Species

[This section requires no edits for the HCP Amendment.]

7.9 Replanting of Native Trees

[This section requires no edits for the HCP Amendment.]

8.0 IMPLEMENTATION

8.1 HCP Administration

[This section requires no edits for the HCP Amendment.]

8.2 Monitoring and Reporting

[The introduction to this section requires no edits for the HCP Amendment.]

8.2.1 Take Monitoring

[This section was revised for the HCP Amendment.]

Kawailoa Wind proposes to document bird and bat injuries and fatalities, including Covered and non-Covered Species, following methods that have been used effectively at other wind energy generation facilities in Hawaiʻi and the continental United States. Details of the intensive monitoring protocol employed through the first 3 years of operation at the Kawailoa Wind Project are provided in Appendix 7, and an adaptively managed long-term monitoring protocol to be used in years 4 to 20 of operation is described in Appendix 17. The intensive monitoring protocol was approved by USFWS and DOFAW prior to the start of Project operations, and the long-term monitoring protocol was similarly approved by USFWS and DOFAW prior to implementation at the beginning of year 4 (see Appendix 17). Take monitoring data will be used to determine the need for minimization adaptive management measures to ensure take is not exceeded (Section 8.3.1). The intensive monitoring plan included the following key components:

- Kawailoa Wind used technical staff and third-party contractors trained by experienced biologists with specialized expertise in conducting wind turbine/bird interaction studies.
- Search plots were cleared and vegetation was maintained to facilitate searches.
- Carcass removal (CARE) and SEEF trials were conducted each season using carcasses of different size classes. Bias correction trial data were collected during two seasons each year because of seasonality of some of the Covered Species and the potential for factors influencing bias correction data to change seasonally: winter/spring season (December – May) and summer/fall (June – November). Two size classes were chosen to represent the size classes of the Covered Species: bat-sized and large birds (waterbirds, seabirds, and owls). CARE and SEEF trials were conducted with sufficient replication to produce scientifically reliable results. These results provided a basis for estimating unobserved take (see Appendix 7 on the study design and Appendix 9 for discussion of the take calculation) and determining suitable search intervals. Kawailoa Wind covered costs and was responsible for acquiring bias correction trial carcasses.
- The intensive searches were conducted for the first 3 years under the direction of a qualified biologist.
- To the extent practicable, searches were conducted using trained canines to maximize SEEF.

The long-term monitoring protocol will be the baseline monitoring program under the HCP Amendment and is described in detail in Appendix 17. The protocol includes the following key components:

- A qualified biologist oversees staff training and monitoring efforts, and meets reporting requirements.

- Search areas consist of roads and graded pads within a 115-foot radius of each of the Project's wind turbines.
- To the extent practicable, searches are conducted using trained canines to maximize SEEF.
- Searches are conducted twice per week.
- Bias correction trials including SEEF and CARE trials.
- An adaptive management strategy that allows for the adjustment of the protocol in consultation with USFWS and DOFAW.
- Reporting of incidentally found downed wildlife by operations staff for the duration of the permits.

Kawailoa Wind will continue to review fatality records in association with other Project data to identify measures that can be implemented to reduce take. This information will be incorporated into the adaptive management program to inform future operational minimization measures (Section 8.3.1)

8.2.1.1 Adaptive Management

New technologies or search methods or new analytical methods may be incorporated under adaptive management in consultation with USFWS and DOFAW if they are demonstrated to increase the efficiency of the monitoring or enable more accurate take estimates to be obtained. Any substantive changes in the program will be done with USFWS and DOFAW approval prior to implementation.

Additionally, if correlations between Project data and observed fatalities cannot be readily identified, Kawailoa Wind may conduct supplemental investigations to inform additional avoidance and minimization measures such as:

- Deploy ground-based acoustic bat detectors to identify areas of higher bat activity during periods when fatalities are occurring;
- Use thermal imaging or night vision equipment to document bat behavior near turbines;
- Conduct additional analysis of bat mortality and operational data; and
- Fund additional necropsy or testing of specimens to identify pre-existing conditions that may play a factor in risk exposure, such as disease, or toxicants.

8.2.1b *Calculating Take*

[New Section for the HCP Amendment.]

Kawailoa Wind will estimate Project take of Covered Species on a quarterly basis in addition to estimating take when fatalities are detected. Estimated take will include one or more of the following 1) observed direct take (actual individuals found during post-construction monitoring); 2) an estimate of unobserved direct take based on results from SEEF and CARE results; and 3) estimated indirect take resulting from the direct take of a breeding adult with dependent young or eggs. Unobserved direct take accounts for individuals that may be killed but that are not found during the monitoring effort for various reasons, including heavy vegetation cover and scavenging.

Direct take (including observed and unobserved direct take) will be calculated based on an estimator approved by USFWS and DLNR. See Appendix 9 for details on the approach. Based on current USFWS and DOFAW guidance, the EoA tool will be used to estimate the probability that Project take is below a particular threshold (Dalthorp et al. 2017). Based on current USFWS and DOFAW guidance, the 80 percent upper credible limit of take will be used to conservatively represent the estimate of direct take. Should other approaches to take estimation be developed during the permit term, Kawailoa Wind will work with USFWS and DLNR to appropriately use and interpret results from mutually agreed upon statistical tools to estimate take.

Indirect take is estimated using USFWS guidance, which represents the best information currently available for determining the presumed breeding status and potential productivity of a taken individual (USFWS 2016a). Agency guidance may change as new information emerges. Based on current information, direct take of female Hawaiian hoary bats during the period from April 1 through September 15 are assumed to result in indirect take.

8.2.2 Reporting

Kawailoa Wind will prepare written reports describing results from monitoring efforts, including mitigation and PCMM, to demonstrate HCP compliance and identify any proposed adaptive management strategies. The timing and level of detail of this reporting may be adjusted over the course of the permit term. However, at a minimum, Kawailoa Wind will meet with USFWS and DLNR semi-annually throughout the permit term to discuss mitigation, PCMM, and take levels in the context of compliance with authorized take limits.

If the monitoring search interval is exceeded (for reasons other than weather, health, or safety), Kawailoa Wind will report the event to USFWS and DLNR within a week. If the monitoring search interval is exceeded more than once per season (for reasons other than weather, health, or safety), USFWS and DOFAW will be notified immediately of the exceeded interval. Kawailoa Wind, DLNR, and USFWS may discuss possible adaptive management measures to address and correct the issue.

Semi-annual meetings with DLNR and USFWS will be held in approximately March and September or as needed to provide brief progress updates and summarize the findings of CARE and SEEF trials as well as results of mitigation measures. Brief quarterly progress reports will be submitted within 30 days for quarters ending March 31, September 30, and December 31 of each year. Quarterly reports will include any updated information for the period since the previous report, including: 1) a current estimate of take at the project, 2) bias correction trial results for the current fiscal year, 3) a summary of adaptive management actions taken or other notable events, and 4) a summary of mitigation measures. Information for the quarter ending June 30 will be provided in the annual report. If necessary, take limits will be reviewed, and changed circumstances or adaptive management measures will be discussed with DLNR and USFWS as needed. In addition, should take of a Covered Species occur, DLNR and USFWS will be notified in accordance with the Downed Wildlife Protocol (see Appendix 11).

Annual reports summarizing the monitoring results will be prepared and submitted to DLNR and USFWS. These reports will identify 1) actual frequency of monitoring of individual search plots; 2) results of SEEF and CARE trials with recommended statistical analyses, if any; 3) directly observed and adjusted levels of take for each species, as applicable; 4) whether or not there is a need to modify the mitigation for subsequent years; 5) efficacy of monitoring protocols and whether or not monitoring protocols need to be revised; 6) results of mitigation measures conducted as part of the HCP; 7) recommended changes to mitigation measures, if any; 8) budget and implementation schedule for the upcoming year; 9) continued evidence of Kawailoa Wind's ability to fulfill funding obligations; and 10) a table summarizing all observed fatalities. The annual report will be submitted by August 1 each year along with electronic copies of HCP related data. The report will cover the period from July 1 of the previous year through June 30 of the present year. Agencies will have 30 calendar days to respond to the report, after which a final report incorporating responses to the agencies will be submitted by September 30. The report may also be presented to ESRC as required. Kawailoa Wind will confer formally with the USFWS and DLNR following submittal of the annual report to review the results and plan appropriate future mitigation and monitoring measures. Any changes to future mitigation and monitoring will only be made with the concurrence of USFWS and DLNR.

8.3 Adaptive Management Program

Adaptive management, as identified in the 2016 Habitat Conservation Planning and Incidental Take Permit Processing Handbook (USFWS and NMFS 2016), is a key strategy for addressing uncertainty associated with an HCP's conservation program, particularly uncertainty that poses a significant risk to the Covered Species (USFWS and NMFS 2016). This includes, but is not limited to, uncertainty related to the Covered Species' status or trend; uncertainty related to the effects of a covered activity on a Covered Species; and uncertainty related to the effectiveness of an applicant's minimization and mitigation measures. Through assumption-based learning and robust monitoring, adjustments can be made to the HCP's conservation program in response to what is learned (USFWS and NMFS 2016). The adaptive management strategy identified here complies with the requirement outlined in HRS 195D-21 to provide an adaptive management strategy which specifies actions that can be taken to ensure the plan is achieving its goals.

Kawailoa Wind has developed an adaptive management strategy to account for uncertainty in the amount of take of the Covered Species expected over the remainder of the permit term and the effectiveness of minimization measures (e.g., LWSC). The adaptive management strategy focuses more specifically on the Hawaiian hoary bat because the potential for take of this species is highest among the Covered Species.

Kawailoa Wind regularly monitors impacts to the Hawaiian hoary bat, and also stays current with any new science or technology that may further minimize the risk to bats. Kawailoa Wind meets with USFWS and DOFAW on an annual basis to review ITP/ITL compliance and evaluates the take trajectory annually, in consultation with USFWS and DOFAW. Kawailoa Wind also submits to USFWS and DOFAW a summary of adjusted take after each fatality. Kawailoa Wind has established "within-tier" triggers to minimize the chances of the Project bat take reaching the next Tier, such that planning for mitigation will occur in parallel to implementation of additional adaptive management. The adaptive management strategy is intended to allow the Project to remain in the lowest tier possible.

8.3.1 Future Minimization Measure Triggers and Actions

Kawailoa Wind has identified additional minimization measures that could be implemented, if necessary, in the future to minimize take of the Hawaiian hoary bat should the current measures prove not to have the effect anticipated. The Habitat Conservation Planning and Incidental Take Permit Processing Handbook (USFWS and NMFS 2016) recommends that adaptive management strategies include milestones that are reviewed at scheduled intervals during the permit lifetime. Kawailoa will evaluate take quarterly, and implement additional operational minimization measures if one or more of the triggers described below occurs.

Triggers:

- Estimated take (direct and indirect) based on PCMM data at the 80 percent credibility level reaches 75 percent of the Tier 5 limit (150 bats) and projected take is on a trajectory to exceed the authorized take limit before the end of the permit term. Thus, a formal evaluation of the take rate will occur, and additional minimization measures will be implemented, if the total take reaches 150 bats (200 * 0.75) before 2032 and the trajectory suggest the authorized take level will be exceeded prior to the end of the permit term.

- Estimated take (direct and indirect) based on the PCMM data at the 80 percent credibility level reaches 75 percent of the Tier 6 limit (165 bats) <u>and</u> projected take is on a trajectory to exceed the authorized take limit before the end of the permit term. Thus, a formal evaluation of the take rate will be occur, and additional minimization measures will be implemented, if the total take reaches 165 bats (220 * 0.75) before 2032 and the trajectory suggest the authorized take level will be exceeded prior to the end of the permit term.

Additionally, the project will monitor the take rate in relation to each Tier: the average take rate to stay within Tier 4 is 5.75, and the average take rate to stay within Tier 5 is 10.

8.3.1.1 Evaluation

To assess projected take, the evaluation will calculate the average annual take rate using the number of years remaining in the permit term and the number of bats estimated by direct and indirect take. This value will be compared to the threshold rate of take authorized under the ITL/ITP. The total authorized take requested under the ITL/ITP amendment is 220 bats over 20 years; therefore, the threshold take rate is 11 (220 bats/20 years). If 75 percent of the Tier 5 or Tier 6 limit is reached, and the average annual take rate is greater than 11 bats per year, additional operational minimization measures will be triggered.

For example, if the total number of bats were to reach 150 (138 direct and 12 indirect) in year 2027, the average annual take rate would be 10 bats per year (150 bats/15 years). This falls below the threshold take rate; therefore, no adaptive management would be triggered. At an annual take rate of 10 bats per year in 2027, it would be anticipated that the total take at the end of the permit would be 200 (150 current estimate + 10 bats per year * 5 years), thus remaining within the Tier 5 limit of 200 by year 2032. Methods of measuring estimated take and projected take are described in Appendix 16.

These triggers are structured to be consistent with USFWS guidance that planning for the next tier of take mitigation should be initiated when 75 percent of the current tier is reached (USFWS 2016c). Thus, the planning for mitigation of the next tier (Table 7-3) aligns with the triggers for adaptive management of minimization measures.

8.3.1.2 Adaptive Management Actions

If additional minimization is triggered, Kawailoa Wind will implement one or more measures from the suite of options listed below within 3 months. The selection of measures to implement will be based on the best available science, results from current Hawaiian hoary bat research (the results of ongoing research are expected to be reported starting in 2020), new technological advances, and Project-specific mortality monitoring data. Kawailoa Wind anticipates that minimization measures for bats will likely evolve over the remaining permit term and will coordinate with USFWS and DOFAW regarding any the new best available science at annual meetings. Kawailoa Wind will review these options at the time additional minimization measures are triggered, and choose the option best suited to minimize impacts to bats. Future minimization measures will include one or more of the following measures:

1. <u>Turbine Operational Adjustments</u>: Kawailoa Wind will alter turbine operation to reduce bat fatalities through incremental increases in hysteresis (extending the offset between turbine shut-down and start-up). Hysteresis alterations will be informed using fatality data, site conditions, and environmental parameters. Alterations will be specific to:
    - A subset of turbines where risk of bat fatalities is higher;
    - The season when risk of bat fatalities is higher; or
    - The hours of the day when risk of bat fatalities is higher.

2. Installation of Bat Deterrents Improvements: It is likely that improvements will be made to deterrent technology during the remaining permit term. Alterations to speaker types, speaker frequencies, speaker composition, orientation, and amplitude have all been hypothesized to impact deterrent effectiveness. Additionally, different types of deterrents (e.g., acoustic, ultraviolet) may prove to have increased or additive effectiveness of reducing bat take to that of installed deterrents (6B.1). Kawailoa Wind will replace or install improvements to deterrent systems on turbines should evidence indicate the potential for additional take reductions from technologies available at the time the additional minimization measures are triggered. Priority will be given to turbines with the highest recorded fatalities, and will be informed by Project-specific PCMM as available, to achieve the greatest reduction in risk to bats.
3. Alteration of Site Conditions: Initial research results suggest that several land uses may be correlated to bat activity. For example, studies have observed interactions between bat activity and artificial water features (Tuttle et al. 2006). Therefore, site conditions could be considered when a wind energy facility is evaluating options to reduce risk to bats. Kawailoa Wind will work with the land owner to identify measures to alter site conditions which could minimize risk to bats. Alterations to site conditions may include changes in landscape features (e.g., forested edges, water features), structures, and/or lighting. Actions considered will be informed by the results of ongoing research on bat activity or occupancy patterns being conducted in Hawaiʻi.
4. Other Technologies: It is possible that additional technologies will be developed to reduce take or identify when a fatality has occurred to better inform monitoring and operations. Kawailoa Wind will implement other technologies as they become available.

The approach to adaptive management of minimization measures outlined above is designed to ensure compliance with permit take limits, and although focused on bats, the suite of additional minimization measures could also be considered to benefit other Covered Species should the take rate be higher than expected. However, as previously described, the likelihood of a higher take rate for the other Covered Species is extremely low.

8.4 Funding Assurances

The HCP includes a habitat conservation program with measures that Kawailoa Wind will undertake to monitor, minimize, and mitigate the incidental take of each Covered Species, plus provide a net conservation benefit, as measured in biological terms. An estimate of the costs of funding the conservation program is presented in Appendix 8 of the approved HCP. The text provided here, and in the table in Appendix 18, provides a supplement to the approved HCP and presents additional estimated costs associated with new commitments related to the HCP Amendment (i.e., the addition of the Hawaiian petrel as a Covered Species and the increased take request for the Hawaiian hoary bat). Kawailoa Wind will provide funding for the required conservation (monitoring, minimization, and mitigation) measures in full, even if the actual costs are greater than anticipated. One way of accomplishing this is that past, current, or future funds allocated to a specific Covered Species may be reallocated where necessary to provide for the cost of implementing conservation measures for another Covered Species, and funding for any individual Covered Species is not limited to those amounts estimated in Appendices 8 and 18. Kawailoa Wind also recognizes the cost of implementing habitat conservation measures in any one year may exceed that year's total budget allocation, even if the overall expenditure for the conservation program stays within the total amount budgeted over the life of the Project. Accomplishing these measures may therefore require funds from future years to be expended, or likewise unspent funds from previous years to be carried forward for later use.

As part of agency compliance monitoring, DOFAW may conduct independent monitoring tasks sufficient to determine compliance, including independent assessment of SEEF, CARE, and net recovery benefit targets and criteria. Pursuant to HRS 195D, and prior agreement, all costs required for that compliance monitoring shall be paid by Kawailoa Wind.

As described in Appendix 19, Kawailoa Wind funded Tier 4 mitigation in the amount of $2,750,000. Additionally, Kawailoa Wind will maintain funding assurances sufficient to cover outstanding and unfulfilled mitigation obligations for the current mitigation obligation, adaptive management, and DOFAW compliance monitoring, while funding on-going obligations out-of-pocket (Appendix 18).

Take will not be authorized for the next pending tier until funding assurances for the pending tier are in place. A financial accounting will be provided before the next pending tier is reached to include the following: the amount of the letter of credit (LOC) for the existing tier; mitigation already funded; and mitigation cost estimated for the new tier.

The funding assurances may be reduced if mitigation obligations are met. Thus, these funds will be available to fund mitigation in the unlikely event that there are unmet mitigation obligations due to a revenue shortfall, default, change of ownership, bankruptcy, or any other cause. As named beneficiary to this letter of credit or similar instrument, DLNR will have the ability to draw upon the financial instrument to fund any outstanding mitigation obligations of the Project. The financial assurances instrument will be automatically renewed prior to expiration, unless it is determined by USFWS and DLNR to no longer be necessary. The funding assurances provided here, in Section 8.4 of the approved HCP, and Appendix 18 comply with both the ESA and HRS 195D requirements to provide adequate funding for the implementation of the plan.

The LOC will be issued by a financial institution organized or authorized to do business in the United States and identify the DLNR as the sole payee with the full authority to demand immediate payment in the case of default in the performance of the terms of the permit and HCP. The LOC presented for approval will contain the following provisions:

- It will be payable to the State of Hawaiʻi DLNR;
- The expiration date will not be less than 1 year from the effective date of the LOC and will contain a provision for automatic renewal for periods of not less than 1 year unless the bank provides written notice of its election not to renew to the DLNR at least 90 days prior to the originally stated or extended expiration date of the LOC;
- It will contain provisions allowing collection of the remainder of the costs by the DLNR for failure of the permittee to replace the LOC when a 90-day notice is given by the bank that the LOC will not be renewed and the LOC is not replaced by another LOC approved by the USFWS and DLNR at least 30 days before its expiration date; and
- The LOC will be payable to the DLNR upon demand, in part or in full, upon notice stating the basis thereof (e.g., default in compliance with the permit or HCP or the failure to have a replacement for an expiring LOC).

LOCs will include 1) guarantee of funds for adaptive management, and 2) sufficient contingency funds to cover inflation and changed circumstances to ensure that success criteria are met, as reflected in the funding matrix (see Appendix 18). The LOC will be renewed annually based on the outstanding mitigation cost at the start of the following year. The purpose of the LOC will be to secure the necessary funds to cover any remaining mitigation and monitoring measures in the unlikely event that there are unmet mitigation obligations.

8.5 Changed Circumstances Provided for in the HCP

Circumstances may change during the life of the HCP, some of which can be anticipated and for which responses can be planned. Such changed circumstances and the procedures to provide for these scenarios are described below.

8.5.1 Listing of New Species or Delisting of a Covered Species

If a new species that occurs on Oʻahu is added to the federal or state endangered species list, Kawailoa Wind will evaluate the likelihood of incidental take of the species due to Project operation. If incidental take appears possible, Kawailoa Wind may seek coverage for the newly listed species under an amendment to the existing HCP, and will avoid take of the newly listed species unless and until the permit is amended. Kawailoa Wind may also reinitiate consultation with the USFWS and DOFAW to discuss whether mitigation measures in place provide a net benefit to the newly listed species or if additional measures may be recommended by USFWS or DOFAW. Should any of the Covered Species become delisted over the permit term, Kawailoa Wind will consult with USFWS and DOFAW to determine if mitigation measures should be discontinued.

8.5.2 Designation of Critical Habitat

If the USFWS designates Critical Habitat, and such Critical Habitat may be adversely affected by the activities covered in the HCP, this to be considered to be a changed circumstance provided for in the plan. Under these circumstances and in consultation with USFWS, Kawailoa Wind will implement adjustments in covered activities in the area of designated Critical Habitat to ensure that Project activities are not likely to result in the destruction or adverse modification of the Critical Habitat. If necessary to avoid destruction or adverse modification of Critical Habitat, Kawailoa Wind will make adjustments in activities. Such adjustments may also require amendment of the ITP in accordance with then applicable statutory and regulatory requirements, or until the USFWS notifies Kawailoa Wind that these adjustments are no longer necessary.

8.5.3 Catastrophic Events

Hurricanes, severe storms, and fires periodically strike or affect the Hawaiian Islands, and the likelihood of a hurricane or fire causing severe damage on Oʻahu during the term of the HCP is high enough to merit treatment as a changed circumstance. Such storms or fires could affect the activities covered by the HCP in several ways: cause significant damage to or destruction of Project facilities; pose a threat to the Covered Species by causing injury or death either directly, or indirectly through the destruction of habitat; or alter the natural and built environment in areas surrounding Project facilities in ways that increase or decrease the potential effects of Project facilities on the Covered Species.

Construction of the facilities at the Project is consistent with applicable codes and industry standards, which are intended to avoid significant damage in severe weather conditions. Should a hurricane, severe storm, or fire cause significant damage to Oʻahu during the term of the HCP, any resulting effects on the Covered Species will be considered based on the best available information at the time. The HCP mitigation measures will be modified to respond to impacts to the Covered Species from a hurricane or fire should USFWS and DOFAW reasonably determine after consultation with Kawailoa Wind that such a response is necessary.

8.5.4 Invasive Species

Introduced animal and plant species have had, and will continue to have, a detrimental effect on the Covered Species. The likelihood that the threat from this source will increase during the term of this HCP is sufficient to warrant treating this threat as a changed circumstance. The habitat enhancement and management measures to be implemented through this HCP could be compromised by new and/or increased populations of invasive species. Should these measures be compromised by invasive species during the term of this HCP, the HCP mitigation measures will be modified should USFWS and DOFAW reasonably determine after consultation with Kawailoa Wind that such a response is necessary.

8.5.5 Disease Outbreaks in a Covered Species

Should prevalence of disease increase substantially and become identified by DOFAW and USFWS as a major threat to the survival of a Covered Species during the term of this HCP, this threat will be treated as a changed circumstance. The habitat enhancement and management measures to be implemented through this HCP could be compromised by new and/or prevalence of increased disease. Should these measures be compromised by disease during the term of this HCP, the HCP mitigation measures will be modified should USFWS and DOFAW reasonably determine after consultation with Kawailoa Wind that such a response is necessary.

8.5.6 Changes in Known Risks to or Distribution of Currently Listed Species

New research could alter the understanding of the potential impacts to species listed at the time this HCP was prepared. The likelihood that our understanding of risks to species and/or the distribution of their populations would change in a manner that would alter the assessment made in preparing this HCP is sufficient to warrant treating this possibility as a changed circumstance. If, as a result of new information, incidental take of a non-covered state or federally listed species appears possible, or if an increase in take of Covered Species is reasonably anticipated, Kawailoa Wind will seek coverage under an amendment to the existing HCP and avoid non-authorized take until the permit is amended. As part of that process, Kawailoa Wind may discuss with the USFWS and DOFAW whether mitigation measures in place meet permit issuance criteria for the non-covered listed species or if additional measures are warranted.

8.5.7 Global Climate Change Alters Status of the Covered Species

Global climate change within the life of the ITP /ITL (20 years) conceptually has the potential to affect Covered Species through region-wide changes in weather patterns, sea level, average temperature, and levels of precipitation affecting the species or their habitats (Intergovernmental Panel on Climate 2007). Covered Species may be affected through changes in temperature, precipitation, the distribution of their food resources, and possible changes in the vegetation at their preferred habitats.

As an expected result of global climate change, hurricanes or storms may occur with greater intensity (Webster et al. 2005, Melillo et al. 2014), which may increase the risk of damage to established mitigation sites. Sea level is predicted to rise approximately 3 feet in Hawaiʻi by the end of the twenty-first century (Fletcher 2009). Given this prediction, any rise in sea level experienced during the life of the Project likely will be less than 3 feet.

Precipitation may decline by 5 to 10 percent in the wet season and temperatures may increase 5 percent in the dry season, due to climate change (Giambelluca et al. 2009). This may result in altered hydrology at mitigation sites. Vegetation may change with decreased precipitation or increased temperatures and threat of fire. Other mitigation sites may be considered for continued mitigation if selected sites are considered no longer suitable and will be changed should USFWS and DOFAW reasonably determine after consultation with Kawailoa Wind that such a response is necessary. Other adjustments to the HCP will be made due to climate change effects that adversely affect Covered Species if USFWS and DOFAW reasonably determine after consultation with Kawailoa Wind that such a response is necessary.

8.6 Changed Circumstances Not Provided for in the HCP

[This section requires no edits for the HCP Amendment.]

8.7 Unforeseen Circumstances and "No Surprises" Policy

[This section requires no edits for the HCP Amendment.]

8.8 Notice of Unforeseen Circumstances

[This section requires no edits for the HCP Amendment.]

8.9 Permit Duration

[This section requires no edits for the HCP Amendment.]

8.10 Amendment Procedure

[This section requires no edits for the HCP Amendment.]

8.11 Renewal and Extension

[This section requires no edits for the HCP Amendment.]

8.12 Suspension/Revocation

[This section requires no edits for the HCP Amendment.]

8.13 Other Measures

[This section requires no edits for the HCP Amendment.]

8.14 Permit Transfer

[This section requires no edits for the HCP Amendment.]

9.0 CONCLUSION

[This section requires no edits for the HCP Amendment.]

10.0 LITERATURE CITED

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APPENDIX 1

Biological Resources Surveys

This Appendix requires no edits for the HCP Amendment.

APPENDIX 2

Jurisdictional Wetland Determination Study

This Appendix requires no edits for the HCP Amendment.

APPENDIX 3

Radar and Visual Studies of Seabirds

This Appendix requires no edits for the HCP Amendment.

APPENDIX 4

Kawailoa Wind Wildlife Monitoring Report and Fatality Estimates for Waterbirds and Bats

This Appendix requires no edits for the HCP Amendment.

APPENDIX 5

Life History Information on Covered Species

This Appendix requires no edits for the HCP Amendment.

APPENDIX 6

Wildlife Education and Observation Program

This Appendix requires no edits for the HCP Amendment.

APPENDIX 7

Wildlife Casualty Monitoring Protocol

This Appendix requires no edits for the HCP Amendment. The protocol identified in this Appendix is updated with Appendix 17 Long-term Monitoring Protocol

APPENDIX 8

Funding Matrix

This Appendix is updated by Appendix 18 to add funding for Hawaiian petrel mitigation and revise funding for the Hawaiian hoary bat mitigation.

APPENDIX 9

Calculating Direct Take

This Appendix is supplemented by Appendix 19 Estimating Fatalities at Kawailoa Wind.

APPENDIX 10

Off-site Microwave Towers Biological Resources Survey

This Appendix requires no edits for the HCP Amendment.

APPENDIX 11

Take Reporting Form

This Appendix is superseded by guidance from the USFWS on the reporting of take.

Downed Wildlife Incident Documentation and Reporting Form
LISTED and MBTA SPECIES

Facility Name:
Species Common Name:
Species Scientific Name:
Four Letter Code: [common name, e.g. HOBA for the Hawaiian Hoary Bat; contact DOFAW unsure]:
File Name: [naming convention: SPECIESCODE_YEAR_MM-DD_FACILITY ABBREVIATION]

Observer Name:	
Report Prepared by:	
Date of Incident:	
Date of report:	
Fatality or Injury:	
Age (Adult/Juvenile), if known:	
Sex (if known):	
Incidental or Routine Search:	
Date Last Surveyed:	
Official Search Dist. and Whether In or Out	
Time Observed (HST):	
Time Initially Reported to DOFAW (HST):	
Time Picked Up and By Who:	
Deceased Animal Sent for Necropsy (Y/N)	
General Location:	
GPS Coordinates units and datum; prefer: GCS WGS84 or NAD83 UTM Zone 4N (specify):	
Closest Turbine #, distance from and bearing:	
Closest structure and distance (non-turbine):	
Ground Cover Type and Height (cm):	
Cloud Cover (%):	
Cloud Deck (m above ground level):	
Precipitation:	
Temperature (^{o}F)	
Wind Direction&Speed for Wind Projects (m/s):	

Details:

Condition of Specimen [include a description of the animal's general condition, as well as any visible injuries, be specific (*e.g.*, large cut on right wing tip)]:

Probable Cause of Injuries and Supportive Evidence [be descriptive, *e.g.*,'teeth marks visible on upper back', or 'found adjacent to tire marks in mud']:

Action Taken [include names, dates, and times, whether sent for necropsy]:

Additional Comments:

Include the following:

-photos up close and photo with nearest structures or turbines in the background; include a ruler or measuring device to provide scale
-map showing aerial imagery with location of found animal, search area polygon, turbine numbers, and nearby features, roads, and structures labeled where applicable

Additional Information Required for Covered Species at HCP Wind Energy Sites

-For the turbine associated with the fatality, include a figure showing rotor speed, wind-speed, and all weather variables for the time period spanning the last two search periods up to the time the fatality or injury was found.
-Moon phase
-Presence and description of grazing cattle within 1 mile of the turbines (bats only)
-Presence of any standing or flowing water within 1 mile of the turbines (including watering troughs)(bats only)

Downed Wildlife Incident Documentation and Reporting Form
SPECIES NOT LISTED OR MBTA

Facility Name:
Species Common Name:
Species Scientific Name:
Four Letter Code: [common name, e.g. HOBA for the Hawaiian Hoary Bat; contact DOFAW unsure]:
File Name: [naming convention: SPECIESCODE_YEAR_MM-DD_FACILITY ABBREVIATION]

Observer Name:	
Date of Incident:	
Species (common name):	
Age (Adult/Juvenile), if known:	
Sex (if known):	
Incidental or Routine Search:	
Time Observed (HST):	
General Location:	
GPS Coordinates; GCS WGS84 or NAD83 UTM Zone 4N) (specify):	
Closest Turbine #, distance from and bearing:	
Closest structure (*e.g.*, Turbine # or Bldg):	
Distance to Base of closest structure:	
Bearing from Base of closest structure:	
Condition of specimen:	
Action Taken:	
Temperature:	
Precipitation within the past 24 hours	
Wind Direction&Speed for Wind Projects (m/s):	

Probable Cause of Injuries and Supportive Evidence:

Additional Information:

[Photos]

APPENDIX 12

Mollusk Survey for the Kawailoa Wind Farm Project, Mount Ka‘ala Microwave Communication Facilities, Mount Ka‘ala, Kamananui, Waialua, O‘ahu

This Appendix requires no edits for the HCP Amendment.

APPENDIX 13

Mitigation Timeline and Reporting Requirements

This Appendix requires no edits for the HCP Amendment.

APPENDIX 14

Letter from Bat Expert Dr. Mike O'Farrell on the Effectiveness of Wetland and Forest Restoration for Improving Bat Foraging Habitat

This Appendix requires no edits for the HCP Amendment.

APPENDIX 15

Goodnature Automatic Cat Trap Development Project Timeline

This Appendix requires no edits for the HCP Amendment.

APPENDIX 16

Estimating Hoary Bat and Hawaiian Petrel Fatalities at Kawailoa Wind

This is a new Appendix for the HCP Amendment.

Appendix 16

Estimating Hoary Bat and Hawaiian Petrel Fatalities at Kawailoa Wind

1.0 INTRODUCTION

This appendix describes Kawailoa Wind's approach for estimating total Project-related take of the Hawaiian hoary bat (*Lasiurus cinereus semotus*) and the Hawaiian petrel (*Pterodroma sandwichensis*) at the Kawailoa Wind Project (Project) over the remaining years of the 20-year term of the incidental take permit (ITP)/incidental take license (ITL) for this Habitat Conservation Plan (HCP) Amendment. The appendix is provided to give additional detail on the estimation process for both species. The current standard for fatality estimation when fatalities occur at a frequency to be considered rare events (i.e., less than seven observed fatalities per year per Dan Dalthorp, pers. comm., March 2, 2018) is to use the Evidence of Absence software (EoA; Dalthorp et al. 2017). EoA is a statistical software package that considers the observed fatalities as well as other study parameters to account for fatalities that may have been missed during regular searches. Additionally, methods for calculating indirect take (take of dependent young resulting from the loss of a breeding adult) for each of these two species are presented along with the calculations.

The estimate of total Project-related take for the Hawaiian hoary bat includes the take currently authorized under the approved HCP and the additional take estimated to occur during the remaining years of the Project's ITP/ITL term and requested under the HCP Amendment. Hawaiian hoary bat ecology and potential Project-related sources of take are described in detail in Sections 3.8.4.4 and 6.3.7 of the HCP Amendment, respectively, and are not discussed further.

The estimate of total Project-related take for the Hawaiian petrel includes data from the past monitoring (for Covered Species that are birds) to project the direct take estimated to occur during the remaining years of the Project's ITP/ITL term and requested under the HCP Amendment. Hawaiian petrel ecology and potential Project-related sources of take are described in detail in Section 6.3.4.2 of the HCP Amendment and are not discussed further.

2.0 DIRECT TAKE

The EoA software package was used to model potential fatality levels (direct take only) over the 20-year ITP/ITL permit term based on Project-specific fatality data for the purpose of developing an appropriate requested take limit. For estimating direct take, the software produces a probability function that estimates the likelihood that estimated mortality is equal to actual mortality. The probability function is illustrated in Figure 1.

The user's manual for EoA recommends a credible level of 50 percent as being the most accurate in that the 50 percent credible level has the highest likelihood that actual take is equal to estimated take. The use of a higher credibility level will lead to a larger take estimate with greater assurance that actual take will be less than estimated take. The credibility level represents the likelihood that the actual mortality exceeds the predicted mortality. This can be illustrated by a comparison of the 50 percent and 80 percent credible limit. Using monitoring data from Kawailoa through December 2017, estimation of direct bat take at the 50 percent credible level predicts 56 or fewer fatalities with a 50 percent likelihood that actual take does not exceed the predicted amount. Whereas estimation of direct bat take at the 80 percent credible level predicts 62 or fewer fatalities with a 20 percent likelihood that actual take is greater than the predicted amount. Figure 1 illustrates the difference between estimating direct bat take at the 80 percent credible level shown in red/orange and at the 50 percent credible level recommended by the EoA manual shown in green. Results are a function of the user-defined credibility level, observed fatalities, and past and projected future monitoring efforts.

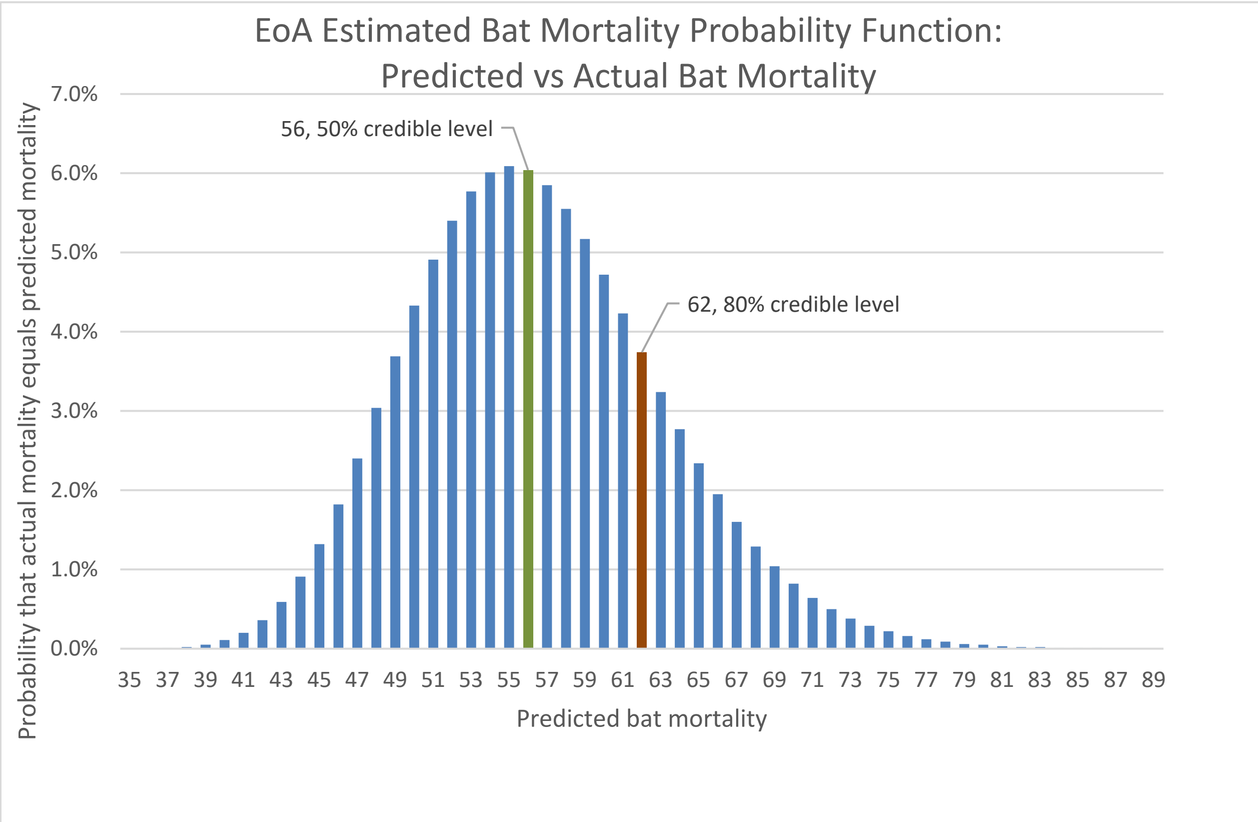


Figure 1. EoA Estimated Mortality Probability Function: Predicted vs Actual Mortality. Data from Post-construction mortality monitoring at Kawailoa through December 2017.

The recommendation to users by the EoA manual is that the 50 percent credible level is the most accurate point estimate. However, the U.S. Fish and Wildlife Service (USFWS) and Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) have required that permittees use the 80 percent credibility level to assess compliance with an ITP/ITL. This results in higher estimates of take with a greater certainty that actual mortality is less than estimated mortality. Therefore, the estimate of total Project-related take for the HCP Amendment will also use this value. The 80 percent credible level means there is an 80 percent probability that actual mortality is equal to or less than the predicted mortality. The 80 percent credible level includes all values below, providing a high level of confidence that actual take would be less than the estimated take.

Data from post-construction monitoring conducted at the Project and planned monitoring efforts for future years were incorporated into the EoA analysis. The Project-specific data for each species was input into the multiple year module of EoA to evaluate the probability of occurrence for various potential future take scenarios. The model runs 10,000 simulations from the observed data and the output provides the user with the levels of confidence that estimates of take at a user-defined credibility level would not be exceeded over the permit term. Kawailoa Wind selected the 75th percentile value of the probability distribution to provide confidence that the assessed level of take would not be exceeded during the permit term. In other words, Kawailoa Wind is 75 percent certain that when fatalities are estimated at the 80 percent upper credible limit, the estimate will not exceed the requested permitted take limit over the permit term based on current data.

Bat and petrel fatalities and their respective bias correction data recorded during post-construction mortality monitoring surveys (Appendix 7 of the approved HCP) conducted during 5 years of Project operation (November 2012 through December 2017) were assumed to be representative of trends expected over the ITP/ITL permit term and provided input values that were incorporated into the model. Inputs include the number of observed fatalities, searcher efficiency and carcass persistence data, and the proportion of the carcass distribution searched to obtain the overall detection probability specific to each species. For the remaining years of the permit term (2018–2032), model input parameters were estimated based on data collected under the current monitoring protocol, including use of dogs in conducting surveys (assumptions are described below). This search regime was initially implemented in November 2015 and is most representative of the long-term monitoring strategy at the Project.

2.1 Hawaiian Hoary Bat

Input parameters are shown in Table 1. These model inputs created a 20-year dataset that was analyzed using the EoA software to model the predicted credible maximum number of fatalities (based on the selected 80 percent credibility level) that could be taken over the life of the Project.

Several assumptions were made to develop input parameters for the remaining years of the ITP/ITL permit term. The analysis assumes continued implementation of the long-term monitoring protocol (Appendix 17 in the HCP Amendment), which reduced the search area to a 35-meter radius around turbines in November 2015. Each of the assumptions is described in the bullets below.

- Searcher efficiency and carcass persistence will remain consistent throughout the remainder of the Project's ITP/ITL permit term. Model input values for these parameters were based on a portion of 2018 fiscal year values (Jul 2017 – Dec 2017), as current conditions are assumed to best represent outcomes from the long-term monitoring protocol (see Appendix 17).
- The change in search area implemented in November 2015 (see Appendix 17) is estimated to encompass approximately 42 percent of the estimated carcass distribution for bats (Figure 2).
- Bat deterrents are assumed to be installed at all turbines by July 2019 (Hawaii Fiscal Year 2020). Two different scenarios were modeled based on assumed effectiveness or availability of deterrents at reducing take.
    - Modeling of take at the Tier 5 level assumes minimization measures will realize a 50 percent reduction in the current level of take; and
    - Modeling of take at the Tier 6 level (requested take authorization) assumes minimization measures realize a 25 percent reduction in the current level of take. This

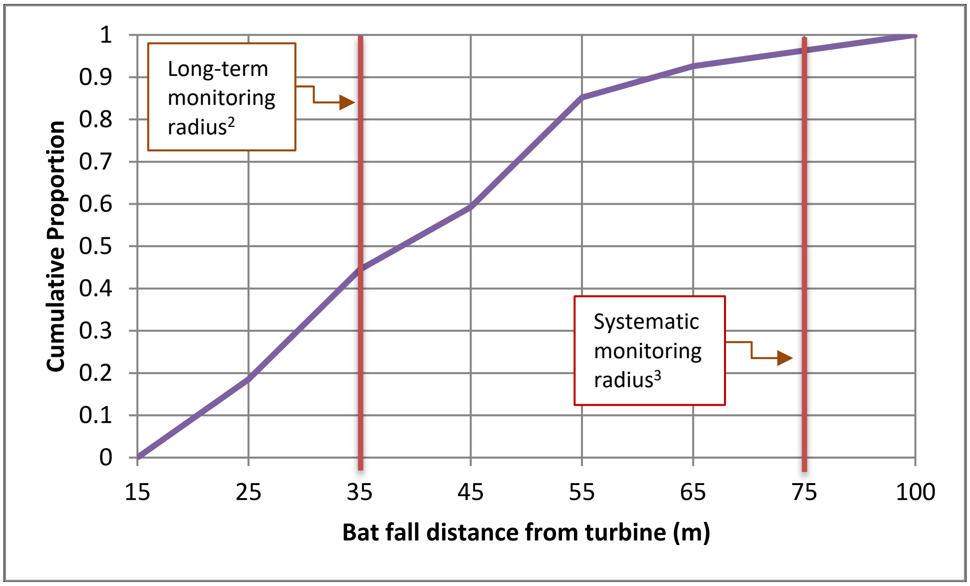
final tier is designed to be conservative in order to provide certainty to USFWS and DOFAW that the requested take will not be exceeded.

The detailed results of the Tier 6 scenario are provided in Figure 3 for illustrative purposes. The model outputs for all three scenarios are summarized in Table 2.

Table 1. Model Input Parameters for the Hawaiian Hoary Bat Direct Take Analysis at Kawailoa Wind Project

Survey Period	Observed Fatalities[1]	Carcass Detection Probability (g)			Duration (years)	Data Used for SEEF and CARE	Percent of Turbines Searched	Proportion of Bat Carcass Distribution Searched[2]
		Mean	Lower (95% CI)	Upper (95% CI)				
Nov 2012 – Jun 2013	4	0.54	0.40	0.67	0.67	Survey Period	100	0.95
Jul 2013 – Jun 2014	9	0.67	0.61	0.72	1	Survey Period	100	0.95
Jul 2014 – Jun 2015	9	0.79	0.76	0.83	1	Survey Period	100	0.95
Jul 2015 – Oct 2016	3	0.83	0.75	0.89	0.33	Survey Period	100	0.95
Nov 2015 – Jun 2016	1	0.42	0.40	0.45	0.67	Survey Period	100	0.42
Jul 2016 – Jun 2017	2	0.38	0.35	0.42	1	Survey Period	100	0.42
Jul 2017 – Dec 2017	4	0.39	0.36	0.42	0.5	Survey Period	100	0.42
Jan 2018 – Oct 2032	NA	0.39	0.36	0.42	14	Jul 2017 – Dec 2017	100	0.42

1. Limited to fatalities observed within search plots.
2. Full search plots searched in 2012–2015; under modified protocol (see Appendix 17 in the HCP Amendment) the search areas were reduced to a 35-meter radius around turbines (that encompasses roads and pads), resulting in a smaller proportion of the carcass distribution searched.



1. Data from between November 2012 and October 2015. Plot size was reduced in November 2015.
2. Searches covering the area within the long-term monitoring radius are estimated to include 42 percent of the carcass distribution.
3. Searches covering the area within the systematic monitoring radius are estimated to include 95 percent of the carcass distribution.

Figure 2. Cumulative Proportion of Bats Found by Distance from Turbine at the Project through October 2015 (n = 27)[1]

Based on the model inputs and assumptions described above, the EoA software analysis estimates the current direct take is 62 at the 80 percent credible level (Figure 3b, Item 3 in red). For the maximum projected take under the Tier 6 scenario, there is an 82 percent probability (Figure 3a, Item 1 in red) that credible maximum estimates of direct take at the 80 percent credibility level will not exceed 204 bat fatalities over the 20-year ITP/ITL permit term (Table 2, Figure 3a Item 2 in red). The median value for future take predictions is 187 bats which indicates a strong likelihood that the take will remain below the Tier 6 predicted take level (Table 2).

```
================================================================================
Summary statistics from posterior predictive distributions for 10000 simulated projects
------------------------------------
Estimated annual baseline fatality rate (lambda for rho = 1): mean = 11, 95% CI = [7.54, 15.1]

Projected fatalities and fatality estimates...
p(M > Tau within 21 years) = 0.0771  [exceedance]
p(M* > Tau within 21 years) = 0.1817  [triggering]
M* based on credibility level 1 - alpha = 0.8

Among projects with triggering (18.17%),1 mean(M) = 197.68 at time of triggering, with median = 197 and IQR = [187, 208]
Among projects with no triggering (81.83%), mean(M) = 168.20 at end of 21 years, with median = 168 and IQR = [155, 182]

Years of operations without triggering:
 Mean = 20.86, with median =  21 and IQR = [21, 21]

----------------------------------------
Summary statistics for projection years
----------------------------------------------------------------------------------------------------
Yr   Mean              quantiles of M                          | quantiles of M*
        M      M*  0.05  0.10  0.25  0.50  0.75  0.90  0.95 |  0.05  0.10  0.25  0.50  0.75  0.90  0.95
----------------------------------------------------------------------------------------------------
1     67.5   73.6    56    58    62    67    73    78    81 |    68    70    71    73    77    79    81
2     75.8   82.7    62    65    70    75    81    87    91 |    74    76    78    82    86    90    94
3     84.0   91.6    69    72    77    83    90    97   101 |    80    82    86    91    97   101   105
4     92.3  100.3    75    79    85    92    99   107   111 |    86    88    95    99   105   112   116
5    100.6  109.1    82    86    92   100   108   116   121 |    92    97   101   107   116   122   129
6    108.9  117.9    88    92   100   108   118   127   132 |    98   103   109   116   127   133   140
7    117.2  126.5    94    99   107   116   127   137   142 |   107   109   118   126   135   144   151
8    125.4  135.3   100   105   114   124   136   147   153 |   113   117   124   135   146   155   162
9    133.7  144.0   106   112   122   133   145   157   164 |   118   123   132   143   155   166   173
10   141.9  152.6   112   118   129   141   154   167   174 |   124   129   140   152   165   177   186
11   150.2  161.2   119   125   136   149   163   177   185 |   130   137   146   160   174   187   197
12   158.4  169.9   125   132   143   157   172   187   196 |   136   143   154   168   184   198   208
13   166.7  178.6   131   138   151   166   182   197   206 |   144   149   163   177   193 2 209   218
14   175.0  187.3   137   145   158   174   191   207   217 |   150   157   171   187   204   220   229

================================================================================
```

Figure 3a. Outputs from EoA for Hawaiian Hoary Bat (page 1 of 2)

Note: Source: Dalthorp et al. 2017.
The EoA summary states 21 years instead of 20 years because of the division of Fiscal Year 2016 into two monitoring periods. This was done to account for the change in search plot size.
Red numbers indicate items of importance referenced in the text.

```
*****************************************************************************************
Summary statistics for mortality estimates through 7 years
------------------------------------
Results
Totals through 7 years
             3
M* = 62 for 1 - alpha = 0.8, i.e., P(M <= 62) >= 80%
Estimated overall detection probability: g = 0.571, 95% CI = [0.548, 0.595]
    Ba = 978.05, Bb = 733.98
Estimated baseline fatality rate (for rho = 1): lambda = 11.01, 95% CI = [7.54, 15.1]

Cumulative Mortality Estimates
Year         M*   median    95% CI   mean(lambda) 95% CI
2013          10    7       [4, 14]  8.5880    [ 2.486,  18.83]
2014          25    21      [15, 29]  22.0600   [ 11.79,  35.65]
2015          36    32      [26, 41]  33.0900   [ 20.76,  48.32]
2016a         39    36      [29, 44]  36.6300   [ 23.73,  52.36]
2016b         44    40      [32, 50]  40.9900   [ 26.81,  58.19]
2017          53    47      [38, 60]  48.2700   [ 32.12,  67.71]
2018          62    56      [45, 70]  56.9300   [ 38.97,  78.28]

Annual Mortality Estimates
Year         M*   median    95% CI   mean(lambda) 95% CI
2013          10    7       [4, 14]  8.5880    [ 2.486,  18.83]
2014          16    13      [10, 20]  14.3000   [ 6.669,  24.87]
2015          13    11      [9, 15]  12.0100   [ 5.619,  20.79]
2016a         4     3       [3, 6]  4.2490   [ 1.022,  9.751]
2016b         5     2       [1, 7]  3.5470   [0.2549,  11.06]
2017          8     5       [2, 12]  6.5200   [ 1.081,  16.78]
2018          14    10      [5, 20]  11.5900   [ 3.468,  24.57]


Test of assumed relative weights (rho) and potential bias              Fitted rho
Assumed rho     95% CI
   0.67     [0.242, 1.454]
      1     [0.614, 2.007]
      1     [0.451, 1.648]
   0.33     [0.083, 0.832]
   0.67     [0.021, 0.856]
      1     [0.106, 1.255]
    0.5     [0.328, 1.877]

p = 0.53771 for likelihood ratio test of H0: assumed rho = true rho
Quick test of relative bias: 1.015

================================================================================
Input
Year (or period) rel_wt  X    Ba     Bb   ghat    95% CI
2013              0.670  4  27.15  23.31 0.538 [0.401, 0.672]
2014              1.000  9  181.7  91.14 0.666 [0.609, 0.721]
2015              1.000  9  390.9  102.7 0.792 [0.755, 0.827]
2016a             0.330  3  96.09  20.24 0.826 [0.752, 0.889]
2016b             0.670  1  794.4   1082 0.423 [0.401, 0.446]
2017              1.000  2  347.7  556.8 0.384 [0.353, 0.416]
2018              0.500  4  421.8  662.5 0.389 [0.360, 0.418]
```

Figure 3b. Outputs from EoA for Hawaiian Hoary Bat (page 2 of 2)

Note: Source: Dalthorp et al. 2017.
The EoA summary states 21 years instead of 20 years because of the division of Fiscal Year 2016 into two monitoring periods. This was done to account for the change in search plot size.
Red numbers indicate items of importance referenced in the text.

Table 2. EoA Model Estimates for Cumulative Take to Date and Future Hawaiian Hoary Bat Take

Observational Data Period (November 2012–December 2017)		
Credible maximum:	62	
Tier 4: Permit Term (November 2012–October 2032), Includes Projections (January 2018–October 2032)		
Credible maximum:	Median (50th Percentile): 98	75th Percentile: 105
Tier 5: Permit Term (November 2012–October 2032), Includes Projections (January 2018–October 2032)		
Credible maximum:	Median (50th Percentile): 155	75th Percentile: 168
Tier 6: Permit Term (November 2012–October 2032), Includes Projections (January 2018–October 2032)		
Credible maximum:	Median (50th Percentile): 187	75th Percentile: 204
All estimates developed based on the search parameters described in Table 1 at the 80% credible level.		

2.2 Hawaiian Petrel

Input parameters for petrels are shown in Table 3. Each of these model inputs created an associated 20-year dataset that was analyzed using the EoA software to model the predicted credible maximum number of fatalities (based on the selected 80 percent credibility level) that could be taken over the life of the Project.

Several assumptions were made to develop input parameters for the ITP/ITL permit term. The analysis assumes continued implementation of the long-term monitoring protocol (Appendix 17 in the HCP Amendment), which reduced the search area to a 35-meter radius around turbines in November 2015. Each of the assumptions is described in the bullets below.

- Searcher efficiency and carcass persistence will remain consistent throughout the remainder of the Project's ITP/ITL permit term. Model input values for these parameters were based on the entire 2017 fiscal year values (July 2016 – June 2017), as these search conditions are assumed to best represent outcomes from the long-term monitoring protocol (see Appendix 17).
- The change in search area implemented in November 2015 (see Appendix 17) is estimated to encompass approximately 23 percent of the estimated carcass distribution for Hawaiian petrels.
- In order to provide a conservative estimate of take, the petrel fatality detected in the first half of the 2018 fiscal year was treated as an observed fatality, even though it was detected outside of the plot area and would normally be excluded.

Table 3. Model Input Parameters for the Hawaiian Petrel Direct Take Analysis at Kawailoa Wind Project

Survey Period	Observed Fatalities[1]	Carcass Detection Probability (g)			Duration (years)	Data Used for SEEF and CARE	Percent of Turbines Searched	Proportion of Petrel Carcass Distribution Searched[2]
		Mean	Lower (95% CI)	Upper (95% CI)				
Nov 2012 – Jun 2013	0	0.91	0.88	0.94	0.67	Survey Period	100	0.97
Jul 2013 – Jun 2014	0	0.84	0.78	0.90	1	Survey Period	100	0.97
Jul 2014 – Jun 2015	0	0.64	0.61	0.68	1	Survey Period	100	0.67
Jul 2015 – Oct 2016	0	0.65	0.61	0.69	0.33	Survey Period	100	0.67
Nov 2015 – Jun 2016	0	0.22	0.21	0.24	0.67	Survey Period	100	0.23
Jul 2016 – Jun 2017	0	0.22	0.21	0.24	1	Survey Period	100	0.23
Jul 2017 – Dec 2017	1	0.17	0.04	0.37	0.5	Survey Period	100	0.23
Jan 2018 – Oct 2032	NA	0.22	0.21	0.24	14	Jul 2016 – Jun 2017	100	0.23

1. Limited to fatalities observed within search plots. As noted above, the petrel fatality observed in 2017 was treated as an observed fatality to provide a conservative estimate of take.
2. Full search plots searched in 2012–2015; under modified protocol (see Appendix 17 in the HCP Amendment) the search areas were reduced to a 35-m radius around turbines, resulting in a smaller proportion of the carcass distribution searched.

Based on the model inputs and assumptions described above, the EoA software analysis estimates the current direct take is 3 birds at the 80 percent credible level (Figure 4b, Item 3 in red), and there is an 85 percent probability (Figure 4a, Item 1 in red) that credible maximum estimates of direct take at the 80 percent credibility level will not exceed 19 petrel fatalities over the 20-year ITP/ITL permit term (Table 4, Figure 4a Item 2 in red). The median value for future take predictions is 11, which indicates a strong likelihood that the take will remain below the predicted take levels (Table 4).

```
================================================================================
Summary statistics from posterior predictive distributions for 10000 simulated projects
------------------------------------
Estimated annual baseline fatality rate (lambda for rho = 1): mean = 0.543, 95% CI = [0.039, 1.69]

Projected fatalities and fatality estimates...
p(M > Tau within 21 years) = 0.0938  [exceedance]
p(M* > Tau within 21 years) = 0.1484  [triggering]
M* based on credibility level 1 - alpha = 0.8

Among projects with triggering (14.84%), mean(M) = 15.67 at time of triggering, with median = 15 and IQR = [12, 18]
Among projects with no triggering (85.16%), mean(M) = 8.09 at end of 21 years, with median = 7 and IQR = [4, 11]

Years of operations without triggering:
 Mean = 20.45, with median =  21 and IQR = [21, 21]

----------------------------------------
Summary statistics for projection years
----------------------------------------------------------------------------------------------------
Yr   Mean              quantiles of M                         | quantiles of M*
       M        M*  0.05  0.10  0.25  0.50  0.75  0.90  0.95 |  0.05  0.10  0.25  0.50  0.75  0.90  0.95
----------------------------------------------------------------------------------------------------
1      2.9     4.3     1     1     2     2     4     5     6 |     4     4     4     4     4     6     6
2      3.4     4.7     1     1     2     3     4     6     7 |     4     4     4     4     4     7     7
3      4.0     6.0     1     1     2     3     5     7     9 |     5     5     5     5     8     8    10
4      4.5     6.5     1     1     2     4     6     8    10 |     5     5     5     5     8    11    11
5      5.0     7.0     1     2     3     4     7     9    11 |     5     5     5     5     8    12    12
6      5.6     7.6     1     2     3     5     7    10    12 |     5     5     5     5     9    12    15
7      6.1     8.8     1     2     3     5     8    11    14 |     6     6     6     6     9    13    16
8      6.7     9.2     1     2     3     6     9    13    15 |     6     6     6     9     9    16    16
9      7.2    10.0     2     2     4     6     9    14    17 |     6     6     6    10    13    17    20
10     7.7    10.6     2     2     4     7    10    15    18 |     6     6     6    10    14    17    21
11     8.3    11.2     2     3     4     7    11    16    19 |     6     6     6    10    14    18    25
12     8.8    11.7     2     3     4     7    12    17    21 |     6     6     6    10    14    22    25
13     9.4    12.8     2     3     5     8    12    18    22 |     7     7     7    11    14 2  22    26
14     9.9    13.6     2     3     5     8    13    19    24 |     7     7     7    11    19    22    26

================================================================================

Governing parameters: Tau = 19, alpha = 0.2

Data for 7 years of monitoring:
            yr    x    g     glwr    gupr   rho  M*
           2013   0 0.9098 0.8805 0.9391  0.67   0
           2014   0 0.8431 0.7838 0.9023  1   0
           2015   0 0.6430 0.6045 0.6814  1   0
          2016a   0 0.6524 0.6137 0.6912  0.33   0
          2016b   0 0.2244 0.2139 0.2348  0.67   0
           2017   0 0.2226 0.2050 0.2402  1   1
           2018   1 0.1636 -0.0098 0.3369  0.5   3

Parameters for future monitoring and operations:
  Number of years:  14
  g = 0.2226, 95% CI  [0.206, 0.24]
  Relative weight (rho): 1
***************************************************************************************
```

Figure 4a. Outputs from EoA for the Hawaiian Petrel (page 1 of 2)

Note: Source: Dalthorp et al. 2017.

The EoA summary states 21 years instead of 20 years because of the division of Fiscal Year 2016 into two monitoring periods. This was done to account for the change in search plot size.

Red numbers indicate items of importance referenced in the text.

```
**************************************************************************************
Summary statistics for mortality estimates through 7 years
------------------------------------
Results
Totals through 7 years
        3
M* = 3 for 1 - alpha = 0.8, i.e., P(M <= 3) >= 80%
Estimated overall detection probability: g = 0.535, 95% CI = [0.513, 0.557]
    Ba = 1060.9, Bb = 922.28
Estimated baseline fatality rate (for rho = 1): lambda = 0.5427, 95% CI = [0.039, 1.69]

Cumulative Mortality Estimates
Year         M*   median   95% CI   mean(lambda) 95% CI
2013          0     0      [0, 0]  0.5497   [0.00052,  2.762]
2014          0     0      [0, 1]  0.5751   [0.0005448,   2.89]
2015          0     0      [0, 1]  0.6372   [0.0006389,  3.202]
2016a         0     0      [0, 1]  0.6492   [0.0006517,  3.263]
2016b         0     0      [0, 1]  0.7457   [0.0007486,  3.747]
2017          1     0      [0, 2]  0.8701   [0.0008685,  4.372]
2018          3     2      [1, 5]  2.8060   [0.2017,  8.746]

Annual Mortality Estimates
Year         M*   median   95% CI   mean(lambda) 95% CI
2013          0     0      [0, 0]  0.5497   [0.00052,  2.762]
2014          0     0      [0, 1]  0.5941   [0.0005953,  2.987]
2015          0     0      [0, 1]  0.7786   [0.00078,  3.914]
2016a         0     0      [0, 1]  0.7672   [0.0007648,  3.857]
2016b         3     0      [0, 7]  2.2300   [0.002206,  11.21]
2017          3     0      [0, 7]  2.2500   [0.002224,  11.32]
2018         23     9      [1, 57]  17.5500   [0.7312,  82.94]


Test of assumed relative weights (rho) and potential bias              Fitted rho
Assumed rho     95% CI
   0.67     [0.001, 1.130]
      1     [0.001, 1.069]
      1     [0.001, 1.349]
   0.33     [0.001, 1.296]
   0.67     [0.002, 2.926]
      1     [0.002, 2.679]
    0.5     [0.451, 4.979]

p = 0.34133 for likelihood ratio test of H0: assumed rho = true rho
Quick test of relative bias: 0.428

================================================================================
Input
Year (or period) rel_wt  X    Ba     Bb   ghat    95% CI
2013             0.670   0  347.5  34.45 0.910 [0.879, 0.936]
2014             1.000   0  126.3  23.51 0.843 [0.781, 0.897]
2015             1.000   0  398.7  221.4 0.643 [0.605, 0.680]
2016a            0.330   0  393.4  209.6 0.652 [0.614, 0.690]
2016b            0.670   0   1437   4968 0.224 [0.214, 0.235]
2017             1.000   0  496.6   1734 0.223 [0.206, 0.240]
2018             0.500   1  2.816   14.4 0.164 [0.035, 0.365]
```

Figure 4b. Outputs from EoA for the Hawaiian Petrel (page 2 of 2)

Note: Source: Dalthorp et al. 2017.

The EoA summary states 21 years instead of 20 years because of the division of Fiscal Year 2016 into two monitoring periods. This was done to account for the change in search plot size.

Red numbers indicate items of importance referenced in the text.

Table 4. EoA Model Estimates for Cumulative Take to Date and Future Hawaiian Petrel Take

Observational Data Period (November 2012–December 2017)		
Credible maximum:	3	
Permit Term (November 2012–October 2032), Includes Projections (January 2018–October 2032)		
Credible maximum:	Median (50th Percentile): 11	75th Percentile: 19
All estimates developed based on the search parameters described in Table 3 at the 80% credible level		

3.0 INDIRECT TAKE

3.1 Hawaiian Hoary Bat

The take of a female bat during the breeding season may result in the indirect loss of dependent offspring. Females are solely responsible for the care and feeding of young. Therefore, indirect take is only associated with the death of an adult female bat. Variables used to quantify indirect take associated with the total Project direct take estimate described above are listed in Table 3 and are based on Kawailoa Wind's data and current agency guidance (USFWS 2016).

The following assumptions were made for estimating indirect bat take:

- 50 percent of fatalities are female. The actual sex determination of all carcasses found will be conducted through genetic testing by USGS.
- The assessment of indirect take to a modeled unobserved direct bat take accounts for the fact that it is not known when the unobserved fatality may have occurred. The period of time from pregnancy to end of pup dependency for any individual bat is estimated to be 3 months. Thus, the probability of taking a female bat that is pregnant or has dependent young is 25 percent.
- The average number of pups attributed to a female that survive to weaning is unchanged and is assumed to be 1.8, which is based on research conducted by Bogan (1972) and Koehler and Barclay (2000).
- There is a 30 percent probability of a pup surviving to adulthood (USFWS 2016). This is recommended by USFWS and is loosely based on the estimated survival of the little brown bat (*Myotis lucifugus*), which ranges from 20 to 48 percent (Humphrey and Cope 1976).

Based on the credible maximum of 204 bat fatalities predicted to occur as a result of direct take over the 20-year permit term, the USFWS guidance for indirect take was used to project future take and is presented in Table 3.

Table 3. Variables Used for Calculation of Indirect Take for Hawaiian Hoary Bat at the Project for Authorized Take Request

Line Number	Component	Calculation of Count	Number of Bats	Calculation[1]	Indirect Take Assessment in Adult Equivalents
1	Observed males, or individuals outside the breeding season	Observed	19	No impact to dependent young, multiply by 0	0
2	Observed females within the breeding season	Observed	2	Estimated reproductive rate 1.8 * proportion of offspring surviving to adulthood 0.3	1.08
3	Observed unknown within the breeding season	Observed	11	Proportion of population assumed to be female 0.5* estimated reproductive rate 1.8 * proportion of offspring surviving to adulthood 0.3	2.97
4	Unobserved estimated by EoA	62 estimated at 80% CI estimated by EoA[2] – 32 observed	30	Proportion of the year females are assumed to have dependent young 0.25 * proportion of population assumed to be female 0.5 * estimated reproductive rate 1.8 * proportion of offspring surviving to adulthood 0.3	2.03
5	Future take (unobserved)	2 estimated total take at the 80% CI[2]- 62 current take estimated at the 80% CI[2]	142	Proportion of the year females are assumed to have dependent young 0.25 * proportion of population assumed to be female 0.5 * estimated reproductive rate 1.8 * proportion of offspring surviving to adulthood 0.3	9.59
6	Indirect take	Sum the indirect take assessment for lines 1-5, rounded up to the nearest whole number	16	Sum the indirect take assessment for Lines 1-5, rounded up to the nearest whole number	16
7	Total take estimated at the 80% CI	Sum the count for lines 1-6	220		

1. Calculations based on USFWS guidance for calculation of Hawaiian hoary bat indirect take. The actual estimation of indirect take will depend on the timing and gender of observed fatalities.
2. Output based on projections of future take from EoA (Dalthorp et al. 2017).

3.2 Hawaiian Petrel

The incidental take of a Hawaiian petrel during the breeding season may result in the indirect loss or take of a dependent chick. Several variables are needed to assess both the potential for and magnitude of this indirect take: the proportion of direct take assumed to be adult, the proportion of the activity period (i.e., period during which adults are visiting the colony) during which adults may be expected to have eggs or chicks, the likelihood that a given adult is reproductively active, the likelihood that the loss of a reproductively active adult results in the loss of its chick, and the average reproductive success. Indirect take of petrels associated with the Project is estimated to be 0.95 petrels per year (Table 4). Thus, over the remainder of the permit term, the total indirect take is calculated as 14 years * 0.34 chicks/year = 5 chicks (4.76 rounded upward).

Table 4. Variables Used for Calculation of Indirect Take for Hawaiian Petrel at the Project

Component	Supporting Evidence or Rationale	Parameter
A. Annual Direct Take (adults/year)	Annual direct take as estimated from EoA (19 predicted over 20 years).	0.95
B. Proportion of take that is adult	Conservative assumption that 100 percent of direct take was of adult birds.	1.00
C. Proportion of "year" that is breeding period (6 of 8 months)	Although adult birds may be present at a breeding colony over an 8-month period (March-October), only six of these months (May – October) represent the breeding period (Simons and Hodges 1998).	0.75
D. Proportion of adults that breed	The proportion of adults attending the breeding colony that attempt to breed in a given year (Simons and Hodges 1998).	0.89
E. Proportion of taken breeding adults with dependent young	The impact of the loss of a single parent on a dependent chick varies within the breeding season: • During May to September, both parents are deemed critical to chick survival. • During May-August, only 89 percent of adults are breeding (89 percent breeding * 1 chick/pair * 100% parental contribution). • By September, only reproductively active adults are present on the colony (100 percent breeding * 1 chick/pair * 100 percent parental contribution). • In October, the chick is no longer dependent on both parents (100 percent breeding * 1 chick/pair * 50 percent parental contribution). The proportion of taken breeding adults with dependent young was calculated as: ((0.89*1*1*4 months) + (1.00*1*1*1 month) + (0.5*1*1*1 month))/6 months = 0.84.	0.84
F. Reproductive success (average chicks/pair)	Average reproductive success for petrels on Maui (Simons and Hodges 1998).	0.63
G. Annual Indirect Take (chicks/year)	Multiply Lines A through F.	0.34
H. Total Indirect Take (chicks)	Multiply Line G by 14 years and round up to nearest integer.	5
I. Total take estimated at the 80% CI	Sum of total direct take as estimated from EoA (19 adults) and total indirect take from Line H.	**24**

4.0 TOTAL TAKE REQUEST

4.1 Hawaiian Hoary Bat

The amount of Hawaiian hoary bat incidental take requested to be authorized under the ITP/ITL is presented below and represents the combined estimates of direct and indirect take. Based on model output from the EoA software package, the credible maximum number of direct fatalities at the 80 percent (conservative) credibility level is 204 adult bats, which represents the projected total adjusted direct take for the entire permit term. It is anticipated that there will be an indirect take of 16 adult equivalents. Therefore, total adjusted take (direct and indirect) for the 20-year ITP/ITL permit term of the Project is estimated to be 220 adult bats, or an additional 160 bats requested for authorization under the HCP Amendment. Mitigation for take requested at the Tier 4 level has been proactively initiated prior to finalization of the HCP Amendment in a good faith effort to mitigate ahead of take, despite being in advance of agency approval. The distribution of tiers for the HCP Amendment is described below in Table 5.

Table 5. Authorized Take Request for Hawaiian Bats and Tier Distribution for the Kawailoa HCP Amendment

Justification	Tier	Direct Take Estimate[1]	Indirect Take Estimate[2]	Total Take Request[3]	Total Bats in Tier
Helemano Wilderness Area mitigation site acquisition	4	105	10	115 [4]	55
50% reduction in years 2020-2032 due to deterrents	5	160	13	200 [4]	85
25% reduction in years 2020-2032 due to deterrents	6	204	16	220	20

1. Direct take is estimated at the 80% credible limit using the 75th quantile of 10,000 simulations.
2. Indirect take is assessed using the USFWS guidance for calculating indirect take. The actual estimation of indirect take will depend on the timing and gender of observed fatalities.
3. Total take includes the prior tiers, i.e., it is cumulative including 60 bats in Tier 1-3.
4. Tier 5 was adjusted from an estimated 173 (160 direct + 13 indirect) to 200.

4.2 Hawaiian Petrel

Based on the assumptions and analysis in the subsections 2.2 and 3.2 above, the combined estimated direct and indirect take of Hawaiian petrels requested for authorization under the permit term is presented in Table 6.

Table 6. Authorized Take Request for Hawaiian Petrel for the Kawailoa HCP Amendment

Description	Value
Adults/fledged young (direct take)	19
Chicks/eggs (indirect take)	5

5.0 REFERENCES

Bogan, M.A. 1972. Observations on parturition and development in the hoary bat, *Lasiurus cinereus*. *Journal of Mammalogy* 53: 611–614.

Dalthorp, D., M. Huso, and D. Dail. 2017. Evidence of absence (v2.0) software user guide: U.S. Geological Survey Data Series 1055, 109 p., https://doi.org/10.3133/ds1055.

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APPENDIX 17

Kawailoa Wind Long-term Monitoring Protocol

This is a new Appendix for the HCP Amendment.

Appendix 17

Kawailoa Wind
Long-Term Monitoring Protocol

1.0 INTRODUCTION

This appendix describes a refined long-term post-construction mortality monitoring protocol for the Kawailoa Wind Project (Project). The approved Habitat Conservation Plan (HCP) included a post-construction monitoring protocol (PCMP; Appendix 7 of the approved HCP) consisting of an initial 3-year intensive monitoring period, followed by alternating periods of scaled-back systematic monitoring, punctuated by a year of intensive monitoring every 5 years (e.g., years 6, 11, and 16). Monitoring during the first 3 years of operation was intended to inform monitoring in future years and eventually refine the long-term sampling regime (SWCA 2011). Kawailoa Wind, LLC (Kawailoa Wind) completed 3 years of intensive post-construction monitoring in November 2015 as specified by the approved HCP, and has since implemented this long-term monitoring approach. Over time, small adjustments to the monitoring protocol have been made with approval from the U.S. Fish and Wildlife Service (USFWS) and Hawaii Division of Forestry and Wildlife (DOFAW) which are documented in the Project's HCP annual reports and incorporated below.

A revised long-term monitoring approach is described in Section 2.0 that includes more consistent monitoring with provisions for adaptive management (Section 3.0). Adopting a modified effort for the long-term mortality monitoring protocol than what was identified in the approved HCP is supported by several factors that provide for a robust and consistent program. First, the Project's ongoing post-construction mortality monitoring described below provides a higher level of overall detection probability than infrequent monitoring (previously proposed for the interim periods) punctuated by intensive monitoring. The continuous monitoring delivers a high degree of certainty that take is occurring at the projected levels and reduces the likelihood of missing clustered fatality events. The revised long-term monitoring protocol provides for the continuation of bias correction trials necessary to accurately estimate take associated with the Project. It also includes continued implementation of canine searching and aggressive vegetation management to increase searcher efficiency. The remaining uncertainty of missing any fatalities is accounted for by the conservative estimation of take by the Evidence of Absence (EoA) modeling software (Dalthorp et al. 2017).

2.0 LONG-TERM MONITORING APPROACH

The long-term monitoring approach described below adapts the measures and analysis methods identified in the PCMP in Appendix 7 of the approved HCP. The sections below describe how the current search area is accounted for in the estimation of take for the Hawaiian hoary bat (*Lasiurus cinereus semotus;* Section 2.1), revisions to the protocol (Section 2.2), Kawailoa Wind's commitment to ongoing collection of bias correction trial data (Sections 2.3 and 2.4), and the analysis approach (Section 2.5).

2.1 Search Area

Kawailoa Wind will continue to search roads and graded pads that occur within a 35-meter radius of each of the Project's wind turbine generators (WTG). GIS maps of the search areas are available to USFWS and DOFAW upon request to assist in compliance monitoring. This long-term monitoring approach includes search plots that encompass approximately 42 percent of the carcass distribution for bats, based on the locations of observed bat fatalities at the Project (see Appendix 16). This estimate will be used in the annual evaluation of potential Project take (Section 2.5). Should take of listed bird species covered by the HCP occur at the Project, the proportion of the carcass distribution searched for birds of similar size will be evaluated using an analysis of an appropriate carcass distribution model (e.g., Hull and Muir [2010]), current analysis suggests this value is 23 percent of the potential fall distribution. The results of this analysis would be used in the evaluation of potential Project take (Section 2.5).

2.2 Search Protocol

The search interval will be consistent for the remainder of the permit term, with no periods of “intensive” monitoring. All WTGs will be searched approximately twice per week. The search plots will primarily be searched by trained dogs accompanied by their handlers, consistent with current methods as documented in Project HCP annual reports. Dogs will traverse the area searching for the scent of fatalities and follow the scent cone back to the source. The dog handler will ensure the dog covers each search plot. Vegetation will be managed to maximize searcher efficiency (SEEF; see Section 2.4). When conditions limit the use of dogs (e.g., weather, injury, availability of canine search team, etc.), search plots may be surveyed by Project staff. If searches are conducted by staff, the observer will walk or drive slowly in an all-terrain vehicle (ATV) along designated transects until the entire 35-meter radius search plot has been searched. Transects will be spaced approximately 6 meters apart. If staff only are used to conduct searches for more than three consecutive searches, vegetation management will occur more frequently (as needed based on the vegetation growth for the season) than with dog-assisted searches because dogs use odor clues rather than vision to locate fatalities. Searchers will be trained in search protocols, and their work will be overseen by a Project biologist. Observed fatalities will be documented and reported according to the joint agency downed wildlife protocol (Appendix 11).

2.3 Carcass Removal

Carcass removal (CARE) trials will be conducted once every quarter using two carcass size classes, with a target minimum of 2 to 3 medium birds and 10 mice/rats (bat surrogates) per trial, as carcass availability allows, for a total of 10 medium birds and 40 mice/rats per year. The black rats act as surrogates for the Hawaiian hoary bat, and the medium-sized bird carcasses act as surrogates for listed bird species (Hawaiian petrel [*Pterodroma sandwichensis*], Newell’s shearwater [*Puffinus newelli*], Hawaiian waterbirds, and Hawaiian short-eared owls [*Asio flammeus sandwichensis*]). CARE trials will last 28 days with daily checks on days 1 through 14, then two final checks on days 21 and 28. Predator trapping will be conducted as necessary to maintain annual mean carcass retention times that meet or exceed the search interval.

2.4 SEEF Trials

SEEF trials will be conducted periodically throughout the year. Carcasses from two size classes (medium birds and rats) will be included in the trials with a target annual minimum sample size of 40 rats (an average 10 per quarter) and 10 medium birds (an average of 2.5 per quarter). Carcasses used for SEEF and CARE are the same type. To ensure that measured SEEF rates are representative of search methods, both dogs and human searchers are tested.

2.5 Analysis and Interpretation

Kawailoa Wind will utilize the EoA software package (Dalthorp et al. 2017) to evaluate Incidental Take Permit (ITP)/Incidental Take License (ITL) compliance and guide adaptive management decisions relating to Project operations. The EoA model utilizes results of post-construction mortality monitoring in conjunction with the detection probability (g) achieved during each monitoring year to determine, with a certain degree of confidence (α), the likelihood that a certain threshold of take (τ) has not been exceeded based on the number of carcasses of the respective covered species found (X) during that monitoring year. Progress toward τ, which in this case is the total authorized take limit under the amended ITP/ITL, will be tracked using the "Multiple Year Total" module in the EoA software. Progress toward the tiered mitigation triggers (see Section 7.6.4 of the HCP Amendment) will also be determined in this way. Estimates of g will be derived based on the search schedule and proportion of the carcass distribution searched (Section 2.1), scavenging rates (CARE trials; Section 2.3), and searcher efficiency (SEEF trials; Section 2.4).

The EoA software requires the selection of a desired level of credibility for making statements regarding thresholds (e.g., “Based on the post-construction monitoring data, one can assert with $100(1–\alpha)\%$ credibility that there were not more than τ fatalities.”). The credibility level is analogous to confidence level in traditional statistics. In accordance with direction from the USFWS and DOFAW, Kawailoa Wind will evaluate compliance with ITP/ITL take limits based on the 80 percent credibility ($\alpha=0.2$). That is, the EoA software will produce a probability distribution that will indicate a “credible maximum” number of fatalities that the Project has an 80 percent likelihood of being at or below. This methodology will be used to estimate take unless an alternative method is agreed upon by USFWS, DOFAW, and Kawailoa Wind.

3.0 ADAPTIVE MANAGEMENT

The long-term monitoring program, including the approach to assessing ITP/ITL compliance, described here is based on the best available science and industry standards at the time of this writing. Adaptive management of the long-term post-construction monitoring program may be considered during the remaining years of the ITP/ITL term if improvements in post-construction monitoring technology, techniques, or analysis procedures change become available that would allow a significantly more precise estimate of take.

Adaptive management of the long-term post-construction monitoring program will continue to be evaluated to ensure that the monitoring is robust and responsive to fatality trends, monitoring conditions, and other factors at the Project over time. Kawailoa Wind will assess potential refinements in the long-term post-construction monitoring program in consultation with USFWS and DOFAW.

4.0 REFERENCES

Dalthorp, D., M. Huso, and D. Dail. 2017. Evidence of absence (v2.0) software user guide: U.S. Geological Survey Data Series 1055, 109 p., https://doi.org/10.3133/ds1055.

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APPENDIX 18

Estimated Funding for the HCP Amendment

This is a new Appendix for the HCP Amendment.

Appendix 18

Estimated Funding for the Kawailoa Wind HCP Amendment

Estimated Funding Matrix for the Kawailoa Wind Project HCP Amendment

Species	Tier	Mitigation[1]	Cost[2]	Explanation
Hawaiian Petrel	N/A	Contribution to National Fish and Wildlife Foundation (NFWF) to fund predator control and burrow monitoring for the Hawaiian petrel colony at Hanakapiai or another Hawaiian petrel colony	$392,800	Mitigation measures to fully offset the Project's anticipated take of the Hawaiian petrel is presented in Section 7.3.2 of the Habitat Conservation Plan (HCP) Amendment. Kawailoa Wind will provide designated mitigation funds to DOFAW and KESRP to conduct predator control and seabird burrow monitoring at the Hanakapiai and Hanakoa seabird colonies. Mitigation funds are expected to be used during 2020. However, if the issuance of the ITP/ITL is delayed beyond 2020, Kawailoa Wind will fund the project or provide funding assurances for the mitigation within 6 months of approval of the ITP/ITL. Funding assurances will be in the form of a letter of credit or other appropriate means.
		Planning and mitigation management contingency and adaptive management	$10,000 per year	Funding contingency for additional planning and evaluation of alternative sites, managing mitigation, and other adaptive management.
		Hawaiian Petrel Sub-total	**$402,800**	
Hawaiian Hoary Bat	Tier 4	Funding provided to the Trust for Public Land toward the purchase of the Helemano Wilderness Area or another mitigation site	$2,750,000	The Helemano Wilderness Area land mitigation plan is presented as Appendix 19 of the HCP Amendment. The acquisition is expected to occur prior to the approval of HCP Amendment based on support for this proposal by the U.S. Fish and Wildlife Service (USFWS), Division of Forestry and Wildlife (DOFAW), and the Endangered Species Recovery Committee (ESRC). However, if the land acquisition option is not viable, an alternative mitigation approach would be submitted within 6 months of that determination.
		Planning and mitigation management contingency and adaptive management	$10,000 per year	Funding contingency for additional planning and evaluation of alternative properties, managing mitigation, and other adaptive management.
		Tier 4 Sub-total	**$2,760,000**	
DOFAW Compliance[3]			***$*10,000 per year**	

Species	Tier	Mitigation[1]	Cost[2]	Explanation
Total to be provided with ITL/ITP			***$3,172,800***	
Hawaiian Hoary Bat	Tier 5	Land-based mitigation as described in Section 7.6 of HCP Amendment	$4,250,000	Timing to be determined in consultation with and approval by DOFAW and USFWS.
		Planning and mitigation management contingency and adaptive management	$10,000 per year	Funding contingency for additional planning and evaluation of alternative properties, managing mitigation, and other adaptive management.
		Tier 5 Sub-total	**$4,260,000**	
	Tier 6	Land-based mitigation as described in Section 7.6 of HCP Amendment	$3,250,000	Timing to be determined in consultation with and approval by DOFAW and USFWS.
		Planning and mitigation management contingency and adaptive management	$10,000 per year	Funding contingency for additional planning and evaluation of alternative properties, managing mitigation, and other adaptive management.
		Tier 6 Sub-total	**$3,260,000**	

1. Other mitigation measures would be agreed upon and consistent with USFWS/DOFAW guidance at the time each specific mitigation tier or alternative is considered.
2. Cost assumes that mitigation costs for Tiers 5 and 6 of Hawaiian hoary bat mitigation will be proportional to prior mitigation (i.e., Tier 4 mitigation). Cost is based on 2018 pricing for land and services, and will be adjusted for inflation as appropriate for the mitigation type at the time of triggering. Land acquisition will be adjusted for the housing price index or other appropriate land cost index. Habitat management will be adjusted for inflation or other appropriate index. Actual cost will be adjusted for the mitigation plan after a plan is developed, should future tiers be triggered.
3. $10,000 per year is allocated to cover DOFAW's independent compliance monitoring (as necessary). Kawailoa Wind will provide funds to DOFAW annually, and the amount can be adjusted annually for inflation. The total amount anticipated for the remaining 14 years is $140,000.

Estimated KESRP and DOFAW Seabird Mitigation Budget for Hanakāpiʻāi and Hanakoa

ITEM	Number of Units	Cost per unit	Total
Seabird Monitoring Budget			
LABOR			
Salaries (project coordinator, field crew leader, 2 technicians)			$54,725
Fringe (project coordinator, field crew leader, 2 technicians)			$17,006
Per diem (20 trips, 2 staff, 4 days)	160	$20	$3,200
EQUIPMENT			
32GB SD cards for SM4 (replacements)	10	$21	$207
Song Meter – D batteries (10 units)	120	$0.92	$111
Reconyx camera repair (including shipping)			$1,000
Lithium AA batteries (3 sets per camera)	180	$34.99	$6,298
SanDisk 8GB SDHC Memory Card (replacements)	40	$8.11	$324
Field Equipment (replacement gear)			$4,000
OTHER EXPENSES			
Analysis of song meter data by Conservation Metrics (10 song meters)			$7,000
Helicopter ($1025*20 – 10 trips per site)	20	$1,025.00	$20,500
Tech 2 position - additional staff training			$1,500
Satellite telephone time for monitoring team			$800
Monitoring Subtotal			$119,071
PCSU/RCUH direct & indirect costs			$16,985
DOFAW Admin Cost (5%)			$6,803
MONITORING TOTAL			**$142,859**

ITEM	Number of Units	Cost per unit	Total
Seabird Predator Control Budget			
LABOR			
Coordinator Salary	0.1	$60,000	$6,000
Technician Salaries	2	$40,000	$80,000
Fringe (30%)			$25,800
TRAINING			
First Aid Training	2	$300	$600
Firearms Training	2	$200	$400
EQUIPMENT			
Camping gear (tents, stoves, tarps, sleeping bags, pads, etc.)	1	$5,000	$5,000
Personnel gear (back packs, rain gear, boots)	2	$1,500	$3,000
GPS	2	$600	$1,200
Handheld camera	2	$300	$600
Goodnature A24 Traps	150	$125	$18,750
Goodnature Counters	250	$45	$11,250
Tomahawk Traps	20	$90	$1,800
MATERIALS & SUPPLIES			
Trapping Supplies	1	$5,000	$5,000
Ammunition	1	$200	$200
Firearm maintenance	1	$500	$500
Bait	1	$800	$800
First-aid kit restocking	2	$250	$500
Weatherport and deck repairs	1	$5,000	$5,000
Propane refills	4	$35	$140
AA Batteries	1	$1,400	$1,400

SD cards	40	$12	$480
GoodNature Bait	2	$4,000	$8,000
GoodNature CO2 cartridges	20	$35	$700
DIRECT PROCUREMENT, COMMUNICATIONS, SERVICES, ETC.			
Sat Comm Services	12	$60	$720
Reconyx camera repair	15	$30	$450
Helicopter Services (35 remote trips)	1	$30,000	$30,000
Predator Control Subtotal			$208,290
Overhead (20%)			$41,658
PREDATOR CONTROL TOTAL			**$249,948**
MONITORING AND PREDATOR CONTROL TOTAL			**$392,807**

APPENDIX 19

Tier 4 Hawaiian Hoary Bat Mitigation Plan

This is a new Appendix for the HCP Amendment.

Appendix 19

Tier 4 Hawaiian Hoary Bat Mitigation Plan

1.0 Introduction

The Habitat Conservation Plan (HCP) Amendment for the Kawailoa Wind Project (Project) identifies the Tier 4 take and associated mitigation for Hawaiian hoary bats (*Lasiurus cinereus semotus*). Tier 4 bat mitigation is the acquisition and protection of the 2,882-acre Helemano Wilderness Area (HWA) through a partnership with The Trust for Public Land (TPL), U.S. Fish and Wildlife Service (USFWS), Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) and other funding partners, including nearly $9 million in secured funding outside of Kawailoa Wind, LLC's (Kawailoa Wind) commitments for the parcels. No other funding partners seek mitigation credit. Kawailoa Wind proposes to derive the Tier 4 mitigation from a portion of the HWA in order to account funds that are prohibited from being used to fund mitigation; however, the funding provided by Kawailoa Wind enables the acquisition and protection of the entire HWA. Current USFWS and DOFAW guidance identifies land acquisition and protection as an appropriate and preferred mitigation option for Hawaiian hoary bats (DLNR 2015).

The HWA acquisition will permanently protect four Tax Map Key (TMK) parcels in central Oʻahu (Figure 1) for the federally and state endangered Hawaiian hoary bat, as well as many other native species, and enhance the connectivity between other natural area reserves. Following purchase of the lands by TPL, the land would be transferred to DOFAW and managed for multiple uses including for the benefit of the Hawaiian hoary bat. Note that the funding provided through TPL is limited to the acquisition and transfer of the parcels; management activities would be funded by DOFAW and their contributing partners. The long-term management strategy identified by TPL and DOFAW will include the restoration and improvement of degraded bat habitat and protection of existing habitat. The management of HWA also provides research opportunities to identify optimal habitat and limiting factors for the Hawaiian hoary bat. Furthermore, DOFAW ownership of the HWA will provide public outreach opportunities to demonstrate the benefit provided by the protection of HWA for the Hawaiian hoary bat and other native species.

The biological objective of the Tier 4 bat mitigation in Section 4 of the HCP Amendment is to protect and preserve, in perpetuity, bat roosting and foraging habitat that would otherwise be threatened by development. This objective is in line with the overarching biological objectives of the TPL and DOFAW as described in this appendix. Section 2.0 provides an overview of the entire HWA, whereas information specific to the portion of the HWA being used by Kawailoa Wind for mitigation is described in Section 3.0.

2.0 Overview of Helemano Wilderness Area

The HWA is comprised of four parcels that total 2,882 acres, of which 2,862 acres are native and mixed forest and agricultural lands (Figure 2, Table 1) within the Hawaiian hoary bat breeding range. The vegetative communities vary in the HWA with portions of the HWA comprised of significant tracts of mature native forest such as koa, sandlewood, and uluhe. Other areas are dominated by non-forested, fallow agricultural areas that currently provide edge habitat, and are planned for managed reforestation. Three major stream complexes traverse the parcels: Helemano, Poamoho, and Kaukonahua (Figure 3).

The current habitat conditions, threats, and associated proposed management actions relevant to the Hawaiian hoary bat for each of the four parcels are summarized below. Known bat activity near HWA is also summarized. Figure 1 provides context for how acquisition of the HWA provides connectivity to other natural preserves and how it integrates with other management actions supporting the Hawaiian hoary bat in the vicinity.

Table 1. Land Use and Land Cover in the HWA

Land Use Land Cover Class Description	Acres	Percent
Residential	12	0.4%
Commercial and services	8	0.3%
Cropland and pasture	669	21.3%
Native and mixed forest	2,193	78.0%
TOTAL	**2,882**	**100.0%**

2.1 Habitat, Threats, and Proposed Management

The HWA parcels are at risk from varying anthropogenic activities. Development and housing needs are a constant pressure on Oʻahu and several of the parcels have the potential for being developed. If the parcels were not protected, it is likely the suitability of the parcels for the Hawaiian hoary bat would be diminished. The following describes the current habitat, threats, and proposed management for each parcel. Three of the parcels are considered to currently have substantial suitable bat habitat whereas the habitat within the fourth parcel contains fewer acres of suitable habitat or a different composition of species. Section 4 provides more detail on the management actions proposed for each parcel.

- **Three Parcels Currently Contain Suitable Habitat**. TMK 7-1-002:011, 7-2-001:003 and TMK 6-3-001:003 are native and mixed forest, streams, and gulches suitable for roosting and feeding that will require varying levels of habitat management.
  - **TMK 7-1-002:011 (59 acres; State land use designation: Agricultural)**—If not protected, this parcel would be impacted both by continued habitat degradation from feral ungulate damage, and by development of TMK 6-4-004:011, which is contiguous and would add pollutants and other runoff from the developed areas. Additionally, the parcel could be negatively impacted by increased exposure to non-native species impacts through the development of TMK 6-4-004:011.
  - **TMK 7-2-001:003 (432 acres; State land use designation: Conservation, resource subzone)**—This parcel is subject to habitat degradation through feral ungulate damage in the stream bed and other gulches, as well as a proliferation of non-native albizia trees, which crowd out native plants and are weakly rooted, causing damages and erosion during high-wind periods. Because of State land use Conservation zoning in the resource subzone, any proposed use that would substantially alter the character of the land to the detriment of the Hawaiian hoary bat would require the preparation of a

Conservation District Use Application and would trigger the Hawaii Environmental Policy Act (Chapter 343). Acquisition of this parcel is in alignment with the Conservation zoning and provides the potential for roosting and foraging habitat.

    - **TMK 6-3-001:003 (1,143 acres; State land use designation: Conservation, resource subzone)**—This parcel will be managed by DOFAW with State and federal funds for fencing, ungulate control, and invasive species removal to prevent habitat from degrading. It is threatened by habitat degradation including feral ungulate damage, which exacerbates erosion in the parcel's stream beds and gulches. Because of State land use Conservation zoning in the resource subzone, any proposed use that would substantially alter the character of the land to the detriment of the Hawaiian hoary bat would require the preparation of a Conservation District Use Application and would trigger the Hawaii Environmental Policy Act (Chapter 343). Acquisition of this parcel is in alignment with the Conservation zoning and provides the potential for roosting and foraging habitat.

- **Fourth (and largest overall) Parcel Combines Suitable Habitat with Areas Planned for Habitat Enhancement through Reforestation**.
    - **TMK 6-4-004:011 (1,248 acres; State land use designation: Agricultural)**—This parcel is former pineapple land and could be subdivided into 5-acre parcels each with a farm dwelling, changing the landscape from a mix of forest and pastureland into a farm-based housing development if it is not protected. DOFAW will increase suitable bat habitat on this parcel through reforestation of fallow, formerly forested, agricultural lands. Ongoing research on optimum feeding and roosting habitat (such as preferred corridor dimensions) may be incorporated into the forest layout. The contrast of forest and open areas provided by this parcel through farmland, forest, and gulches, and in conjunction with the other forested parcels, provides significant edge habitat, which has been associated with bat foraging and refugia (Jantzen 2012, Downs and Racey 2006). Additionally, the eastern portion of this parcel is forested with gulches, and thus includes some suitable roosting habitat.

2.2 Current Hawaiian Hoary Bat Occupancy

Hawaiian hoary bats have been detected near all HWA parcels. In 2014 and 2015, bat detectors placed by the Army Natural Resource Center (Army) approximately 0.5 mile west, 0.8 mile north, and 1.1 miles south of the HWA detected measurable bat activity. A detector deployed by Tetra Tech for 2 months in 2014 at the Poamoho Trail summit also detected bat activity. Thus, all parcels of the HWA are surrounded by bat activity, and there is a high likelihood that the HWA itself is occupied by Hawaiian hoary bats. Acoustic bat activity detected throughout the northern Koʻolau Mountains (Gorresen et al. 2015) also provides strong support for this assumption. In addition to detections to the immediate north, south, east, and west of the HWA, Army surveys detected bat populations about 5 miles to the west, across agricultural lands from the HWA. It is likely that habitat in the HWA and lack of development in this area supports movements of bats between central Oʻahu and the North Shore.

2.3 DOFAW Stewardship and Management of the Helemano Wilderness Area

DOFAW is responsible for funding and implementing the day-to-day management of the HWA. Management will vary among the parcels based on the objectives and management needs of each specific area. DOFAW has included HWA in the State Forest Reserve System as an addition to the Poamoho section of the ‘Ewa Forest Reserve, including TMKs 6-4-004:011, 7-1-02:011, and 7-2-001:003, as well as portions designated either as Forest Reserve or Wildlife Sanctuary in TMK 6-3-001:003. However, other designations may be considered that allow for the implementation of similar management strategies.

TMK 6-3-001:003 (1,143 acres—the easternmost parcel and in the Conservation District), which already includes quality native forest and edge habitats associated with bat use, will be managed by DOFAW to further enhance habitat for the bat including control of feral ungulates, rodents, and invasive plant species. Areas subject to erosion will be managed through out-plantings and other methods depending on the causes. Because of the terrain, hiking will largely be confined to designated trails, which will prevent impacts to Hawaiian hoary bats. Camping, if allowed, will be restricted to along designated trails. Hiking and camping allow opportunities for public outreach on protection and management actions designed to promote the stability of the Hawaiian hoary bat populations. Forestry harvesting activities will be limited to hazardous tree mitigation associated with necessary management of the area. Such forestry activity would be constrained by best management practices designed to avoid or minimize impacts to the Hawaiian hoary bat.

TMK 7-1-002:011 (59 acres—Agriculture District), though zoned for agriculture, is essentially a gulch through which the Poamoho Stream passes. The management priority for this area is watershed protection. The current scrub trees and brush could eventually be replaced by compatible native species. Human use will be limited to access for hunting purposes or to provide access to other sections of HWA or the larger forest reserve. Camping will not be permitted.

DOFAW management of **TMK 7-2-001:003** (432 acres—Conservation District) will emphasize watershed protection including erosion control and may eventually include native forest restoration after restoration activities in higher priority areas are substantially completed. Camping, if allowed, will be limited to along designated trails, and human use would be limited to access the area for hunting purposes or to provide access to the larger forest reserve.

TMK 6-4-004:011 (1,248 acres—Agriculture District) will be reforested, by DOFAW, with both native and high value, non-invasive, hardwoods and will incorporate research findings on optimal bat habitat such as feeding corridors and roosting preferences into the restoration design. This parcel will have the most human use including recreational and sustainable forestry operations. Two campsites are planned and will be positioned to be a reasonable distance from the corridors designed into the forest for bat feeding corridors. Because of the parcel’s large size, this will not be difficult. Trash disposal facilities will similarly be centralized at these locations and appropriately containerized. DOFAW will coordinate with USFWS and other resource experts and/or agencies, as appropriate, to implement and maintain a rodent control program. Access, hiking, and recreational trail development will also be planned in coordination with resource experts and agencies to mitigate and avoid negative impacts to sensitive and rare native species. Use of trails by all-terrain vehicles (ATVs), if any, may be permitted if they are utilized on designated trails to access campsites or forestry plantings and that they do not adversely harm natural resources. This type of activity, if permitted, will be highly controlled, limited to designated trails, and limited to daylight hours.

With respect to commercial forestry activities, it would be at least 15 to 30 years before any planted trees would be harvested. When trees reach an age at which they could be harvested, such harvest will focus on sustainable harvest methods as well as implementation of avoidance or minimization measures to ensure that the Hawaiian hoary bat is not adversely impacted. Any harvesting activities will be limited in area and size to ensure that the entire parcel will never be subject to a one-time clear-cut harvest. DOFAW will coordinate with USFWS and other resource experts to determine appropriate avoidance and/or mitigation measures to ensure that Hawaiian hoary bat and other rare species are not significantly negatively impacted by commercial forestry operations. The overall intention for commercial harvest activities is small scale harvesting that will not impact the aesthetics, enjoyment, or environmental sustainability of the parcel.

Common native seed orchards and cultural gathering forests will also be planted in a configuration compatible with other uses on the property. These plants will likely be in the ground for extended periods and will provide a supply of seeds for restoration projects as well as for people to access non-timber forest products for subsistence or cultural uses. At least one area will be used as an inter-situ site for endangered plants that need a place to grow outside of a nursery setting while means are explored to address limiting factors in the field (e.g., *Flueggea neowawraea* and *Colubrina oppositifolia* impacts from black twig borer). This type of planting and use should have no impact on bat roosting or feeding.

Any individual management actions that may have the potential to negatively impact bats will be implemented through a suite of best management practices developed in consultation with DOFAW and USFWS to avoid detracting from the overall benefits gained through the acquisition and management of the HWA for the benefit of the Hawaiian hoary bat.

3.0 Tier 4 Mitigation

The Tier 4 mitigation for the Hawaiian hoary bat is responsive to recovery goals identified in the Hawaiian hoary bat recovery plan (USFWS 1998) as well as agency guidance described in the DLNR Bat Guidance (DLNR 2015). Kawailoa Wind contributed $2,750,000 to TPL toward the purchase and long-term protection of the HWA as mitigation for the 55 adult bats requested for Tier 4 authorized take. Funding of this commitment toward the purchase of HWA occurred prior to the approval of Kawailoa Wind's HCP Amendment. These funds, in combination with other anticipated funding commitments from other partners including federal and state partners (see Section 6.0), provided TPL with sufficient secure funding to purchase the four HWA parcels in 2018. Following purchase of the lands by TPL, the land was transferred to DOFAW to be managed for multiple uses, including for the benefit of the

Hawaiian hoary bat. In addition to protecting existing habitat, DOFAW will develop a long-term management strategy to restore and improve degraded habitat.

Because of its commitment to this land acquisition as appropriate bat mitigation and knowing that other buyers are interested in these parcels for development, Kawailoa Wind is willing to provide a funding deposit to TPL prior to issuance of the ITP/ITL to ensure that the HWA can be purchased for conservation in a timely manner. However, should USFWS or DOFAW fail to grant an ITP or ITL to Kawailoa Wind for the HCP Amendment, Kawailoa Wind reserves the right to sell their paid interest in this mitigation.

3.1 Land Acquisition/Protection Evaluation Criteria

Current DLNR Bat Guidance (DLNR 2015) and the revised HCP handbook (USFWS and NOAA Fisheries 2016) describe criteria to be considered when evaluating a parcel(s) for land acquisition or protection as mitigation for incidental take of the Hawaiian hoary bat. These criteria are listed below and identify how the criteria are applicable to the acquisition of HWA:

- Does the proposal include land acquisition alone, or land acquisition plus a management plan?
    - *The funding proposal is limited to land acquisition; however, the land deed specifies the property will be managed in perpetuity for the protection of habitat and conservation of listed endangered species including the Hawaiian hoary bat, 20 species of listed plants, and other rare species. As a condition of ownership, DOFAW will prepare and implement a management plan*.
- What is the status of the parcel (e.g., level of protection, intact versus degraded habitat, etc.) and what are the threats?
    - *The parcels contain intact habitat but are currently under multiple threats including development, and degradation through proliferation of non-native species inconsistent with the habitat needs of the Hawaiian hoary bat. The acquisition by TPL and DOFAW will protect the forested habitat from any future development, and preserve current connectivity corridors for the potential movement of bats between central O'ahu and the North Shore. Active management by DOFAW, as a condition of the acquisition of the area, is also anticipated to help protect or reduce threats to Hawaiian hoary bats such as habitat loss, reduction in prey, and predation that would result if the parcel was not protected (see Section 2.0).*
- What is the size of the parcel? Larger parcels are typically preferable to smaller parcels. However, the location of a smaller parcel (e.g., adjacent to another larger area that supports bats or is being restored to support bats) could make it more attractive as a mitigation site.
    - *The HWA is relatively large (2,882 acres) and spans a wide elevational range (2,900 to 5,500 feet.). The acquisition will protect approximately 2,862 acres of suitable habitat for bats, of which 1,116 acres are being applied by Kawailoa Wind toward Tier 4 mitigation.*
- The acquisition should be protected in perpetuity (i.e., fee simple, conservation easement, or other arrangement agreed upon by the applicant and the agencies).

    - *The land will be protected in perpetuity.*
- Distance from Project facilities?
    - *The HWA is approximately 4 miles from the nearest Kawailoa Wind project infrastructure and greater distances from other existing and proposed commercial wind facilities on O'ahu, thus meeting recommendations to avoid close proximity (DLNR 2015).*

The acquisition and protection of the HWA meets USFWS and DOFAW goals associated with each of the land acquisition evaluation criteria. Therefore, acquisition of the HWA is appropriate compensatory mitigation under Kawailoa Wind's HCP Amendment.

3.2 Success Criteria

The success criteria for this mitigation is defined in Section 7.6.3.4 of the HCP Amendment. Measures of success for Tier 4 are derived from the proxy measurement of habitat equivalency, because the current tools for measuring and monitoring rare and cryptic species, such as the Hawaiian hoary bat, are limited and direct measures of the population are unavailable. The measures of success provided below are drawn from a combination of the available scientific literature and agency guidance.

The mitigation will be deemed successful if:

- Kawailoa Wind provides funding of $2,750,000 to TPL to be used toward the purchase of the HWA;
- The transfer of the parcels includes a requirement that the HWA will be managed in perpetuity for the protection of habitat and conservation of listed endangered species including the Hawaiian hoary bat; and
- TPL secures the ownership of the HWA, and transfers ownership to DOFAW or equivalent entity who will then have responsibility for management and oversight of the parcels by the time of ITP/ITL issuance.

Kawailoa Wind will work with DOFAW to obtain their annual reports that summarize the monitoring and management efforts at HWA for submittal to USFWS and DOFAW. Additionally, Kawailoa Wind will include a summary of these efforts in the project annual reports submitted to USFWS and DOFAW.

3.3 Adaptive Management

Should the acquisition of HWA not proceed, Kawailoa Wind will pursue another land acquisition or contribute to restoration activities on other lands as described for Tiers 5 and 6 in the HCP Amendment (see Section 7.6.4).

Should DOFAW be unable or unwilling to accept ownership and management responsibilities of the HWA by the time of ITL/ITP issuance, TPL will work with partners and agency staff to identify and approve another suitable entity with the ability to provide long-term management and protection of the HWA (Stephen Rafferty/TPL, pers. comm., July 2018).

4.0 Take Offset and Benefits to Bats

As described in Section 7.6.3 of the Kawailoa HCP Amendment, HWA will provide a net benefit to the Hawaiian hoary bat and fully offset the take of 55 bats. Acquisition of these parcels would ensure protection of Hawaiian hoary bat habitat from future development and meets the USFWS and DLNR long-term conservation goals including the enhancement and connectivity of important conservation areas. These actions would benefit bats beyond the term of the ITP/ITL by providing native forest roosting and foraging habitat in perpetuity, thereby providing a net benefit to the species. Protection of HWA also provides a unique opportunity to conduct habitat management on a large scale to assess the effectiveness of various approaches in recovering bat populations.

The long-term management by DOFAW of the HWA would include a variety of measures designed to benefit the Hawaiian hoary bat (Marigold Zoll/DOFAW, pers. comm., May 2018). These management actions include the following:

- **Forest Restoration will aid in the recovery and protection of bat habitat at risk due to the impacts of non-native species.** Fencing, ungulate control, and invasive species removal will promote recovery of native forest habitat that supports breeding, roosting, and foraging habitat for the Hawaiian hoary bat.
- **Protection of forested habitat from development will enhance connectivity corridors for the potential movement of bats between Central Oʻahu and the North Shore.** Protection of HWA strengthens protects and enhances native forest, watershed habitat, and transitory corridor contiguous with the 4,300-acre Poamoho section of the ʻEwa Forest Reserve. It also links to the 5,300-acre Ahupuaʻa ʻO Kahana State Park and the 4,524-acre Oʻahu Forest National Wildlife Reserve (more than 14,000 acres in addition to the HWA).
- **Reforestation of fallow agricultural areas will improve foraging habitat and create roosting and breeding habitat for the Hawaiian hoary bat.** In addition to creating and enhancing bat habitat, the reforestation of significant tracts of land provides a significant research opportunity that could be used to improve habitat management approaches for Hawaiian hoary bats.
- **Protection of HWA provides a water source for bats**. The streams within the parcels provide open water for bats which are known to forage over streams, reservoirs, wetlands, and other water sources (USDA 2009; SWCA 2011).
- **Protection of the HWA facilitates access to other mitigation sites.** State control of this land would facilitate year-round access to the Poamoho Section of the ʻEwa Forest Reserve where additional HCP mitigation is being conducted (A. Siddiqi, DOFAW, pers. comm., February 2016).
- **Protection of HWA provides an opportunity for public outreach.** Sharing with the public the benefits of protecting large parcels and native species habitat can be influential in raising awareness of the needs of the Hawaiian hoary bat and benefits that individuals can provide to the bat such as awareness of the timing for residential tree trimming, bat habitat needs, and use of barbed wire fence.

The mitigation credit originally assessed for the HWA acquisition was based on a funding amount of $50,000 per bat, in accordance with DOFAW guidance at the time. Because of changes to USFWS and

DOFAW guidance, updates were made to the HCP Amendment in 2018 to also demonstrate the biological value of the mitigation to the Hawaiian hoary bat by assessing mitigation credit on an acreage-per-bat basis.

Mitigation credit for the HWA acquisition is assessed based on the acreage funded by Kawailoa Wind, as well as a percentage of the remaining acres. No other funding partners are seeking mitigation credit. The proportion of acreage equal to USFWS Section 6 and USFWS Pittman-Robertson funds (and associated matches) are excluded (see Table 3). Of the total acquisition, 74 percent is either funded directly by Kawailoa Wind or by other sources from which a proportion of the mitigation credit may be assessed. Native and mixed forest habitat, particularly the contiguous tracks that would be protected in the HWA provide both foraging and roosting areas and is considered highly suitable for the Hawaiian hoary bat. The median core use area for the Hawaiian hoary bat is 20.3 acres per bat (DLNR 2015). A total of 1,116.5 acres would be required to offset the take of 55 bats (1,116.5 acres / 20.3 acres per bat = 55 bats). There are 1,614 acres of native and mixed forest land that may be used to calculate take offset after the reduction is applied, this equates to a mitigation credit of at least 55 bats. The mitigation offset of 20.3 acres per bat assumes terrestrial, not water feature or wetlands, which have been documented to be associated with higher densities of bats.

Based on the calculation of reproduction outlined in the guidance for calculating indirect take, providing habitat for 55 bats would be anticipated to generate 14.85 adults per year (55 bats * 50% female * 0.54 offspring per female surviving to adulthood). This may overestimate the number of offspring produced but is provided for a direct comparison of take estimation to mitigation, and as an illustration of the ongoing productivity expected to be provided by the HWA. Because no tools exist to monitor Hawaiian hoary bat breeding, it must be inferred that breeding will occur on the HWA. Therefore, Kawailoa Wind is not requesting additional mitigation credit from subsequent generations, or offspring produced by the HWA. The impact of productivity and future generations should aid in the assessment of the benefit of the mitigation. With the addition of future generations, there is a clear net benefit to the Hawaiian hoary bat from the protection of the HWA parcels as Tier 4 mitigation.

Acquisition of the HWA ensures protection of Hawaiian hoary bat habitat from future development, meeting USFWS and DLNR long-term conservation goals described in the ESRC Bat guidance (DLNR 2015), the Hawaiian hoary bat recovery plan (USFWS 1998), and the USFWS 5-year review (USFWS 2011). Protection of HWA also enhances the connectivity of important conservation areas. These actions would benefit bats beyond the term of the ITP/ITL by providing native forest roosting and foraging habitat in perpetuity, thereby providing a net benefit to the species. Protection of this area also provides a unique opportunity to conduct habitat management on a large scale to measure the effectiveness of various approaches in recovering bat populations.

Based on the above discussion, the Tier 4 mitigation fully offsets the take of the 55 bats in Tier 4 and provides a net benefit to the species as outlined in HRS 195D. The offset of Tier 4 and the biological basis for the offset is supported by USFWS and DOFAW in letters of support dated 26 September 2018 and 21 September 2018, respectively. In accordance with HRS 195D-21, the mitigation provides certainty that the ecosystems and habitat types that support the Hawaiian hoary bat will be maintained for the life of the plan. The projected future take is conservative, so it is highly probable that the total take will be less than the estimated take. Additionally, the project impacts will last only for the permit term, while the benefits of acquiring the HWA will be in perpetuity.

5.0 Partners and Funding

Kawailoa Wind, USFWS, DOFAW, TPL, and other funding partners have worked diligently to assemble a land acquisition package that meets shared broad conservation goals with superior opportunities for Hawaiian hoary bat conservation. In addition, USFWS, DOFAW, and TPL have worked with a variety of partners to secure funding and potential funding commitments with contingency funding options to provide great confidence that the HWA can be purchased. Funding partners and commitments are described in Table 2.

Table 2. Costs and Funding Partners

Funding source	Funding Amount	Percent of Total Funding	Excluded from Mitigation	Applicable % of Funding for Mitigation Offset
Hawaii State Legacy Land Conservation Fund	$1,513,800	10.0%	Yes	0
US Forest Service Legacy Program	$5,000,000	33.0%	No	33%
USFWS Section 6 - HCP Planning and Acquisition	$2,000,000	13.2%	Yes	0.0%
USFWS Pittman Robertson	$400,000	2.6%	Yes	0.0%
US Navy REPI	$3,500,000	23.1%	No	23.1%
Kawailoa Wind	$2,750,000	18.1%	No	18.1%
Total Funding	**$15,163,800.00**			
Applicable Funding				**56%**
Not Applicable Funding				**44%**

6.0 Schedule

Final commitments to fund the purchase have been acquired. The Hawaii Board of Land and Natural Resources has given DOFAW final authorization to purchase the property, and the purchase was finalized in 2018. Although the closure date is earlier than issuance of the ITP, ITL, HCP Amendment is anticipated, Kawailoa Wind is committed to fund their portion of the HWA to meet the required schedule and in good faith that the ITP and ITL will be forthcoming. Ownership of HWA has been transferred to DOFAW and allows for the prompt initiation of research and restoration activities.

7.0 References

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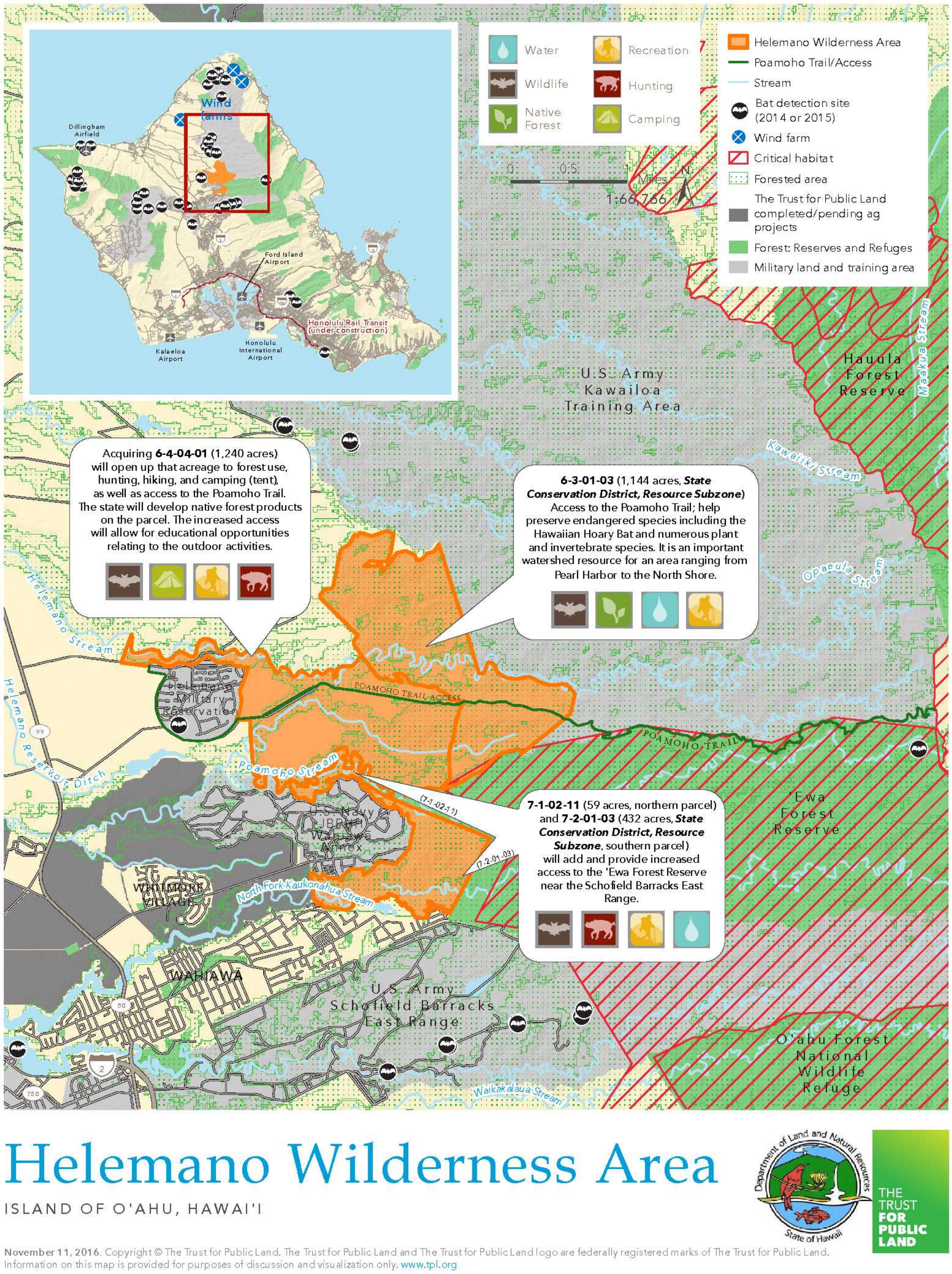

Figure 1. Helemano Wilderness Area: Overview of Connected Resources and Proposed Management

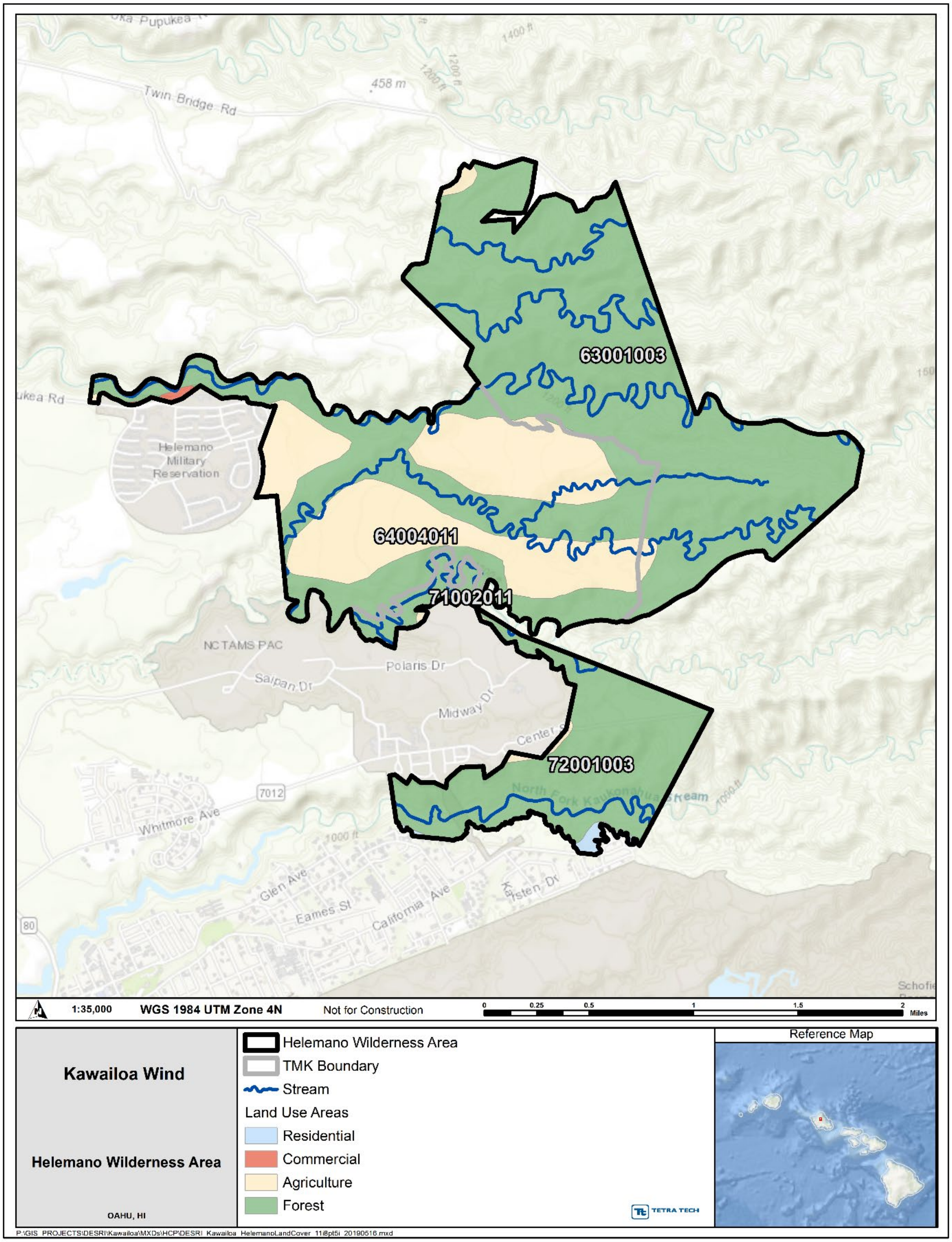

Figure 2. Helemano Wilderness Area: Land Use and Land Cover

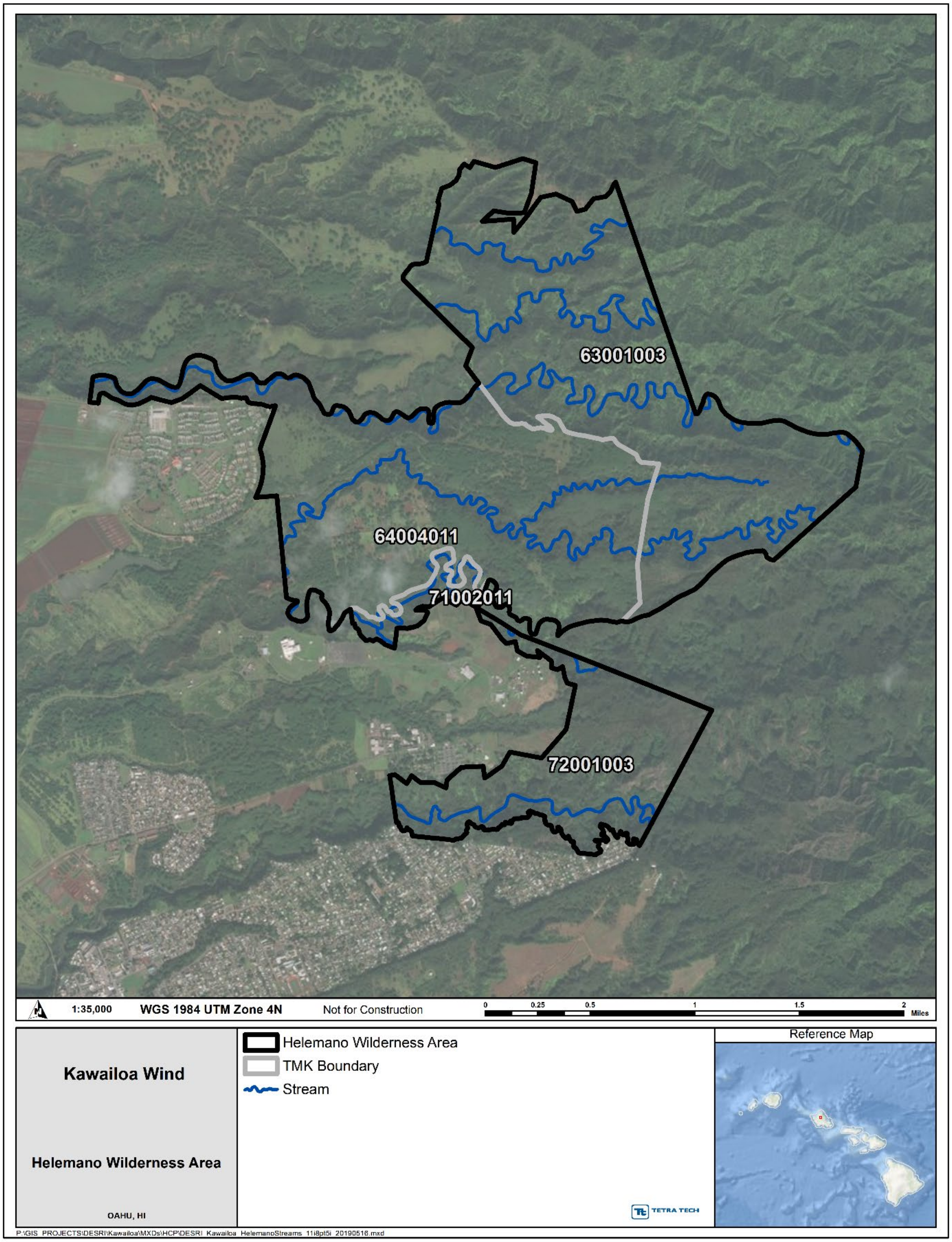

Figure 3. Helemano Wilderness Area: Aerial Imagery and Streams