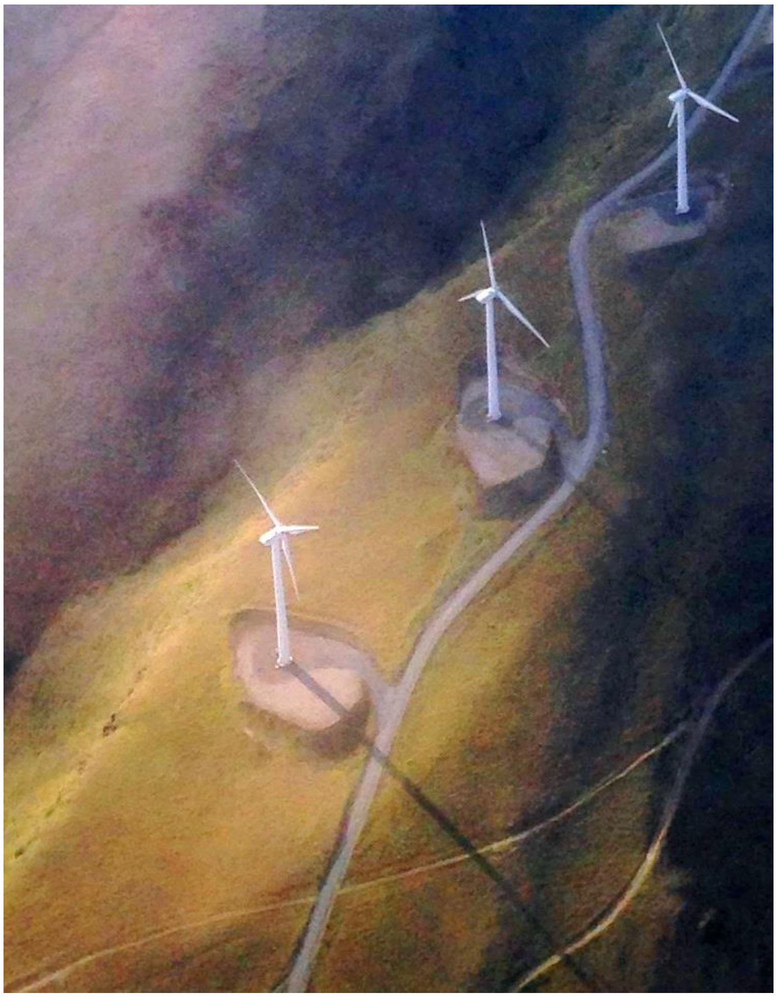
KAHEAWA WIND POWER II

DRAFT HABITAT CONSERVATION PLAN
(Amended)



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Original: December 2011; Amended: June 2018

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Acronyms and Abbreviations

§	section
ac	acre
Applicant	Kaheawa Wind Power II, LLC
APLIC	Avian Power Line Interaction Committee
bbl	barrels
BESS	Battery Energy Storage System
BLNR	Board of Land and Natural Resources
CARE	Carcass Retention
CDUP	Conservation District Use Permit
CFR	Code of Federal Regulations
cm	centimeter(s)
CO_2	carbon dioxide
DEIS	Draft Environmental Impact Statement
df	degrees of freedom
DLNR	Department of Land and Natural Resources
DOFAW	DLNR Division of Forestry and Wildlife
e.g.	for example
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EoA	Evidence of Absence
ESA	Endangered Species Act
ESRC	Endangered Species Recovery Committee
et al	and others
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
ft	foot, feet
FY	fiscal year
GE	General Electric
ha	hectare
HBRC	Hawaii Bat Research Cooperative
HCP	Habitat Conservation Plan
hr	hour
HRS	Hawaii Revised Statutes

Inc	Incorporated
ITL	Incidental Take License
ITP	Incidental Take Permit
kg	kilogram(s)
kph	kilometers per hour
kV	kilovolt(s)
kW	kilowatt(s)
kWh	kilowatt hour(s)
KWP	Kaheawa Wind Power
LLC	Limited Liability Company
LWSC	Low Wind Speed Curtailment
m	meter(s)
MM	million
m/s	meters per second
MBTA	Migratory Bird Treaty Act
MECO	Maui Electric Company
met tower	meteorological tower
mi	mile(s)
MOU	Memorandum of Understanding
mph	miles per hour
MW	megawatt(s)
MWh	megawatt hour(s)
N/A	not applicable
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	US Department of Commerce, National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxides
NRAG	Nēnē Recovery Action Group
NREL	National Renewable Energy Laboratory
OCCL	Office of Conservation and Coastal Lands
O&M	operation and maintenance
p	probability
PPA	Power Purchase Agreement
Project	Kaheawa Wind Power II
PUC	Public Utility Commission
rpm	revolutions per minute
RSZ	rotor swept zone
SEEF	Searcher Efficiency
SHPO	State Historic Preservation Officer
SO2	sulfur dioxide
spp	species
TM	registered trademark
USDA-NRCS	United States Department of Agriculture-Natural Resources Conservation Service
unpub	unpublished
USFWS	U.S. Fish and Wildlife Service
USGS-BRD	U.S. Geological Survey, Biological Resources Division
WEOP	Wildlife Education and Observation Program
WTG	wind turbine generator
yd	yard(s)

1.0 INTRODUCTION AND PROJECT OVERVIEW

1.1 Summary and Rationale for the Amendment -UPDATED

~~The Applicant~~KWP II is seeking an amendment to ~~their~~ its Incidental Take Permit (ITP) in accordance with Section 10(a)(1)(B) of the Federal Endangered Species Act (ESA) of 1973, as amended, and Incidental Take License (ITL) in accordance with Chapter 195-D, Hawai'i Revised Statutes. The letter of intent to request an amendment to the state ITL and federal ITP was sent July 10, 2014. KWP II submitted a request for this amendment on May 8, 2015. These permits are issued by the U.S. Fish and Wildlife Service (USFWS) and State Department of Land and Natural Resources (DLNR) (also referred to as the "agencies"), respectively. The requested amended take for KWP II is summarized in Table 1.1. KWP II is requesting an additional 14 adult nēnē (total 44) and 27 adult Hawaiian hoary bats (total 38).

This HCP amendment supports the issuance of these permits, and describes how the Applicant will avoid, minimize, mitigate and monitor the incidental take of threatened and endangered species that may occur during operation of the project. Efforts to minimize the potential impacts the facility may have on these listed species have already been incorporated into the site design and configuration. The general and species-specific mitigation measures the Applicant has proposed are intended to increase knowledge of the species' biology and distribution, enhance populations, ~~or~~ restore degraded native habitat or protect valuable habitat. Mitigation measures are intended to offset take to the maximum extent practicable and are required to provide a net benefit to the species as required under State law. Mitigation measures are briefly summarized in Table 1.2 and Table 1.3 for the Covered Species.

This amended Habitat Conservation Plan (HCP) includes added, updated or deleted text necessary to amend the original HCP, federal Incidental Take Permit (ITP # TE2760 A-0), and State Incidental Take License (ITL # 15), ~~approved in January 2012 for a 20-year term,~~ to increase take of the Hawaiian hoary bat (*Lasiuris cinereus semotus*) and the Hawaiian goose or nēnē (*Branta sandvicensis*). The Permit and License were approved in January 2012 for a 20-year term. The proposed amendments are for an existing facility; no additional construction or changes in operations are proposed. KWP II did not begin operations until July 2012. Since the permit ends in January 2032 the number of years take projections will be based upon is 19.5 years. The terms "permit term" or "20-year permit term or period" will always equate to 19.5 years.

Operation of the KWP II project has the potential to result in the incidental take of four Federally and State-listed threatened and endangered species: the Hawaiian petrel ~~(*Pterodroma sandwichensis*)~~, Newell's shearwater ~~(*Puffinus newelli*)~~, nēnē or the Hawaiian goose ~~(*Branta sandvicensis*)~~, and Hawaiian hoary bat ~~(*Lasiurus cinereus semotus*)~~. Hereafter, these four species are collectively referred to as the "Covered Species." These species are known to fly in the vicinity of the project area and could be injured or killed if they collide with a WTG or other project component. Two seabird species are addressed in the original HCP. This amendment only addresses the bat and nēnē. No other listed, proposed, or candidate species has been found or is known or expected to be present in the project area.

The purpose of this document is to present the changes to the HCP that pertain to the proposed increase in take of Hawaiian hoary bat and nēnē. Sections of the HCP that are being amended are indicated as UPDATED or NEW in the section headings. In Section 1.0, Subsections that are not being amended are labeled "NO CHANGE" or "NOT APPLICABLE". In later Sections (2.0 and higher) Subsections that are not being changed are labeled "NO CHANGE" or "NOT APPLICABLE" and the text is deleted. These include, for example, the impacts analysis, conservation measures, impacts analysis and compensatory mitigation for Newell's shearwater (*Puffinus newelli*) and Hawaiian petrel (*Pterodroma sandwichensis*) which will remain unchanged with this amendment.

Rates of incidental take of bats and nēnē were estimated for KWP II prior to operations commencing based on the rates of observed take documented at the adjacent KWP I site and measurements of bat and nēnē activity that were made at the proposed site as well as at the neighboring KWP I site. These pre-operation inputs used to estimate projected take represent information from the best scientific methods available at the time for downed wildlife monitoring and take estimation. The pre-operations calculated incidental take estimates determined the original ITP and ITL permit requests. The revised and higher incidental take estimates of the bat that have prompted this request for take amendments are based on calculations using the latest version of the Evidence of Absence estimation software (v. 2.06) and actual take observed as well as other parameters measured (explained in this document) during systematic downed wildlife monitoring conducted continuously at the site since the project became operational in July 2012 (Dalthorp *et al.* 2017, Kaheawa Wind Power I and II, LLCs. 2013, Kaheawa Wind Power II, LLC. 2014, 2015, 2016, 2017 and 2018). The revised and higher incidental take estimates of the nēnē are based on calculations using the actual nēnē take observed as well as other parameters measured (explained in this document) during systematic downed wildlife monitoring. Downed wildlife monitoring provides an estimate of the actual take that is likely to be occurring and is used adaptively by the wildlife agencies and Applicant to ensure that take is estimated as accurately as possible.

For various reasons explained in this document the best available information at the time the take permit and license were issued for KWP II was not adequate to accurately project estimated bat take for the 20-year permit period. Since operations began at KWP II the estimation software has improved, is more robust in a variety of situations, and is now able to estimate take with a user-chosen level of credibility that the true mortality is not greater than the estimate. At the request of the USFWS the level of credibility all permittees and applicants use is a conservative 80%. This change alone has increased the projected estimate compared to the pre-operations estimates. The search conditions and methods and the bat detection sensitivity also have improved considerably. Also, canine-assisted downed wildlife monitoring, vegetation management and scavenger trapping implemented since operations began (at both KWP I and KWP II) improved searcher efficiency and carcass retention increasing accuracy and reducing uncertainty. Currently two other wind generation facilities in Hawaii have also underestimated the take of bats and are requesting or are expected to request take amendments.

The pre-operations estimate of bat take for KWP II assumed the take rate per turbine would be less than the rate recorded at KWP I between 2006 and 2012 primarily because Low Wind Speed Curtailment (LWSC) to 5.0 m/s would be implemented at KWP II. LWSC was expected to reduce the take rate relative to the rate measured at KWP I prior to 2012. LWSC was not implemented at KWP I prior to FY 2015. The annual take rate per turbine at KWP II had been projected to be 0.04 bats compared to 0.07 bats for KWP I considering the first 5 years of operations at KWP I (Section 1.4.5.5). In retrospect, the bat take rate at KWP I during those years before KWP II was operational was lower than the rate for subsequent years at KWP I either because the take or bat activity was actually lower before FY 2013 or downed wildlife monitoring search conditions and methods did not provide sufficiently accurate information to use in projecting estimated take at KWP II (or KWP I).

Given the current observed nēnē take for KWP I for 20 turbines, the estimated take for the 20-year permit period is 64 adult nēnē (KWP I 2018). A simple extrapolation of take by number of turbines (3.2 nēnē per turbine) would suggest the 20-year take estimate for nēnē for KWP II with 14 turbines would be about 45 adult nēnē which is very close to the current projected 20-year estimate for nēnē at KWP II. The level of nēnē activity at KWP I has always been greater than the activity level in the KWP II area (see KWP I and KWP II HCP annual reports). Consequently the 20-year projected take estimate for nēnē calculated in 2012 for KWP II was assumed to be 50% less per turbine than at KWP I. Considering observed take derived from downed wildlife monitoring we can more accurately estimate the 20-year projected take of nēnē at KWP II and that estimate is about 50% higher than originally predicted, i.e., similar to the take rate at KWP I.

Kaheawa Wind Power II, Limited Liability Company (LLC) ("KWP II LLC" or the "Applicant") currently operates a 21-megawatt (MW) wind energy generation facility near Kaheawa Pastures above Māʻalaea in the southwestern portion of the Island of Maui, Hawaiʻi. The Project, known as Kaheawa Wind Power II (KWP II), is situated on approximately 143 acres (ac) (58 hectares (ha)) of State Conservation Land southeast of the existing 30-MW Kaheawa Wind Power (KWP I) project (see Figures 1.1 and 1.2) and began commercial operations on July 2012. KWP I commenced operation in June 2006. Like the KWP I project, KWP II supplies wind-generated electricity to Maui Electric Company Ltd. (MECO).

The project components of KWP II ~~will~~ consist of:

- 14 General Electric (GE) 1.5-MW wind turbine generators (WTGs)
- sharing of the existing operations and maintenance building (O&M) with KWP I
- one 5,000 feet squared (ft^2) maintenance building next to the existing KWP I O&M building
- one substation
- underground cables carrying electrical power from the individual wind generators to a new electrical substation
- a battery energy storage system (BESS)
- an overhead electrical collection line across Manawainui Gulch connecting the collection system with the new substation
- a short overhead electrical transmission line connecting the substation to the uppermost of the two existing MECO 69 kiloVolt (kV) transmission lines through the area
- a communications system of underground fiber optic cables connecting to the existing KWP I communications tower
- ~~one permanent meteorological tower~~
- service roadways connecting the WTGs and other facilities to the existing main access road serving KWP I

These components disturb approximately 43 acres (17.4 ha) of land or approximately 30% of the project area; the remainder would remain undisturbed.

During preconstruction, the Applicant collected meteorological data at the KWP II site to determine suitable areas for the proposed WTGs. The data show that the most favorable areas are to the west and south of the KWP I turbines. Because of the characteristics of the prevailing winds, constructability and other factors, the Applicant determined that the "Downroad" area was the best site for the KWP II project. Fourteen WTGs were constructed along the existing KWP I access road below the existing WTGs (see Figure 1.3, and Figure 4.1).

Adjusted take estimates at KWP II for all species consider both direct and indirect take. Direct take comprises individuals that are killed or injured colliding with turbines or associated structures on site. Indirect take considers that it is possible that adult birds killed ~~through on-site~~ due to collisions could have been tending to eggs, nestlings or dependent fledglings, or adult bats could have been tending to dependent juveniles. In such cases, the loss of these adults would then also lead to the loss of their eggs or dependent young. Loss of eggs or young would be "indirect take" attributable to the project.

Mitigation for loss of productivity resulting from nēnē and seabird take is considered in addition to mitigating for direct and indirect take. Loss of productivity is the loss of offspring that an adult could have potentially produced if it had not been killed and continued to reproduce in future years. For mitigation purposes, loss of productivity accrues between the time the direct/indirect take occurs and the time that mitigation for the direct/indirect take is provided. Although mitigation is provided to offset the impact, loss of productivity is not counted as permitted take. As of June ~~2017~~2018, direct take~~s~~ observed ~~documented~~ within the search area at the existing KWP I facility include seven Hawaiian petrels, 23 nēnē and ~~nine~~ eight Hawaiian hoary bats. Direct take observed within the search area at the existing KWP II facility include three Hawaiian hoary bats and ~~four~~ five nēnē. No seabirds have been found at KWP II.

~~Multiple options for mitigation measures for the nēnē and bat are provided to allow flexibility at the time the measures are implemented and are based on highest priority needs identified at that time by the wildlife agencies and the nēnē advisory group. Bat ecology research as mitigation is specifically targeted to inform existing or future land management mitigation measures. For example, if research indicates bats prefer to prey on koa moths associated with koa trees, then an effective mitigation project may be to protect koa forests or enhance/restore them through invasive tree removal or koa tree out-planting.~~

Additionally, the HCP outlines a monitoring protocol to determine the actual take of each species after the facility began operating. Most importantly, this HCP incorporates adaptive management provisions to allow for modifications to the mitigation and monitoring measures as knowledge is gained during implementation.

Table 1.1. Requested Take for KWP II at Tier 1, Tier 2, Tier 3, and Tier 4.-*UPDATED*

Common Name	Scientific Name	Mitigation & Take	Annual Take Limit	Five Year Take Limit[1]	Twenty Year Take Limit
Nēnē (Hawaiian goose)	*Branta sandvicensis*	Tier 1	4 adults/ immatures and 1 fledgling	8 adults/ immatures and 1 fledgling	up to 21 total nēnē: 18 adults/ immatures and ~~2~~ 3 fledglings
		Tier 2	up to 6 adults/ immatures and 1 fledgling	up to 12 adults/ immatures and 3 fledglings	up to 30 total nēnē: 27 adults/ immatures and 3 fledglings
		Tier 3	not applicable (n/a)	n/a	up to ~~36~~ 44 adult nēnē
		~~Tier 4~~	~~n/a~~	~~n/a~~	~~up to 41 adult nēnē~~
ʻŌpeʻapeʻa (Hawaiian hoary bat)	*Lasiurus cinereus semotus*	Tier 1	5 adults[2]	7 adults[3]	7 adults[3]
		Tier 2	11 adults[4]	11 adults[4]	11 adults[4]
		Tier 3	n/a	n/a	up to ~~45~~ 30 adult bats
		Tier 4	n/a	n/a	up to ~~48~~38 adult bats

[1] The five-year take limits are included only in the State ITL, The Federal ITP includes only 20-year limits.
[2] This was revised to be equivalent to 5 adult bats in a clarification letter from USFWS and DOFAW (2014-TA0260), dated May 20, 2014.
[3] This was revised to be equivalent to 7 adult bats in a clarification letter from USFWS and DOFAW (2014-TA0260), dated May 20, 2014.
[4] This was revised to be equivalent to 11 adult bats in a clarification letter from USFWS and DOFAW (2014-TA0260), dated May 20, 2014.

Table 1.2. Mitigation for Nēnē and Bat: Tier 1 and Tier 2 Mitigation Scenarios. -*UPDATED*

Tier 1 Mitigation	Tier 2 Mitigation
Nēnē	
1a. Perform systematic visual observations of nēnē activity within KWP II site to document how nēnē use the project area following construction. Ongoing. 1b. Establish predator trap lines in known nesting areas, remove invasive vegetation in and around open-top release pens, and monitor movements and nesting activities throughout Maui County. Ongoing	1. Support logistics, DLNR Division of Forestry and Wildlife (DOFAW) staffing predator control and vegetation management. Monitor and model benefits of action to confirm mitigation offsets Tier 2 take. ~~(Tier 1 Take Not Exceeded)~~
Hawaiian Hoary Bat	
1a. Conduct surveys to document bat occupancy at different habitat types (e.g., ridges vs. gulches) and elevation ranges at KWP II and vicinity to support Maui bat research. Ongoing. 1b. Restoration of bat habitat at acreage commensurate with the requested take. Ongoing at Kahikinui Forest Reserve (Appendix 29, KWP II 2016).	1a. Continue surveys to document bat occupancy at different habitat types (e.g., ridges vs. gulches) and elevation ranges at KWP II and vicinity to support Maui bat research. Ongoing. 1b. Restoration of additional bat habitat at acreage commensurate with the requested take. Ongoing at Kahikinui Forest Reserve (Appendix 29, KWP II 2016).

Table 1.3. Summary of Proposed Tier 3 ~~and Tier 4~~ Mitigation for Nēnē and Tier 3 and Tier 4 Mitigation for Hawaiian Hoary Bats. -*NEW*

Nēnē

Tier 3

The applicant will fully offset the impacts of the take by:

- ~~Implementing~~ Extending predator control and vegetation management for nesting and foraging at the Pi'iholo Ranch ~~and providing monitoring reports at an existing~~ pen on Maui ~~or at a site where nēnē regularly forage or nest,~~ which will increase productivity and fledgling survival rates (Appendix 31)~~and productivity commensurate with the requested take~~.

- Providing status reports to the wildlife agencies.

~~AND/OR~~

- ~~Building a new pen to protect nesting nēnē or fence suitable habitat for foraging or nesting.~~

~~AND/OR~~

- ~~Managing vegetation for nesting and foraging.~~

Hawaiian Hoary Bat

Tier 3

The applicant will offset the impacts of the take to the maximum extent practicable by:

- ~~Restoring bat habitat or implementing other land management measures at an approved conservation site commensurate with the requested take, monitoring restoration efforts, and providing status reports to the wildlife agencies.~~

~~AND/OR~~

- Funding ~~or supporting~~ bat research on Hawai`i Island conducted by the USGS Hawaiian Hoary Bat Research Group that will provide basic bat ecology and life history information, better inform future mitigation efforts and aid in the recovery of the species. (see DOFAW 2015 and Appendix 30).

- Providing status reports to the wildlife agencies.

~~AND/OR~~

- ~~Mitigation through an approved federal and state Hawaiian hoary bat in lieu fee program.~~

Tier 4

The applicant will offset the impacts of the take to the maximum extent practicable by:

- Purchasing land that is not already in conservation, where bats are present, and where the land parcel is in danger of being developed or compromised. The approximate acreage per bat would be 60-80 acres or 480-640 acres total for eight bats. The specific parcel would be determined when funding and planning for Tier 4 take is required.

- Providing status reports to the wildlife agencies.

OR

Mitigation through an approved federal and state Hawaiian hoary bat in lieu fee program.

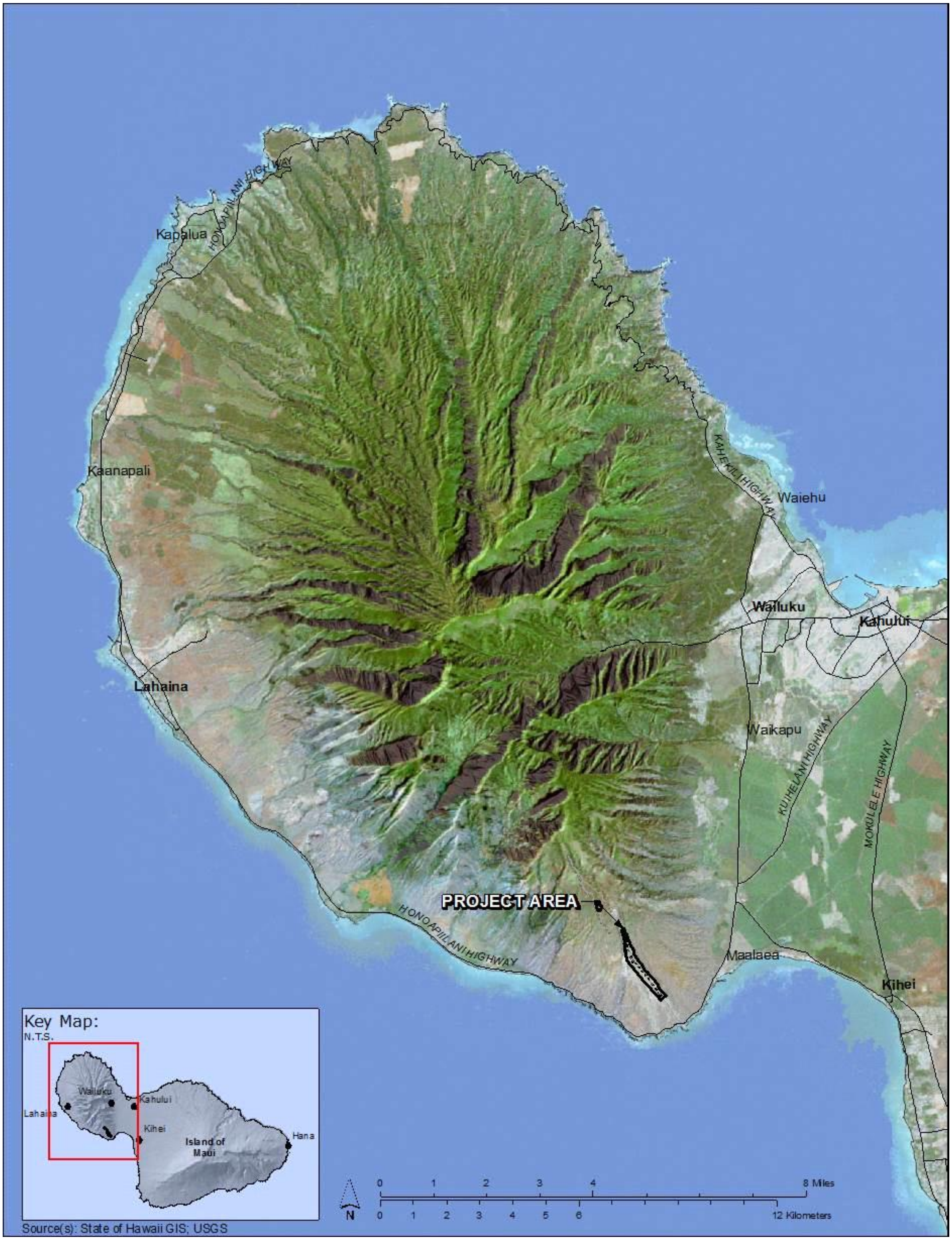

Figure 1.1. KWP II Project Location Map. -*NO CHANGE*

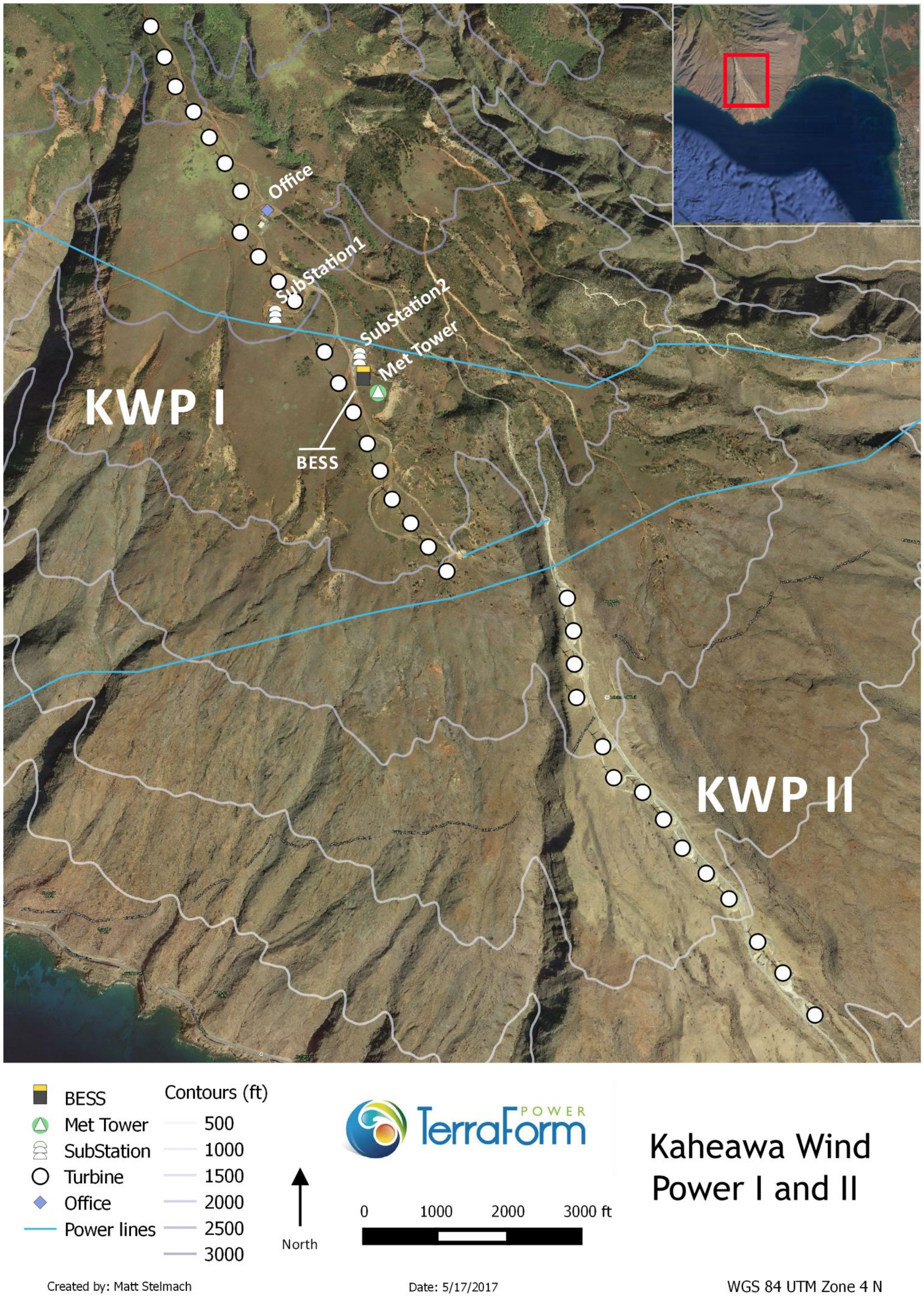

Figure 1.2. Site layout. *-NEW*.

~~Additionally, the HCP outlines a monitoring protocol to determine the actual take of each species after the facility began operating. Most importantly, this HCP incorporates adaptive management provisions to allow for modifications to the mitigation and monitoring measures as knowledge is gained during implementation.~~

1.2 Applicant Background -*UPDATED*

~~KWP II LLC was formed by Hawai`i Holdings LLC, which comprised two entities, First Wind and Makani Nui Associates, LLC. First Wind a Boston-based wind energy company. Makani Nui Associates LLC is a Maui-based partnership providing local resources for the project. KWP II LLC was created for the express purpose of developing a new wind generation facility adjacent to KWP I.~~ KWP II LLC is currently owned by Terraform Power LLC. In North America Terraform Power LLC has a global portfolio of more than 4,000 MW of wind and solar energy generation in operation.

1.3 Regulatory Context

1.3.1 Federal Endangered Species Act -*UPDATED*

Section 9 of the ESA prohibits the unauthorized "take" of any endangered or threatened species of fish or wildlife listed under the ESA. Under the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect species listed as endangered or threatened, or to attempt to engage in any such conduct. "Harm" in the definition of "take" in the ESA means an act which kills or injures wildlife, and may include significant habitat modification or degradation where it kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering (50 Code of Federal Regulations (CFR) section (§)17.3). "Harass" in the definition of take in the ESA means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR 17.3).

The USFWS may permit, under certain terms and conditions, any taking otherwise prohibited by Section 9 of the ESA if such taking is incidental to the carrying out of an otherwise lawful activity through the issuance of an Incidental Take Permit (ITP). As a condition of an ITP, an applicant must prepare and submit to the Service for approval a HCP containing the following mandatory elements set forth under section 10(a)(2)(A) of the ESA:

- The impact that will likely result from the taking;
- What steps the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps;
- What alternative actions to such taking the applicant considered, and the reasons why such alternatives are not being utilized; and
- Such other measures that the Service (under authority delegated by the Secretary of the Interior) may require as being necessary or appropriate for the purposes of the HCP.

Under provisions of the ESA, the Service (under authority delegated by the Secretary of the Interior) will issue an ITP if the application meets the following issuance criteria identified in section 10(a)(2)(B) of the ESA and implementing regulations:

- The taking of the listed species will be incidental;
- The Applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking on the species;

• The Applicant will ensure that adequate funding for implementation of the HCP, including procedures to deal with changed and unforeseen circumstances, will be provided;

• The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild; and

• Other measures required by the Service as being necessary or appropriate for purposes of the HCP will be implemented.

The Service will document its assessment of the ITP and HCP in an ESA Section 10 findings document. If the Service makes the requisite findings, the Service will issue the ITP and approve the HCP. In such cases, the Service will decide whether to issue the ITP conditioned on implementation of the proposed HCP as submitted, or as amended to include other measures the Service determines are necessary or appropriate. If the Service finds that the requisite criteria are not satisfied, the permit request will be denied.

The USFWS may permit, under certain terms and conditions, any taking otherwise prohibited by Section 9 of the ESA if such taking is incidental to the carrying out of an otherwise lawful activity. To apply for an ITP, an applicant must develop, fund and implement a USFWS-approved HCP to minimize and mitigate the effects of the incidental take. Such take may be permitted provided the following issuance criteria of ESA Section 10(a)(1)(B) and 50 CFR §17.22(b)(2) and 50 CFR §17.32(b)(2) are met:

- The taking will be incidental.
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such takings.
- The applicant will ensure that adequate funding for the conservation plan and procedures to deal with unforeseen circumstances will be provided.
- The taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild.
- Other necessary or appropriate measures required by the Secretary of the Interior, if any, will be met.

To obtain an ITP, an applicant must prepare a supporting HCP that provides the following information described in ESA Section 10(a)(2)(A) and 50 CFR 17.22(b)(1) and 50 CFR §17.32(b)(1):

- The impact that will likely result from such taking.
- The measures the applicant will undertake to monitor, minimize and mitigate such impacts, the funding that will be available to implement such measures, and the procedures to be used to deal with unforeseen circumstances.
- The alternative actions to such taking the applicant considered and the reasons why such alternatives are not proposed to be utilized.
- Such other measures that the Director of the USFWS may require as necessary or appropriate for purposes of the plan.

The *Habitat Conservation Planning and Incidental Take Permit Processing Handbook*, published by the USFWS and the National Marine Fisheries Service (NMFS) in November 1996 and updated December 2017, provides additional policy guidance concerning the preparation and content of HCPs. The USFWS and NMFS published an addendum to the *HCP Handbook* on June 1, 2000 (65 FR 35242) (USFWS and National Oceanic and Atmospheric Administration (NOAA) 2000). This addendum, also known as the Five-Point Policy, provides clarifying guidance for the two agencies in issuing ITPs and for those applying for an ITP under Section 10. The five components addressed in the policy are discussed briefly below:

Biological Goals and Objectives: HCPs must include biological goals (broad guiding principles for the conservation program – the rationale behind the minimization and mitigation strategies), and biological objectives (the measurable targets for achieving the biological goals). These goals and objectives must be based on the best scientific information available and are used to guide conservation strategies for species covered by the plan.

Adaptive Management: The Five-Point Policy encourages the development of adaptive management plans as part of the HCP process under certain circumstances. Adaptive management is an integrated method for addressing biological uncertainty and devising alternative strategies for meeting biological goals and objectives. An adaptive management strategy is essential for HCPs that would otherwise pose a significant risk to the Covered Species due to significant information gaps.

Monitoring: Monitoring is a mandatory element of all HCPs under the Five-Point Policy. As such, an HCP must provide for monitoring programs to gauge the effectiveness of the plan in meeting the biological goals and objectives, and to verify that the terms and conditions of the plan are being properly implemented.

Permit Duration: Under existing regulations, several factors are used to determine the duration of an ITP, including the duration of the applicant's proposed activities and the expected positive and negative effects on Covered Species associated with the proposed duration. Under the Five- Point Policy, the USFWS will also consider the level of scientific and commercial data underlying the proposed operating conservation program, the length of time necessary to implement and achieve the benefits of the operating conservation program, and the extent to which the program incorporates adaptive management strategies.

Public Participation: Under the Five-Point Policy guidance, the USFWS announced its intent to expand public participation in the HCP process to provide greater opportunity for the public to assess, review and analyze HCPs and associated documentation (e.g., National Environmental Policy Act [NEPA] review). As part of this effort, the USFWS has expanded the public review process for most HCPs from a 30-day comment period to a 60-day period.

1.3.2 Federal National Environmental Policy Act ***-UPDATED***

Issuance of an ITP is a Federal action subject to compliance with the National Environmental Policy Act (NEPA). The purpose of NEPA is to promote agency analysis and public disclosure of the environmental issues surrounding a proposed Federal action to reach a decision that reflects NEPA's mandate to strive for harmony between human activity and the natural world. The scope of NEPA goes beyond that of the ESA by considering the impact of a Federal action on non-wildlife resources, such as water quality, air quality and cultural resources.

The USFWS ~~will~~ prepared ~~and provide for public review an~~ a Final Environmental Assessment (EA) dated December 26, 2011 that ~~to~~ evaluated the potential environmental impacts of issuing ~~an~~ the original ITP. ~~and approving the implementation of the proposed KWP II HCP. The purpose of the EA is to determine if ITP issuance and HCP implementation will significantly affect the quality of the human environment. If the USFWS determines significant impacts are likely to occur, a comprehensive Environmental Impact Statement (EIS) for the proposed action will be prepared and distributed for public review; otherwise, a~~ A Finding of No Significant Impact (FONSI) and the original ITP were ~~will be~~ issued January 3, 2012. ~~The USFWS will not decide on ITP issuance until after the NEPA process is complete. The original State EIS is dated April 22, 2010 and the Federal EA is dated December 26, 2011.~~ A ~~supplemental State EIS and a~~ new Federal EIS for this amendment ~~are~~ is being prepared by the USFWS. The Notice of Intent (NOI) to draft an EIS was published in the Federal Register on June 1, 2018 and public scoping meetings relating to the NOI are planned for mid-June 2018 and will be held on Hawai'i, Maui and Oahu Islands.

1.3.3 Federal Migratory Bird Treaty Act –UPDATED

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 MBTA provides no process for authorizing incidental take of MBTA-protected birds. ~~However, if the HCP is approved and USFWS issues an ITP to the Applicant, t~~The terms and conditions of ~~that~~ the ITP will also constitute a Special Purpose Permit under 50 CFR §21.27 for the take of the Hawaiian petrel, Newell's shearwater, and nēnē under the MBTA. Therefore, subject to the terms and conditions to be specified in the ITP, ~~if issued,~~ any such take of the three listed bird species also will not be in violation of the MBTA. However, because the MBTA provides for no incidental take authorization, other MBTA-protected birds that are not protected by the ESA and that may be adversely affected by the proposed wind facility ~~will~~ are not be covered by any take authorization.

To avoid and minimize impacts to MBTA-protected species, the KWP II project incorporates design and operational features based on 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 that have been adopted by KWP II to avoid and minimize the potential for impacts to MBTA-protected species are detailed in Section 4.3. ~~If take of~~ For any MBTA species take that occurs, these will be documented and reported in a similar fashion to that applied to any endangered or threatened species wildlife listed under the ESA.

1.3.4 Federal National Historic Preservation Act -NO CHANGE

USFWS issuance of an ITP under ESA Section 10(a)(1)(B) is considered an "undertaking" covered by the Advisory Council on Historic Preservation and must comply with Section 106 of the National Historic Preservation Act (NHPA) (36 CFR §800). The undertaking is defined as the land-use activity that may proceed once an ITP is issued to an Applicant. Section 106 requires USFWS to assess and determine the potential effects on historic properties that would result from the proposed undertaking and to develop measures to avoid or mitigate any adverse effects. Accordingly, USFWS must consult with the Advisory Council on Historic Preservation, the State Historic Preservation Officer (SHPO), affected Tribes, the applicant, and other interested parties, and make a good-faith effort to consider and incorporate their comments into project planning. The USFWS will determine the "area of potential effects" associated with the proposed undertaking, which is usually defined as the geographic area where the undertaking may directly or indirectly change the character or use of historic properties included in or eligible for inclusion in the National Register of Historic Places. The USFWS generally interprets the area of potential effects as the specific location where incidental take may occur and where ground-disturbing activities may affect historic properties. The USFWS, in consultation with the SHPO, must make a reasonable and good-faith effort to identify undiscovered historic properties. The USFWS also determines the extent of any archeological investigations that may be required; the cost of NHPA compliance, however, rests with the Applicant.

1.3.5 State Endangered Species Legislation (Chapter 195D, Hawai'i Revised Statutes) –UPDATED

Section 195D-4, Hawai'i Revised Statutes (HRS), states that any endangered or threatened species of fish or wildlife recognized by the ESA shall be so deemed by State statute. Like the ESA, the unauthorized "take" of such endangered or threatened species is prohibited [§195D- 4(e)]. The definition of "take" in Section 195D-2, HRS, mirrors the ESA definition.

Under §195D-4(g), the Board of Land and Natural Resources (BLNR), after consultation with the State's Endangered Species Recovery Committee (ESRC), may issue a temporary license (subsequently referred to as an "ITL") to allow a take otherwise prohibited if the take is incidental to the carrying out of an otherwise lawful activity.

To qualify for an ITL, the following must occur:

- The applicant minimizes and mitigates the impacts of the take to the maximum extent practicable (i.e., implements an HCP);
- The applicant guarantees that adequate funding for the HCP will be provided;
- The applicant posts a bond, provides an irrevocable letter of credit, insurance, or surety bond, or provides other similar financial tools, including depositing a sum of money in the endangered species trust fund created by §195D-31, or provides other means approved by BLNR, adequate to ensure monitoring of the species by the State and to ensure that the applicant takes all actions necessary to minimize and mitigate the impacts of the take;
- The plan increases the likelihood that the species will survive and recover;
- The plan takes into consideration the full range of the species on the island so that cumulative impacts associated with the take can be adequately assessed;
- The activity permitted and facilitated by the license to take a species does not involve the use of submerged lands, mining or blasting;
- The cumulative impact of the activity, which is permitted and facilitated by the license, provides net environmental benefits; and
- The take is not likely to cause the loss of genetic representation of an affected population of any endangered, threatened, proposed or candidate plant species.

Section 195D-4(i) directs DLNR to work cooperatively with Federal agencies in concurrently processing HCPs, ITLs, and ITPs. Section 195D-21 deals specifically with HCPs and its provisions are similar to those in Federal regulations. HCPs submitted in support of an ITL application must:

- Identify the geographic area encompassed by the plan; the ecosystems, natural communities, or habitat types within the plan area that are the focus of the plan; and the endangered, threatened, proposed and candidate species known or reasonably expected to be present in those ecosystems, natural communities or habitat types in the plan area;
- Describe the activities contemplated to be undertaken within the plan area with sufficient detail to allow DLNR to evaluate the impact of the activities on the particular ecosystems, natural communities or habitat types within the plan area that are the focus of the plan;
- Identify the steps that will be taken to minimize and mitigate all negative impacts, including without limitation the impact of any authorized incidental take, with consideration of the full range of the species on the island so that cumulative impacts associated with the take can be adequately assessed; and the funding that will be available to implement those steps;
- Identify the measures or actions to be undertaken; a schedule for implementation of the measures or actions; and an adequate funding source to ensure that the actions or measures are undertaken in accordance with the schedule;
- Be consistent with the goals and objectives of any approved recovery plan for any endangered species or threatened species known or reasonably expected to occur in the ecosystems, natural communities or habitat types in the plan area;
- Provide reasonable certainty that the ecosystems, natural communities or habitat types will be maintained in the plan area throughout the life of the plan;

- Contain objective, measurable goals; time frames within which the goals are to be achieved; provisions for monitoring; and provisions for evaluating progress in achieving the goals quantitatively and qualitatively; and
- Provide for an adaptive management strategy that specifies the actions to be taken periodically if the plan is not achieving its goals.

Section 195D-25 provides for the creation of the ESRC, which is composed of biological experts, representatives of relevant Federal and State agencies (i.e., USFWS, U.S. Geological Service (USGS), DLNR), and appropriate governmental and non-governmental members to serve as a consultant to the DLNR and the BLNR on matters relating to endangered, threatened, proposed and candidate species.

Duties of the ESRC include reviewing all applications for HCPs, Safe Harbor Agreements, and ITLs, and making recommendations to the DLNR and the BLNR on whether they should be approved, amended or rejected; reviewing all existing HCPs, Safe Harbor Agreements and ITLs annually to ensure compliance, and making recommendations for any necessary changes; and considering and recommending appropriate incentives to encourage landowners to voluntarily engage in efforts that restore and conserve endangered, threatened, proposed, and candidate species. Hence, the ESRC plays a significant role in the HCP planning process. The Applicant ~~has~~ met with the ESRC during the preparation of this amended HCP on September 8, 2015 and again on October 19, 2017.

1.3.6 State Environmental Review: Chapter 343, Hawai'i Revised Statutes *-NO CHANGE*

The project area is located in a State Conservation District and on land that is owned by the State of Hawai'i; both of these are triggers for Chapter 343 review. KWP II LLC prepared an *Environmental Impact Statement Preparation Notice* (*EISPN*), which was released for public comment on February 8, 2008. It then prepared a Draft Environmental Impact Statement (DEIS), dated February 2, 2009 (Planning Solutions Inc., 2009a). Following the end of the 45-day public review period for the DEIS, its review of the comments and of additional wind data that became available following publication of the DEIS led KWP II to decide to make the site evaluated in the DEIS an alternate and to identify the site that is the subject of this HCP as its "Preferred Alternative." KWP II LLC submitted a *Revised Draft Environmental Impact Statement (Revised DEIS)* in November 2009. The public comment period for the State *Revised Draft KWP II EIS* (Planning Solutions, Inc. 2009b) extended from December 8, 2009 to January 22, 2010.

Feedback and comments on the proposed scope of the analysis and the completeness of the alternatives analyzed in the document were incorporated into the *Final KWP II EIS* (Planning Solutions, Inc. 2010). The FEIS was accepted by the Office of Coastal and Conservation Lands (OCCL) on May 19, 2010, completing the State environmental review process for the project. In addition to the *FEIS*, Kaheawa Wind Power II LLC will also comply with Chapter 343 for any actions conducted under this Habitat Conservation Plan as required by law.

The state has determined that a Supplemental Environmental Impact Statement (SEIS) is required to be prepared for the requested amended take. The SEIS Preparation Notice was published in the state *Environmental Notice* on February 23, 2017 and comments were received until March 28, 2017. A draft of the KWP II amended HCP was also published in the state *Environmental Notice* on October 8, 2017 and comments were received until December 7, 2017. A public meeting to solicit comments about the draft HCP amendment occurred November 27, 2017. An ESRC public site visit occurred at KWP II on February 22, 2018.

1.4 Project Description

1.4.1 Project Design and Components *–UPDATED*

KWP II consists of a 21-MW wind power generating facility and related facilities at Kaheawa Pastures above Mā'alaea, Maui, Hawai'i. The project area is located on approximately 143 acres (58 ha) of State land southeast of the existing KWP I facility at Kaheawa Pastures along the existing access road (see Figures 1.1 and 1.2).

The ApplicantProject comprises the following components and site features:

- Construct new Internal service roads that connect the facility to the existing KWP I access road.
- Install 14 General Electric (GE) 1.5-MW WTGs and supporting equipment. Each WTG is set in a concrete foundation that is no more than 40 feet (12 meters (m)) × 40 feet in lateral directions. An additional 20-foot (6-m) wide cleared gravel perimeter is provided around each foundation to facilitate access and maintenance. Table 1.4 lists other pertinent characteristics of the selected WTGs.
- Install a An underground electrical collection network connecting all of the turbines, including excavation and burying of all wires and re-vegetation of the disturbed areas;
- A 1,225 1,258 foot (374 387 m) overhead collection line mounted on poles approximately 60-90 70 feet (18-25 21.5 m) above ground level required for crossing Manawainui Gulch.
- Construct An new electrical substation and install underground electrical power lines connecting the turbines with the new substation.
- Install Interconnection facilities to connect the project to the existing MECO power transmission system.
- Construct A Battery Energy Storage System (BESS) adjacent to the substation to provide dispatchable energy under various operating conditions. This stored energy is used to improve the ability of the MECO system to absorb additional as-available wind- generated resources.
- Construct A maintenance building to house operations personnel, equipment and facility spare parts.
- A water tank near the highway for accessing County water to be used at the project site. This Water is hauled up hill in a 150-gallon tank as needed and is used for non-potable bathroom plumbing, dust control, irrigating re- introduced native plants and emergency firefighting. The project uses bottled water and portable pumped toilets similar to the KWP I facility (Planning Solutions, Incorporated (Inc.) 2010); Potable water is purchased and trucked up to the project area.
- Construct one permanent un-guyed meteorological (met) tower and A communications tower attached to the operations building to support data gathering and control functions.

Figure 1.2 provides a site plan showing the locations of the above-mentioned facilities. Access to the site is from Honoapi'ilani Highway (State Highway 30) via an existing State-owned road that was improved during construction of the KWP I facility. Construction of the project disturbed approximately 43 ac (17.4 ha) of land (i.e., approximately 30% of the leased area, Table 1.5); the remainder remained undisturbed.

The total "developed" area of the site, or the total area that contains structures, hardened surfaces or roads is 39.2 ac (15.9 ha). The *Final KWP II EIS* for the project contains a detailed technical description of the infrastructure for the project (Planning Solutions, Inc. 2010).

Table 1.4. Characteristics of 1.5-MW Wind Turbine Generators. -*NO CHANGE*

Power Generation	1.5 MW each
Tower Structure and Height	Tubular; 213 ft (65 m) tall
Rotor Diameter	231 ft (70 m)
Total Height (Tower + ½ Rotor)	328 ft (100 m)
Rotor Swept Area	50,130 ft^2 (4,657 m^2)
Rotor Speed	10-21 rpm (variable)
Wind Speed at Which Generator Starts	8 mph (3.6 m/s)
Wind Speed at Which Generator Cuts Out	56 mph (25.0 m/s)
Rated Wind Speed (Unit Reaches Maximum Output)	27 mph (11.9 m/s)
Note: Based on GE Model 1.5SE on 64.7 m tower.	
Source: Kaheawa Wind Power LLC (2004).	

Table 1.5. Area Occupied Project Components. -*NO CHANGE*

Project Component	Approximate Area Disturbed
14 WTG Foundations and Pads[1]	21 ac
Trenching for Underground Electrical Cables[2]	2 ac
~~Permanent Meteorological Tower[3]~~	~~0.2 ac~~
Maintenance Building, Substation, BESS	2 ac
Access Roads[3]	16 ac
Temporary Lay-Down Area[4]	2 ac
TOTAL	43 ac

(1) Each foundation occupies 2,500 ft^2; total disturbed area is 1.5 acres per turbine.
(2) Trenches were 2.0 ft (0.6 m) wide and 4.0 ft (1.2 m) deep and backfilled to finish grade.
~~(3) Includes one met tower.~~
(3) Estimate based on 36-ft wide (11-m) strip of "disturbance."
(4) One construction lay-down area for equipment staging roughly 150 ft x 250 ft (46 x 76 m).

Source: Planning Solutions, Inc. (2010)

To minimize the risk of attracting seabirds to the facility in accordance with the guidelines discussed in Section 4.3, lighting is kept to the minimum necessary for safety and operations. Lighting at the project include that which is required by the Federal Aviation Administration (FAA) for aircraft safety. In March 2005, the existing KWP I facility received FAA approval of lighting only six wind turbines (at intervals of 2,500 to 3,000 feet or 762 to 915 m) with medium intensity, simultaneously flashing red lights, utilizing the minimum flash frequency. ~~KWP II LLC a~~A similarly reduced lighting plan was approved for the KWP II project, resulting in lighting of an additional four turbines at KWP II.

Other lighting is provided at the operations and maintenance facility and substation for the purpose of illuminating the ground area, solely when work needed to be performed beyond daylight hours. Such lighting consists of halogen flood lights that are shielded and/or directed downward. Lights are turned on infrequently, and strictly as necessary, on the rare occasions when personnel are working at the site during darkness. Inside lights at the maintenance and operations buildings likewise are turned off at the end of each work day (more detail is provided in Section 4.3.1).

Personnel are generally present at the facility on a daily basis throughout project operation. They monitor the condition of the roadways and ensure that any needed maintenance is performed promptly, as well as ensure that the turbines and supporting facilities are operating properly. Site maintenance includes vegetation control (manual and chemical) on the turbine pads to prevent new growth that may otherwise attract nēnē, as well as revegetation in other disturbed areas using species commonly found in the general project area. Additional maintenance and site work is conducted for fire prevention purposes at the direction of DLNR forestry officials, although any such work is first reviewed and approved by USFWS and DLNR wildlife officials to ensure that it isn't expected to have any adverse impacts on any listed species.

The electrical power generated by KWP II is purchased by MECO via a Power Purchase Agreement (PPA) reviewed and approved by the State of Hawai'i Public Utilities Commission (PUC). Power generated by the facility is delivered from the proposed substation to the existing MECO 69kV (kilovolt) transmission line that passes directly through the southern end of the project area.

KWP II implements a fire contingency plan as outlined in detail in the *Final KWP II EIS* for the project (Planning Solutions, Inc. 2010.) that closely follows the fire contingency plan developed for KWP I (Fire Contingency Plan for CDUA MA-3103, 2005, Appendix 18).

1.4.2 Purpose and Need for KWP II Project *–UPDATED*

Original HCP Purpose and Need

Maui presently depends heavily upon fossil fuels for its electrical energy needs. The purpose of the KWP II project is to reduce that dependency by providing an alternative source that is renewable. The project provides an estimated 70,000 MW-hours of electricity per year (MWh/year) to MECO's system.[1] That is equivalent to well over 5% of the electricity produced on the island in 2007 or enough electricity to power about 7,700 average Maui homes (at 750 kilowatt-hours per month). By substituting a "local renewable" fuel source for imported fossil fuel, the project helps the State move toward its goal of energy independence and sustainability. Based on the best available projections of the cost of fossil fuel, it could also provide electricity to Maui's residents at a lower cost than would be possible using fossil fuel.

KWP II LLC estimates that the 21 MW of power that the project provides could reduce fossil fuel consumption by an estimated 138,000 barrels (BBLs) of fuel oil per year, significantly lowering Maui's dependence on imported fossil fuels.[2] Fossil fuel pricing has historically been volatile; fuel prices are subject to fluctuation based on supply and demand conditions, as well as political concerns that can affect the long-term availability of world supply.

Based on an average cost of oil at $80/BBL over the life of the project, the Applicant estimates that the substitution of wind energy for fossil fuel energy would reduce the amount that MECO spends on imported fuel by approximately $~~100,000,000~~215,280,000 ($80/BBL*138,000 BBL/year*19.5 years). The cost to MECO to purchase 70,000 MW-hours at $250/MW-hour would be $17,500,000. Reducing the proportion of its energy that comes from fossil fuel would also buffer the system from the energy cost fluctuations that accompany volatile oil prices.

Reducing the consumption of fossil fuel for energy generation by the estimated amount (138,000 barrels per year) also benefits the environment in a number of ways. The most important of these is by reducing air pollutant emissions associated with the combustion of fossil fuels. Additional emission reductions stem from the elimination of the need to transport petroleum fuels from distant ports to the island. These reductions in fossil fuel consumption would result in the following environmental benefits:

Avoidance of approximately 107 million pounds (48.5 million kilograms (kg)) of carbon dioxide (CO_2) annually emitted into the atmosphere.

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[1]This conservatively assumes that the turbines operate at an average of 40% capacity over the course of a year. The actual number of megawatt-hours per year (MWh/year) is expected to be somewhat higher than this.

[2]This estimate is based on the following: (a) Net capacity factor = 38%; (b) average heat rate for MECO-owned generation = 11,500 British Thermal Units (BTU)/Net kilowatt hours (kWh); (c) BTU Savings = 803,905- 1,148,436 Million(MM) BTU/yr; (d) 5.825 MMBTU/BBL of distillate (diesel) fuel oil; and 21 MW installed capacity.

Elimination of approximately 0.75 million pounds (0.34 million kg) of sulfur dioxide (SO_2) annually emitted into the atmosphere.

Elimination of approximately 195,000 pounds (88,450 kg) of nitrogen oxides (NO_X) annually emitted into the atmosphere.

These gases are known to contribute to various undesirable environmental effects, including global warming and acid rain. Additionally, it has been shown that these gases are detrimental to human health and the health of other living organisms. In general, the elimination of these harmful pollutants result in reduced health costs and respiratory illnesses.

1.4.2.1. Reduced Pollutants during Operations -NEW

As of January 1, ~~2017~~2018, KWP II has generated ~~288,803~~ 355,537 MWs of power used by Maui residents and businesses (Figure 1.3). To produce this energy through fossil fuel combustion would have required approximately 701,256~~569,354~~ BBLs or 29,400,000 ~~23.9 million~~ gallons of petroleum distillates. This amount of fossil fuel when combusted would have produced approximately 543,000,000 ~~441 million~~ pounds of CO_2, 3,800,000~~3.09 million~~ pounds of SO_2 and 990,000~~804,375~~ pounds of NO_X. The amount of water conserved from not burning 29,400,000 gallons of fossil fuels so far is 167,200,000 ~~135,737,000~~ gallons.

Table 1.6. Energy generated and used on Maui in Megawatt-hours by Wind and Fossil Fuel Sources. -*NEW*

	Maui Megawatt-hours Generated per Year[1]					
Source	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
KWP II	28,501	44,748	69,480	65,878	80,196	66,734
KWP I	121,218	101,510	108,980	110,677	110,484	90,325
Auwahi	3,206	83,970	79,754	87,951	84,144	74,629
MECO (fuel)	943,216	847,296	805,844	715,785	704,389	720,807
Total	1,096,141	1,077,524	1,064,058	980,291	979,213	952,495
Wind Total	152,925	230,228	258,214	264,506	274,824	231,688
Wind Percent	**14.0**	**21.4**	**24.3**	**27.0**	**28.1**	**24.3**

[1]www.eia.gov, www.hawaiianelectric.com

1.4.3 Project Schedule and Timeline -*UPDATED*

The life of the project is anticipated to be 20 years beginning in ~~July~~ January 2012, after which time the Applicant would arrange either to extend the life of the project or remove the facilities. This amendment to the HCP and permits will not change the current life of the project. The continuance of the project's operation beyond 20 years would be subject to a renewal of KWP II LLC's lease with DLNR, as well as an extension of the term of this HCP, as it may be amended. Should KWP II LLC discontinue the operation of KWP II during or after this 20-year period, the lease terms require that the turbines and other structures be removed and the site remediated and stabilized.

1.4.4 List of Preparers *–UPDATED*

The original HCP was prepared by Ling Ong, Ph.D., Paul Sunby, B.S., Ryan Taira, B.A., John Ford, M.S., Shahin Ansari, Ph.D., Jaap Eijzenga, M.S, and Tiffany Thair, B.A. of SWCA Environmental

Consultants and Perry White, MRP, Melissa White, M.A., Julia Ham Tashima and Makena White of Planning Solutions, Inc. Contributors on behalf of Kaheawa Wind Power II, LLC include Dave Cowan, Greg Spencer and Robert Roy of First Wind Energy, LLC. Comments and guidance provided by Dr. Paula Hartzell, Dr. Scott Fretz, Sandee Hufana, and Lauren Goodmiller of the Division of Forestry and Wildlife (DOFAW), James Kwon, Dawn Greenlee, Patrice Ashfield, and Jeff Newman of USFWS, as well as members of the ESRC are gratefully acknowledged.

The amendment has been prepared by Mitchell Craig of Terraform Power, LLC; SWCA's Amanda Ehrenkrantz, Jaap Eijzenga and Ling Ong; Law Offices of Kim McCormick; and with review by Dave Cowan of SunEdison, LLC; Glenn Metzler and Afsheen Siddiqi of the DOFAW; and Diane Sether, Ph.D. and Jodi Charrier of USFWS.

1.4.5 Changes and Improvements that have Affected Projected Take *-NEW*

~~Rates of incidental take of bats and nēnē were estimated for KWP II prior to construction based on the rates of observed take documented at operating wind energy facilities in Hawai'i (especially KWP I), and measurements of bat and nēnē activity that were made at the proposed site as well as at the neighboring KWP I site. These pre-construction inputs were obtained using the best scientific methods in use at the time. The resulting data provided the basis for the take estimates presented in the original KWP II HCP, and for the incidental take permit issued by USFWS and incidental take license issued by DOFAW.~~

~~The revised incidental take rates are based on data from systematic downed wildlife monitoring that has been conducted continuously at the site since the project became operational in July 2012. On-site monitoring provides estimate of the actual take that is occurring and is used adaptively by the wildlife agencies and Applicant to ensure that take is estimated accordingly.~~

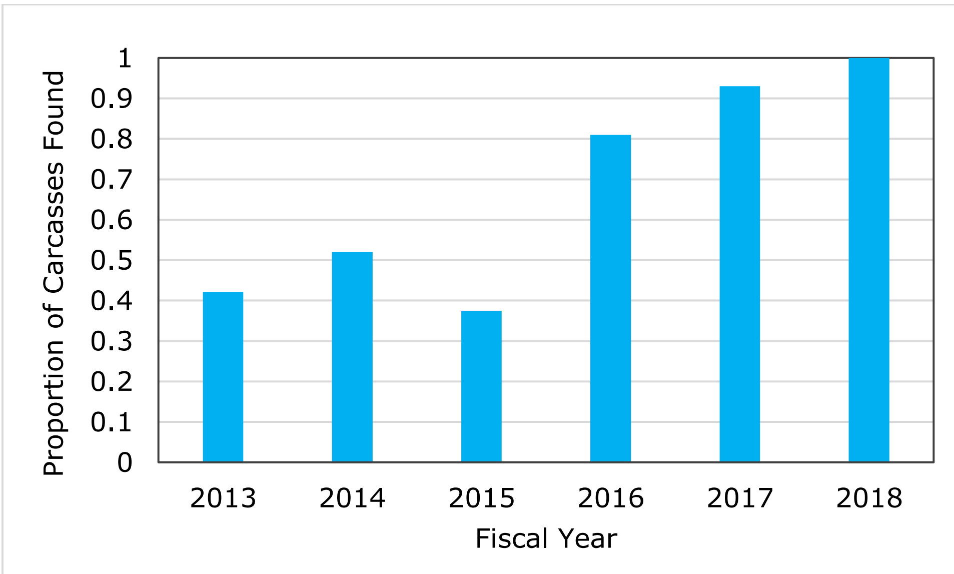
The following sections explain why current take projections are higher than projected in the original HCP. The increases in projected take for the Hawaiian hoary bat and nēnē are due, at least in part, to improvements in compliance monitoring and~~,~~ advances in take estimation and modeling methods~~, and improvements in methods for measuring bat activity~~. Projections of take through the remaining permit period have more certainty than previous projections because they are based on actual on-site monitoring data, and were generated using the improved methods discussed below.

1.4.5.1. Compliance Monitoring

KWP II has voluntarily implemented a variety of measures since the project began operation that have improved the ability to detect and accurately estimate fatality rates at the project. Several of these measures have contributed to the increase in statistically projected take at the project. Measures have included improved searcher efficiency (SEEF) using canine assistance, longer carcass retention (CARE) time due to trapping of scavengers, and increased visibility through vegetation management.

"SEEF" is a measure of searchers' ability to find downed wildlife and is expressed as the percentage of trial carcasses available that are found by searchers (see Appendix 2 for SEEF Trial explanation). Increasing SEEF reduces uncertainty, which means that estimates are likely to be closer to the actual mortality occurring in the searched area. Prior to 2015 all searches were conducted by human searchers walking linear transects laid out across the site, in keeping with standard industry practice. In state fiscal year (FY) 2015, in consultation with USFWS and DOFAW, KWP II voluntarily initiated a six-month study to compare the efficiency of canine-assisted searches to standard human searches (KWP II 2015). For small (bat-sized) dark-colored rat carcasses the SEEF for humans searching was 34.7% compared to a canine-assisted SEEF of 93.9%. All other factors being equal, a SEEF of 34.7% means that for every ~~one~~ bat found at least 2~~.88~~ bats were assumed to have been missed by searchers (although, see Appendix 27 for explanation of expected fatality distribution and extrapolation of take from portion searched). ~~A higher SEEF can reduce the amount of uncertainty around the fatality estimate.~~ SEEF trials are also conducted for medium and large sized birds (seabirds and nēnē) although generally the efficiency for these size classes has always been high whether for human or for canine-assisted searching.

Following the canine trial, KWP I and KWP II began using a trained canine and professional handler for all downed wildlife monitoring. SEEF for small bat-sized carcasses at KWP II in FY 2016 was 81.4% ~~(KWP II 2016) and in FY 2017 was~~ 93.0% and 100% in 2016, 2017 and 2018, respectively (Figure 1.3~~,~~; KWP II 2016, 2017 and 2018). These rates include when humans searched 43.9%, 14.1 % and 1% of total searches made in FY 2016 ~~and 14.1% in FY~~ 2017 and 2018~~,~~ when canine-assistance was not available (KWP II 2016, ~~and~~ 2017 and 2018). KWP I and KWP II will continue to use canine-assisted searching if downed wildlife monitoring is required.



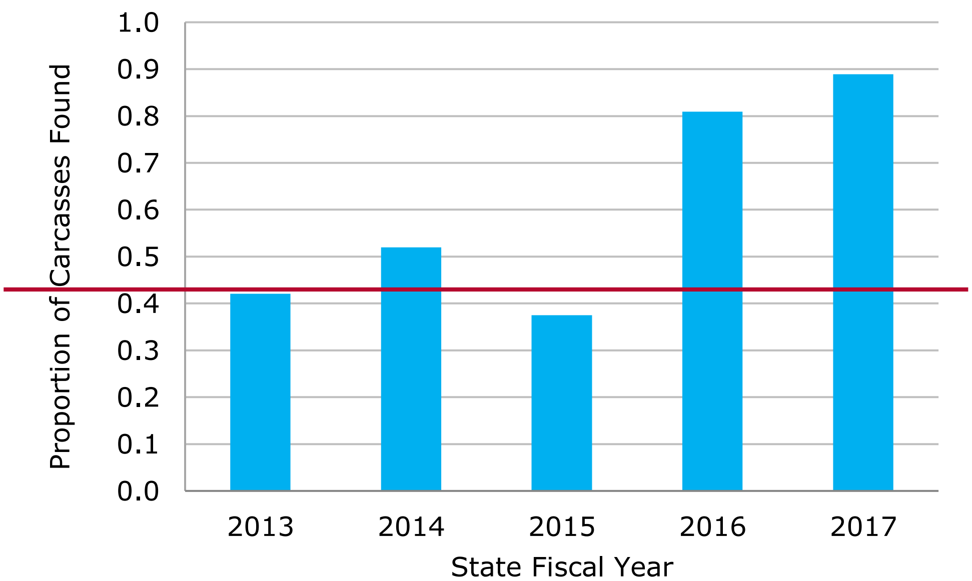
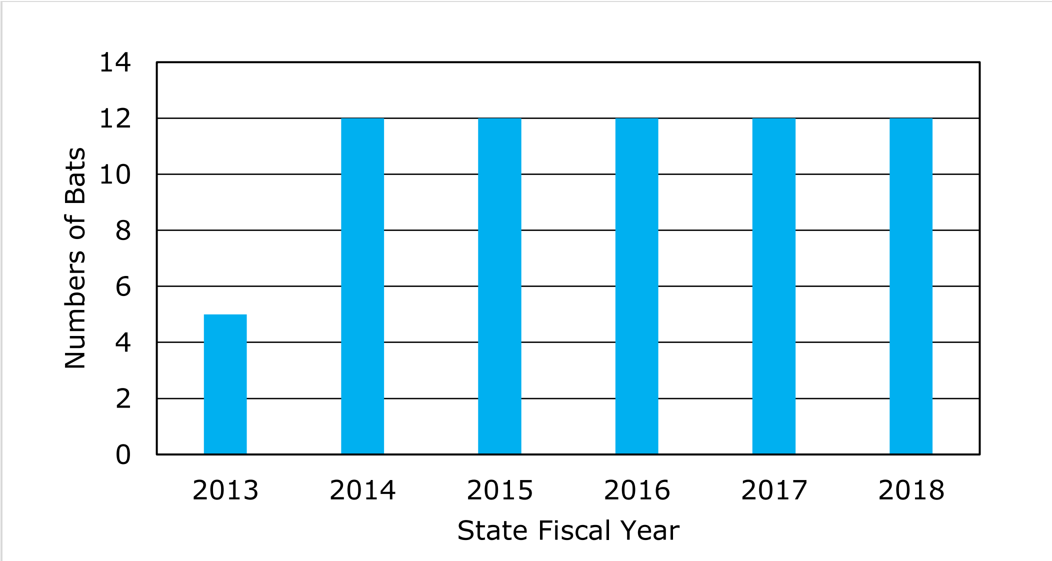


Figure 1.3. Searcher Efficiency for Small Bat-size Carcass Trials at KWP II in State Fiscal Years 2013-~~2017~~ 2018 (Canine assisted downed wildlife monitoring began in 2016). -*NEW*

If humans while searching for downed wildlife had consistently missed finding bat fatalities we might have expected canine-assisted searching to have found disproportionately more bats. However, the number of bat fatalities estimated annually at KWP II since canine-assisted searching began did not reveal a large increase that would have occurred if canines had found disproportionately more bats than humans (Figure 1.4).



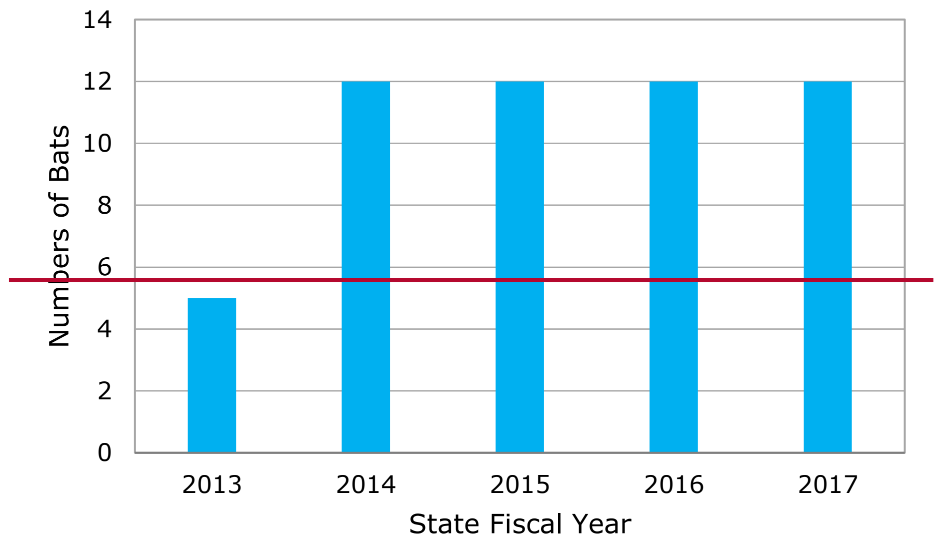


Figure 1.4. Annual Total Estimated Bat Direct Take at KWP II in State FY 2013-2017 2018 Estimated Annually. -*NEW*

"CARE" or carcass persistence is a measure of the rate of disappearance of downed wildlife due to scavenging by mongoose, rats and cats, and dispersal by decomposition and wind (see Appendix 28). Like SEEF, the CARE rate is one of the inputs used for take estimate calculations. Increasing the frequency of searches or lengthening the period that carcasses are present on-site increases the chances a carcass will be found, and improves the accuracy of estimates by reducing the uncertainty that is created by a shorter CARE. In FY 2015 KWP biologists began an intensive trapping program to reduce scavenger activity in the area and increase the chance that searchers (human or canine) can find downed wildlife (KWP II 2015). This program has been continued to date. Trials are conducted quarterly to continually re-estimate CARE and account for changes that may vary over time.

The annual mean CARE did improve after scavenger trapping commenced (FY2015) because carcass trials lasted longer (Figure 1.5).

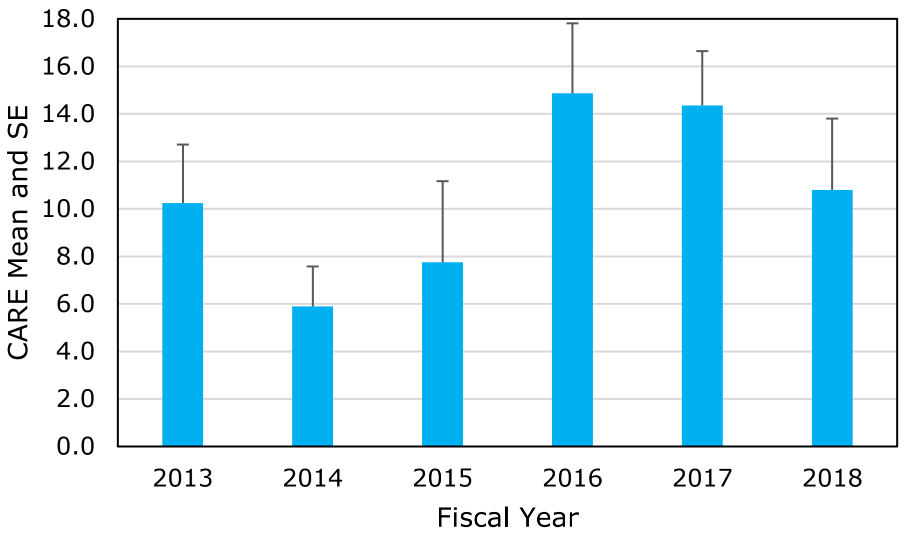


Figure 1.5. Mean and Standard Error of Carcass Persistence (CARE) for Bats at KWP II. - *NEW*

Ground visibility has been improved through removal of non-native shrub cover (primarily at KWP I) and regular mowing and weed trimming of grassy areas. With permission from DOFAW, in FY 2014 KWP II began periodically managing vegetation in searched areas to increase detectability of downed wildlife around turbines (KWP II 2014). Shorter vegetation increases human searchers' ability to see small carcasses and increases a dog's ability to move around and pick-up scent. Prior to 2014, DOFAW had been reluctant to allow vegetation management due to concerns about nēnē disturbance. KWP I and KWP II have worked closely with DOFAW to limit vegetation management to times when nēnē would not be disturbed.

1.4.5.2 Take Estimation, Modeling and Uncertainty

Take estimation theory, modeling, and software have been evolving rapidly over the past 10 years, resulting in more accurate estimates and, importantly, greater confidence in estimates for agencies and project stakeholders (Huso 2008, Huso 2011, Warren-Hicks *et al.* 2013, Huso and Dalthorp 2014a, Dalthorp *et al.* 2014, Huso *et al.* 2015, Dalthorp *et al.* 2017). Inherent biases in estimation methods used prior to 2010 were not well understood in relation to wind-associated fatalities and thus their potential to both under- and over-estimate take (depending on the method and inputs) was not always fully accounted for (Erickson *et al.* 1998, Huso 2008 and 2010, Shoenfeld 2004, Warren-Hicks *et al.* 2013). Further, monitoring methods were not standardized and could vary considerably among projects. Estimation and monitoring methods have co-evolved so that as biases were better understood, monitoring methods were improved and standardized to overcome the biases.

Also in this period the USGS became a leader in the development and deployment of wind energy-specific statistical estimation methods and standardization has greatly improved (Huso 2008, 2010, Huso *et al.* 2012, Huso *et al.* 2015, and Dalthorp *et al.* 2017). The most current USGS application is called the Evidence of Absence (EoA v.2.06) software.

An important change from EoA version 1.0 to version 2.0 is: "The default **prior distribution** used for calculating the posterior distribution for M has been changed from uniform to an integrated reference prior, which is often referred to as the objective prior (Berger and others, 2012). In most cases, the two priors give the same posteriors. When they differ, the objective prior is more accurate in the sense that when $M*$ is calculated using the objective prior $P(M>M*)$ is closer to α than it is when the uniform prior is used (appendix B). The difference is most noticeable when X is small, when the objective prior frequently gives a smaller $M*$ than does the uniform prior." (USGS 2017). The "uniform prior distribution" assumes any number of fatalities might be expected before any data had been collected, i.e. from 0 to 200 fatalities. The "objective prior distribution" assumes a much smaller number of fatalities may occur before any data was collected. Our search results especially for bats tend to reveal no observed take, therefore this change to version 2.0 has reduced the estimated fatalities compared to version 1.0 for the same input parameter values.

The USGS has provided improved guidance and standardized methods for generating these inputs (Huso *et al.* 2015, Dalthorp *et al.* 2017).

As stated in the Evidence of Absence (v.2.0) software user guide (USGS 2017), "the software application is particularly useful in addressing whether the number of fatalities is below a given threshold and what search parameters are needed to give assurance that the thresholds were not exceeded. The software was designed specifically for cases where tolerance for mortality is low and carcass counts are small or even 0. The software addresses the general problem of estimating numbers of fatalities over an extended period using systematic counts of carcasses and adjustments of the carcass counts to account for imperfect detection. Imperfect detection may be due to any of several possible detection biases, for example: (1) search teams fail to find carcasses that are present in the searched area at the time of the search, (2) scavengers remove carcasses before searches are conducted, (3) carcasses fall outside the searched area, or (4) fatalities occur outside the monitored period. The overall probability of detection (*g*) is estimated primarily from results of field trials in which carcasses are placed at known locations within the searched areas at the site and monitored for persistence times and for evaluating the efficiency of search teams in detecting carcasses that are not scavenged. Combining the number of carcasses (*X*) found in the systematic carcass searches with information about the detection rate, ~~Evidence of Absence software (~~EoA~~)~~ estimates the total mortality (*M*) and quantifies the uncertainty associated with the estimation."

The probability of detection (*g*) can also be used to compare how likely a fatality will be found when total search area is changed from one period to the next. If an average of one bat is found annually with a *g* of 0.5 then when reducing the search area so that *g* becomes 0.25, we would expect to find an average of one bat every other year.

The measured variables and EoA software designated abbreviations (in italics) used as inputs for fatality estimation at KWP I and II are:

- Search interval (*I*): the number of days between search efforts at the WTGs,
- Start of monitoring: the date of the first search in a period being represented,
- Number of searches: determined by the search interval and the monitored period length,
- Spatial coverage (*a*): the fraction of the total number of carcasses expected to arrive in the searched area (from interaction with the WTGs or other structures associated with a wind farm). From the user guide: "The number of carcasses arriving at a given distance from a turbine tends to decrease with distance while the area increases so that an area nearer to a turbine generally accounts for more carcasses than does an area of equal size at a greater distance from a turbine. Thus, *a* should be a density-weighted proportion (dwp) of the area sampled (Huso and Dalthorp, 2014). When the number of carcasses of the target species is too small to model the relationship between distance and carcass density, a surrogate species is often used to estimate *a*. If no surrogate is available, then a mechanistic model or a model fit at a similar site is sometimes used." Spatial coverage essentially characterizes what portion of the total expected carcass arrivals around each WTG will never be found in areas not searched.
- Temporal coverage (*v*): the fraction of the total number of carcasses expected to arrive during the monitoring period. Year-round searching is complete (*v* = 1) temporal coverage.,
- Observed take (*X*) is carcasses found by searchers only in the searched area,
- Searcher efficiency (SEEF) (*p*): from independent trials using surrogate carcasses to best represent the species whose mortality is being estimated. *p* represents the efficiency only for the first search of a carcass after the carcass arrival,
- Searcher efficiency (SEEF) after the first search (*k*): the decrease in search efficiency for a carcass not found on the first search but found (or not) on the second or later search after

carcass arrival. *k* varies with carcass and searcher type, i.e. a larger size carcass may be found as easily on multiple successive searches as for the first search; a canine-assisted searcher may find a carcass as easily on subsequent searches as on the first search (or potentially even easier than the efficiency for the first search if a carcass decays and the smell becomes more pronounced and therefore easier for a canine to find),

- Carcass retention or persistence (CARE): The amount of time a carcass persists without being lost to scavenging or decay is modeled as a persistence distribution. The rate of carcass removal tends to change with time therefore with the input CARE trial results four possible persistence distributions are fitted to the trial results and the best fit distribution is selected to represent the results. The distributions are characterized by shape and scale parameters.
- Assumed relative mortality rate (ρ or rho): if operations or ecological conditions change, the ρ parameter should be adjusted to reflect those changes, or ρ is assumed to be 1 for similar units of time (typically one year). For example, if minimization measures that are expected to reduce fatalities by 30% are implemented in year 3, then ρ=1 for years 1 and 2, and ρ=0.7 for year 3. Although the authors suggest reducing rho could be appropriate with increased minimization measures like LWSC, a reduction in rho with added or increased LWSC has not yet been approved in Hawai'i.

~~The USGS has provided improved guidance and standardized methods for generating these inputs (Huso *et al.* 2015, Dalthorp *et al.* 2017).~~

To project take estimates to the end of the permitted period (20-years for KWP II) the detection probability (*g*) determined for the last period when input parameters were measured (2018) is assumed to be the same for each subsequent year in the future. The Evidence of Absence software generates the year by year future estimated mortality and the 20th year estimate is used to determine if an existing permit may be exceeded in the future and if so what level of take would likely be requested for a permit amendment.

A significant advancement in modeling take has been the ability to generate estimates that have a corresponding level of statistical credibility. "Credibility" in this context is defined as the percent frequency at which the actual take was not more than the estimated value. Thus 80% credibility means the actual take was likely to be at or below the estimated value 80% of the time and, conversely, not more than the estimated value more than 20% of the time. A 100% credibility value means there is statistically no chance the actual take is higher than the estimated value. For a given observed take an estimate generated at a higher level of credibility will be more conservative (i.e., higher) than an estimate at a lower level of credibility. Factors that contribute to uncertainty regarding the observed take, such as low SEEF and high scavenging rates will result in a higher fatality estimate for a given level of credibility.

With the advent of statistical credibility USFWS and DOFAW began requesting that take estimates be reported at an 80% credibility level although there is no specific research supporting why this value is better than a higher or lower value. The 80% credibility level suggested is just considered more conservative than the 50% level. KWP I and II began all reporting to this standard in FY 2015. The purpose of this change is to provide a more conservative estimate of take, i.e., greater certainty that the estimated take level has not been exceeded by the project. This one factor alone resulted in an ~~quantum~~ increase in the estimated ~~rate of~~ take and projection of estimated take for the 20-year permit period occurring at both sites and therefore one reason a take permit amendment is requested.

Current take projections to the end of the permit period may in fact be conservative (i.e., somewhat higher than necessary). Take projections for the remaining ~~15~~ 13.5 permit years for KWP II may be somewhat inflated because they are based on data accumulated over a period during which various monitoring improvements were implemented. Since future estimates include the variability as measured for the input parameters of monitored years the future estimate includes the uncertainty characterized by the input variability. As additional years of monitoring are added to fatality estimates (and future projections are for shorter periods of time relative to current projections) the uncertainty will become less.

Data from the first ~~three~~ two years of operation are more likely to have been affected by ~~bias,~~ greater uncertainty (lower SEEF/shorter CARE) ~~and thus have a greater uncertainty~~. When the 80%

credibility threshold is applied to the more uncertain data, the resulting estimate is adjusted upward to a greater degree than are the estimates from the next ~~two~~four years when uncertainty was reduced (higher SEEF/longer CARE). While the latter ~~two~~four years may better represent take going forward, the current projections ~~consider~~ include all ~~five~~six years of observed data ~~as a conservative measure~~. Going forward, as the proportion of data gathered using the improved methods increases, and if the input variables do not change appreciably, projections of future take ~~may~~ will decline. For example, the 20-year projection of estimated bat take made in September 2015 when the ESRC reviewed the first draft of this HCP amendment was 80 bats, now the 20-year permit period projection is 38 bats.

If no additional bat takes are observed for the remaining permit period and the search conditions are similar throughout, the total take that will be the final estimate using EoA at the end of the 19.5 years of the permitted operations period will be 14 bats (or three more than the current permitted take). If one bat is found every other year (the average number of bats found for the first six years of operations) for the remaining 13.5 years (7 hypothetically observed bats) the total take estimate using EoA at the end of the 19.5 years will be 39 bats. Given no bats have been found since 2014 the projected take estimate of 38 adults bats is considered conservative.

1.4.5.2.1 Assumptions Made in the Take Estimation Calculation Inputs

Although the permit term is considered to be 20 years, actual operations began in July 2012 and the permit term ends January 2032. Therefore, all take projections are for 19.5 years.

The expected density distribution by distance from the turbines for bats falling to the ground after being struck informs the value of the total spatial coverage (*a*) at KWP II. As explained previously *a* is the portion of the total fallout distribution actually searched. The density distribution by distance from the turbines is calculated using the distribution of bats actually found at KWP I and KWP II (Appendix 27). As of May 2018, 14 bats have been found and are used to calculate the percentage of the total distribution that are expected to fall in each successive 10-meter-wide band around all the turbines. We assume that 14 bats are an adequate sample size to reasonably determine these percentages. The distribution modelled using ballistics theory for short turbines and bats by Hull and Muir (2010) is similar compared to the distribution we have established with bat fatalities found at both KWP sites (Figure 1.6). The turbines at KWP I and KWP II would be classified as "small" by Hull and Muir.

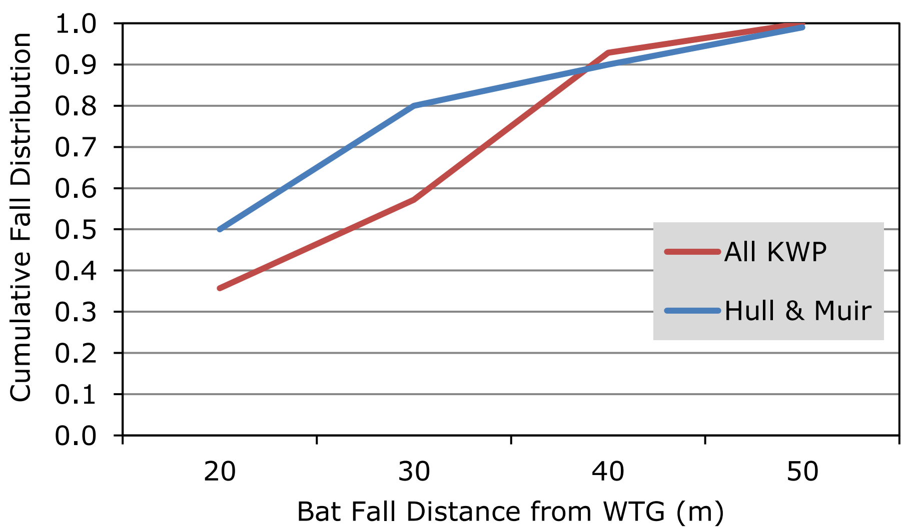


Figure 1.6. Comparison of Fall Distribution for All KWP Bats and Hull and Muir (2010) Bats at Small Turbines. *-NEW*

As of May 2018, 30 nēnē have been found at KWP I and KWP II and are used to calculate the percentage of the total distribution that are expected in each successive 10-meter-wide band around all of the turbines. Although no nēnē fatalities were found beyond 70m when the search plots at KWP I were between 80 and 100m radius from the turbines (FY 2006 through FY 2010), the search plots at KWP II have never been greater than a 75m radius from the turbines. Therefore, we also added six "hypothetical fatalities" beyond 70m (three between 71 and 80m, two between 81 and 90m and one between 91-100m) to ensure the total distribution is not biased or skewed closer to the turbines. We assume that 30 nēnē plus six hypothetical nēnē are an adequate sample size to reasonably determine where nēnē fatalities will fall relative to the turbines. The distribution modelled for short turbines and large birds (nēnē) by Hull and Muir (2010) is similar compared to the distribution we have established with nēnē fatalities found at both KWP sites (Figure 1.7).

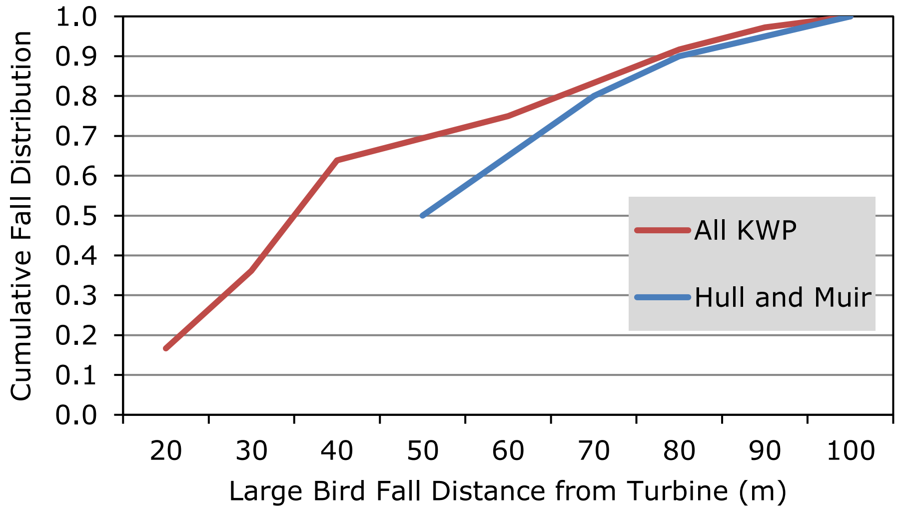


Figure 1.7. Comparison of Fall Distribution for All KWP Nēnē and Hull and Muir (2010) Large Birds at Small Turbines. *-NEW*

The observed take input to the estimation calculation for bats and nēnē includes all take found within the designated search area during a formal search or within the search area but not on a formal search *if* the SEEF is 75% or higher and *k* (described above) is 0.7 or higher at the time a take is found, according to the USFWS Protocol for Incidental Carcass Finds (Appendix 34). Bats or nēnē takes that are found outside of the search area are not included as observed takes. These incidental takes are accounted for in the estimation calculation as the unobserved take that is assumed would have been found if the search area were larger. As of June 2018, there have not been any bats or nēnē found incidentally inside or outside the formal search area at KWP II.Occasionally, SEEF trials carcasses that are put out for searchers to find are scavenged before the searcher gets to the location of the carcass. As soon as a search is concluded the SEEF proctor goes to the location of the carcass to confirm that the carcass was either missed by the searcher (the carcass is still present to be found) or was no longer available to be found (scavenged). SEEF trials not available to be found are not included in the SEEF trial results used as inputs to the estimation calculations. Carcass scavenging rates are formally tested during CARE trials.

The input value for the *k* parameter (SEEF percentage found after the first search (*k*)) is assumed to be 1 for both bats and nēnē for all canine-assisted searches, that is, at least for the second search made after a carcass was placed and was considered still available to be found, the canine is expected to have the same chance of finding a carcass on the second search even after it has degraded somewhat from decay and weathering. It's likely that a canine could have an even better chance of finding a carcass once it begins to decay and creates even more scent for the canine to detect (*k* would then be greater than 1). Also, since SEEF results for canines are typically very high there are rarely any SEEF trials that are not found on the first search. For human only searches the *k* value for bats is assumed to be 70% (there is a 70% chance the carcass would still be available to find on the second search) and for nēnē is assumed to be 1 (nēnē are large and are still easily visible even when scavenged).

The density weighted proportion of the total possible fatality distribution, i.e. spatial coverage (*a*), represents the proportion of all fatalities expected that fall in the formal search area that is smaller than the area the total possible fatality distribution encompasses. We assume the distribution around the turbines is uniform. It is reasonable to believe fatalities are more likely to be blown downwind of the turbine as they fall if there were no other force than gravity propelling a carcass, especially when winds are strong. However, we are not able to determine what force is imparted to a flying bat or bird from the impact of a turbine blade tip spinning at over 150 miles per hour or at what stage of the blade rotation (moving upwards, downwards or sideways) the bird or bat is struck. Hull and Muir (2010) indicated that "after an initial impulse and deposition of velocity (taken from the contact point of the rotor), our projectile is assumed to be inert. Therefore, the only forces acting upon it are those of wind drag and gravity". However, they also suggest "A dominant wind direction, or other relation between rotor direction and likelihood of animal strike, will affect the shape of the fall. As the predominant wind strength increases, we expect the circular fall zone to contract to an ellipse aligned in the direction of travel".

~~To project take estimates to the end of the permitted period (20-years for KWP II) the detection probability (*g*) determined for the last period when input parameters were measured is assumed to be the same for each subsequent year in the future. The Evidence of Absence software generates the year by year future estimated mortality and the 20th year estimate is used to determine if an existing permit may be exceeded in the future and what level of take a permit amendment would likely propose. Since future estimates include the variability as measured for the input parameters of monitored years the future estimate includes the uncertainty characterized by the input variability. As additional years of monitoring are added to fatality estimates (and future projections are for shorter periods of time relative to current projections) the uncertainty becomes less. Therefore, the actual take estimate at 80% credibility after 20 years of monitoring will likely be less than the projected take estimate made today at the 80% credibility level.~~

1.4.5.3 Evolution of Bat Detection Equipment and Assessment of Bat Activity

Hawaiian hoary bat activity at KWP I and KWP II has been monitored using acoustic bat detectors installed at various locations around the sites on a more-or-less continual basis since 2008. However, bat detection technology has evolved considerably during the time over which KWP I and II have been developed and operated, resulting in greater rates of bat detection over time, and a more sophisticated characterization of when and under what conditions bats are most likely to be at risk of turbine collisions. Had these technology improvements existed at the time the initial HCPs were being developed the resulting estimates of projected bat take would likely have been assumed to be higher. It is also possible but difficult to prove that bat activity did actually increase at both sites after the KWP II turbines were built and began operations.

Bat detection studies conducted by KWP biologists in state fiscal year 2010 through 2012 (before KWP II began operation) used Titley AnaBat™ SD 2 detectors. Although state-of-the-art at the time, these earlier detectors required supplemental housing for weather protection. Incoming sound had to be reflected into the protected microphone, diminishing detector sensitivity and call quality. Beginning in 2013 both projects voluntarily transitioned to the more weatherproof Wildlife Acoustics SM2BAT+™ technology (KWP II 2013). These detectors are relatively waterproof and use better quality microphones, and thus can better represent the timing and frequency of bat activity at the sites. Along with the transition to new technology additional detectors were added on the ground as an adaptive management measure at KWP I in 2013. Bat detectors were also added to turbines at the nacelle height to better understand bat activity aloft.

The substantial relative increase in bat detections that resulted from the above changes in detector type are evident in the timing and frequency of detections at both sites (see Figures 3.5 and 3.6). Detectors deployed at KWP I and KWP II from 2008 through 2010 detected bats during an average of 1% of total detector nights (range 0% to 3% for 21 specific locations), at seven of 21 locations (30%) and only during seven months (58%) of the calendar year (KWP II HCP).The location with the highest detection rate of all seven detectors deployed at KWP I and KWP II during FY 2010 (detector location 14 or 14G in annual reports) recorded an annual detection rate of 3% of total nights (KWP I 2010). Three of the seven detectors recorded no activity during FY 2010. Rates of detection recorded at detector location 14 during FY 2011, 2012 and 2013 were 7%, 4% and 2%, respectively (KWP I 2011, 2012 and KWP II 2013). Seven of nine (78%) detector locations at KWP I and KWP II detected bats during eight of 12 months (75%) in each of FY 2011 and FY 2012.

In FY 2014, KWP II (and KWP I) began replacing the older bat detectors with newer more sensitive detectors (KWP II 2014). In FY 2015, 2016 and 2017 a new replacement detector placed at the same location cited above (detector location 14G), detected bat calls on 13%, 8% and 11% of total detector nights, respectively (KWP II 2015, 2016 and 2017).

All eight detectors deployed on the ground at KWP II in FY 2015, 2016 and 2017 detected bats at an average annual nightly rate of 7%, 8% and 8% in FY 2015, 2016 and 2017 (range: 2% to 13%) (KWP II 2015, 2016 and 2017). Bats have been detected in every month of the year detectors were deployed in FY 2015, 2016 and 2017.

1.4.5.4 Low Wind Speed Curtailment Changes

While most of the above-mentioned changes (maintaining vegetation to improve SEEF, implementing predator control, more conservative and appropriate fatality estimation, and implementing canine-assisted to replace human searching~~, and improved bat detection capability~~) are believed to have contributed to increasing the statistical projections of bat take, Low Wind Speed Curtailment (LWSC), ~~designed~~ expected to decrease bat take, was also implemented, ~~– and~~ extended and increased ~~– during this period~~ since operations began (see sections 4.2.2 and 4.2.3 for the explanation why LWSC is implemented). KWP II committed to voluntarily implement LWSC ~~at~~ up to 5.0 meters per second (m/s) beginning at the start of operations (July 2012) as a minimization measure under the approved HCP. The initial period of LWSC was April 1 through November 30, sunset to sunrise. This period coincides with typical nocturnal bat activity and the months when KWP biologists had recorded higher bat activity using ultrasonic bat detectors (KWP II HCP).

The first bat fatality at KWP II occurred March 13, 2013 and as an adaptive management measure the LWSC period began March 14, 2013 and was extended to begin the following year on March 1, 2014. However, a third bat fatality at KWP II was subsequently documented on February 26, 2014 so LWSC began immediately (February 27, 2014) and was scheduled to begin the following year on February 15, 2015. After a bat fatality was documented at KWP I on December 14, 2013 the LWSC at KWP II was extended the following year from November 30 through December 15. Currently the annual LWSC period is from February 15 through December 15. No bat fatalities have been observed at KWP I and KWP II between December 15 and February 15.

In addition to extending the calendar period of curtailment, KWP I and KWP II also increased LWSC to 5.5 m/s in August 2014 (from 5.0 m/s) as an adaptive management measure to further reduce bat fatalities. Since then, in ~~three~~ four years, only two bat fatalities have been observed within the search area at KWP I and none at KWP II. The decrease in the rate of observed bat takes occurred during the period when KWP II began canine-assisted searches, which increases confidence that the observed reduction in fatalities was representative of the actual fatality rate at the time. However, in July 2015 the search area was reduced at all turbines relative to before then, which would necessarily have also reduced the potential number of observed fatalities available to find within the searched area if the take rate remained similar to the rate before July 2015. Nonetheless, these changes are accounted for in the EoA take estimate.

1.4.5.5 Observed Fatality Rate Changes

Although the changes in methods described above have undoubtedly contributed to a higher ~~an increase in~~ projected take, it is also possible that ~~circumstances~~ bat activity near the turbines changed somehow and led to more fatalities occurring than originally projected. Importantly, the rate of bat take projected in the KWP II HCP was based in part on the rate of take that had occurred over the initial five years at the 20-turbine KWP I site. However, the rate of take observed at KWP I increased considerably after the initial five-year period.

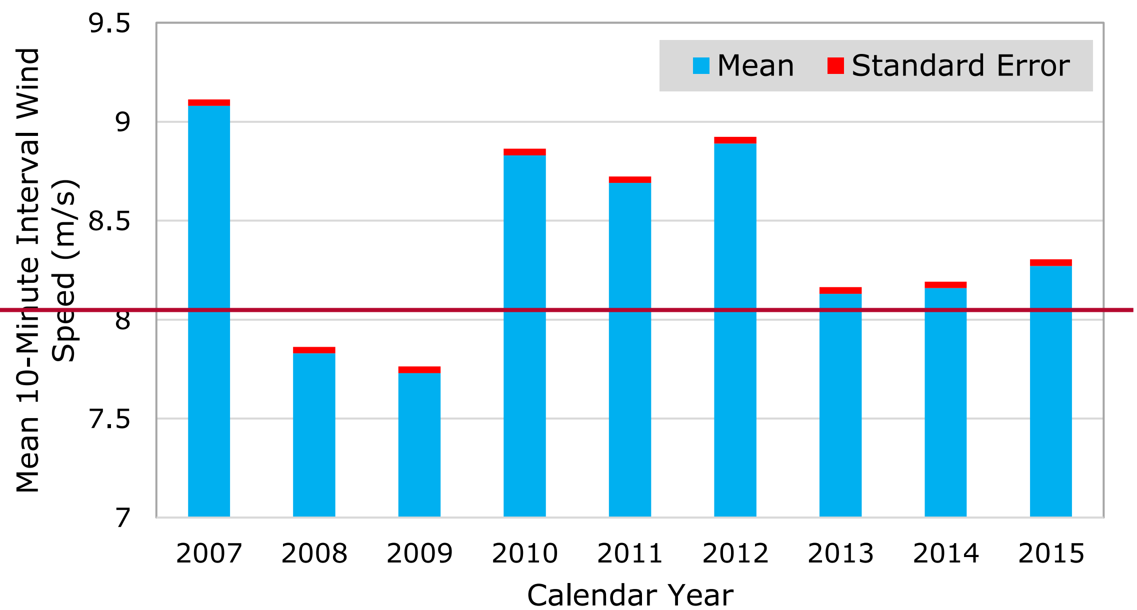
The total observed (unadjusted) bat take at KWP I during the first five-year period was two bats, which yielded an estimated total take of six bats (KWP I 2011). Accounting for indirect take (lost offspring) would have added the equivalent of approximately one adult bat, for a total estimated take of seven bats over five years, or 0.07 bats per turbine per year.

The HCP for the 14-turbine KWP II project relied on these findings and considered indirect take and a reduced fatality rate due to LWSC. LWSC was not implemented at KWP I until August 2014. On this basis, the rate of take at the highest Tier level (Tier 2) was projected to be no higher than 0.04 bats per turbine per year for 20 years, or 11 adult bats total (KWP II HCP).

In the first two fiscal years (FY 2013 and 2014) of operations at KWP II, the observed take at KWP I and KWP II totaled nine bats or 0.13 observed bats per turbine per year (for 34 turbines), approximately two times the observed annual fatality rate per turbine at KWP I during the first five years before KWP II began operations.

One possible explanation for an increase in bat fatalities during this period could be lower overall average wind speeds during 2013-2015 (Figure 1.~~5~~8 and Table 1.7, unpublished Terraform Power Wind Turbine Anemometer data). Annual variation in average wind speeds is illustrated by the average 10-minute interval nighttime wind speeds at Turbine 1 at KWP I. Averaged wind speeds were lower in years 2013-2015 compared to the three years before. Whether these differences are significant, and whether they explain differences in observed bat fatality rates is not known.

Nonetheless, bats are thought to be less likely to fly at turbine height along the exposed ridges during windier conditions, preferring to forage in the sheltered ravines and valleys. And, mainland studies have documented reduced bat fatalities when turbines are set to begin operating at higher wind speeds (Arnett *et al.* 2013). However, Gorresen *et al.* (2013) in a five-year occupation study on Hawai'i Island did not find evidence that Hawaiian hoary bats were less likely to occur in areas with above-average wind speeds.



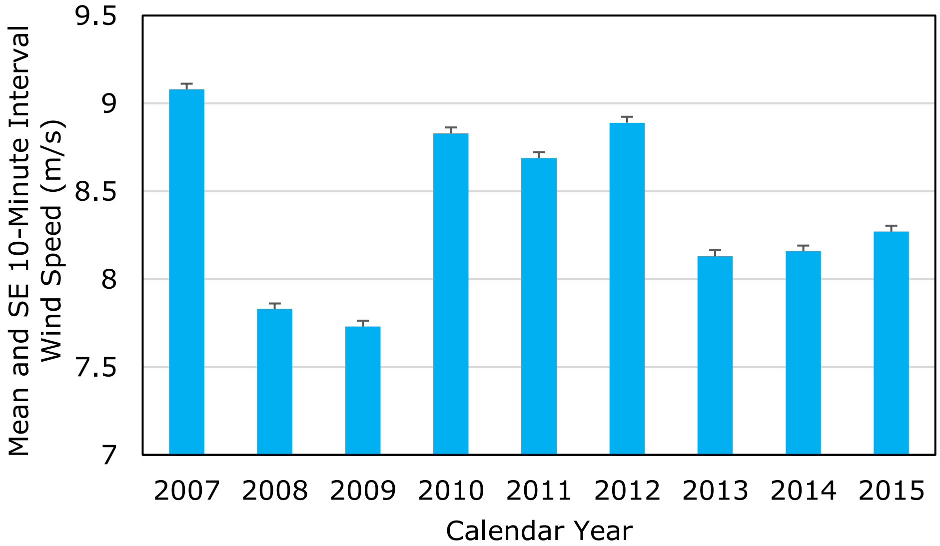


Figure 1.~~5~~8. Mean and Standard Error of Wind Speed in Meters per Second (averaged every 10-minutes) per Calendar Year (2007-2015) at KWP I Turbine # 1 at Night from 7 PM to 6 AM. -*NEW*

Table 1.7. For Figure 1.5: Minimum, Maximum and Standard Deviation of Wind Speed in Meters per Second (averaged every 10-minutes) and Numbers of 10-Minute Intervals (N). -*NEW*

Year	Minimum	Maximum	Standard Deviation	N
2007	0.05	21.34	5.00	24455
2008	0.05	18.92	4.93	24522
2009	0.05	21.27	5.27	24388
2010	0.05	24.06	5.16	24388
2011	0.05	21.95	5.08	24388
2012	0.11	20.29	5.31	24455
2013	0.02	22.86	5.45	24388
2014	0.19	20.47	4.84	24456
2015	0.13	20.43	5.31	24389

1.4.5.6 Summary

In summary, a combination of factors ~~is believed to~~ may have contributed to the increase in projected bat fatalities at KWP II, including improvements in compliance monitoring, more conservative assumptions in calculating take estimates, lower average wind speeds in 2013 through 2015, and the possibility that circumstances changed causing bats to be at greater risk of collision after KWP II was in operation. At the same time, increases in LWSC beginning in August 2014 ~~may have eventually~~ appears to have led to a lower take rate at ~~both KWP I and~~ KWP II, ~~partially~~ and is now beginning to offset~~ting~~ the effects of the above factors.

If increasing LWSC from 5.0 to 5.5 m/s is the primary cause for the decrease in rate of take during the last four years and the decreased rate of take continues to the end of the permit period, the take estimated at the end of the permit period will likely be much lower than the 38 bats requested in this amended HCP.

It appears the pre-operations assumption that the take rate of nēnē per turbine would be lower than that recorded at KWP I was not correct. At this point the take rate and estimated projected take per turbine at KWP II is approximately similar to the take rate at KWP I. Currently the projected take rate for the permit period is 3.14 nēnē per turbine (44/14 = 3.14) and for KWP I is 3.20 nēnē per turbine (64/20 = 3.2).

2.0 DESCRIPTION OF THE HABITAT CONSERVATION PLAN

2.1 Purpose of this HCP *-UPDATED*

On May 8, 2015, Kaheawa Wind Power II, LLC submitted a request to the USFWS and the Hawai'i DLNR to amend ITP (TE-27260A-0), dated January 3, 2012, and the ITL (ITL-15) dated January 5, 2012. The requested amendment would increase the take authorized under the Permits for the Hawaiian hoary bat and nēnē. Upon approval of the ITP/ITL Amendment, conforming and needed changes to the KWP II HCP are effective. This document (the "HCP amendment") reflects the revisions needed to conform to the ITP/ITL amendment.

The construction and operation of the KWP II wind energy generation facility could adversely impact four species protected under the ESA and HRS Chapter 195-D, and other Federal and State laws and regulations. These species are the Federal and State-listed endangered Hawaiian petrel, the threatened Newell's shearwater, the endangered nēnē or Hawaiian goose, and the endangered Hawaiian hoary bat (collectively referred to as the "Covered Species"). These species have the potential to collide with the stationary WTGs and other facilities, or be struck by the moving WTG rotors, resulting in injury or mortality. These species also may collide with the temporary and permanent met towers, the guy wires supporting the temporary met towers and overhead collection lines; they could also be struck by vehicles and construction equipment during construction and operation.

The Hawaiian petrel (ʻuaʻu) and the Newell's shearwater (ʻaʻo) are endangered tropical Pacific seabirds that are endemic and nest only in the Hawaiian Islands (American Ornithologists' Union 1998). The nēnē, or Hawaiian goose, is the rarest species of goose and is endemic to Hawaiʻi. The Hawaiian hoary bat (ʻōpeʻapeʻa) is an endangered mammal unique to Hawaiʻi. These species are protected because of on-going threats to their survival. For the seabirds, threats are posed mainly by predation by introduced mammals and human-created hazards; for the goose and bat, threats are assumed to largely stem from loss of habitat~~.~~, although for bats there is no research to date demonstrating a negative effect on the population from loss of habitat nor is there research that demonstrates habitat has been "lost". Considering that bats choose prey and use trees that are not native suggests that the Hawaiian hoary bat may have been able to adapt successfully to changing conditions.

Pursuant to ESA Section 10(a)(1)(B), as amended, and HRS Chapter 195-D, an HCP is required to accompany application to the USFWS for an ITP and the State of Hawaiʻi for an ITL. Upon issuance of the amended ITP and ITL, KWP II LLC will be authorized for the additional incidental take for Hawaiian hoary bats and nēnē in connection with the operation of the proposed wind energy generation facility. The purpose of this HCP amendment is to make supportable determinations as to the potential impact that the wind energy generation facility could have on the Hawaiian hoary bat and nēnē; to discuss alternatives to amending the ITP and ITL and therefore increasing take levels; to propose appropriate efforts to minimize, and monitor for any impacts of take and fully mitigate (offset) those impacts to the maximum extent practicable; to ensure funding for the completion of these efforts; and to provide for adaptive management and adjustment of the above measures as determined necessary by the USFWS, DOFAW and the ESRC during this HCP amendment's implementation.

KWP II LLC is proud to play a role in increasing Maui's renewable energy portfolio and in reducing the island's dependence on imported fossil fuels. Through the successful implementation of this HCP amendment, and in keeping with the project's other environmental benefits, the Applicant will offset any impacts to the Covered Species to the maximum extent practicable and provide a net conservation benefit to these four species.

2.2 Scope and Term *–UPDATED*

The original HCP dated December 2011 and this HCP amendment seek to offset the potential impact of the wind energy generation facility on the Covered Species with measures that protect and perpetuate these species island-wide and statewide. This amendment will not change the original 20-year permit term (expires January 2032) throughout which this HCP amendment would be in effect. With monitoring and review by the USFWS and DLNR, the provisions for adaptive management allow mitigation of project impacts to be adjusted appropriately. Accordingly, this HCP amendment includes provisions for post-construction monitoring and adaptive management to allow flexibility and responsiveness to new information over the life of the project. Monitoring and adaptive management are coordinated with USFWS and DLNR, as further detailed in Chapter 7–Implementation.

2.3 Surveys and Resources *–UPDATED*

The following sources were used in the preparation of this HCP amendment:

General information on the site's physical environmental setting was summarized from the *Kaheawa Wind Power II Final Environmental Impact Statement* (Planning Solutions Inc. 2010). Additional general information on the project and site was obtained from the HCP and environmental assessment documents previously prepared for the KWP I facility. Information on endangered species occurrence in the project area and documented take at the KWP I facility was obtained from various site-specific studies conducted prior to and since the KWP I facility commenced operation.

These sources include:

Studies completed in support of the KWP I and KWP II HCPs.

Annual reports documenting compliance with the HCP and status of ongoing post-construction take monitoring, research and mitigation, and on-site acoustic monitoring for bats at the KWP I and KWP II facilities.

USGS "Evidence of Absence" estimation software and guides for Version 1.0 (Huso *et al.* 2015) and Version 2.0 (Dalthorp *et al.* 2017).

Hawaiian Hoary Bat Guidance Document (DOFAW 2015).

An invertebrate survey of the project area that Mike Severns conducted in September 2009 (Appendix 9 and 17) to investigate the status of protected Hawaiian snails (*Achatinella species (*spp.)) and other native invertebrates in the project area

Botanical survey of the proposed KWP II project area that Robert Hobdy conducted August 2009 and January 2010 (Appendix 7 and 15). The reports confirm that no rare, threatened or endangered flora occurs in the project area.

An archaeological inventory survey and cultural impact assessment of the proposed KWP II lease area prepared by Rechtman Consulting LLC (Rechtman *et al.* 2009). The two reports demonstrate project compliance with the NHPA and document the fact that no historic, archaeological or cultural resources are expected to be adversely impacted by the project. Details are provided in the *Final KWP II EIS* (Planning Solutions Inc., 2010)

ABR Inc. reports documenting passage rates and modeling collision probabilities to estimate passage rates and rates of take for the KWP II facility (Appendix 3, 13, 23).

Seabird colony surveys to establish potential seabird mitigation sites and a proposed seabird mitigation plan (Appendix 22)

Modeling of seabird productivity to guide the implementation of seabird mitigation measures (Appendix 21, 24, 25)

In addition to site-specific surveys, staff from KWP I and II, USFWS and DLNR provided unpublished information, data and reports to ensure that all available resources could be considered and evaluated in the preparation of this HCP amendment. Continued coordination with USFWS and DLNR biologists and KWP I staff also greatly contributed to the preparation of this HCP.

3.0 ENVIRONMENTAL SETTING

This chapter provides an overview of the existing environment in the KWP II project area. The discussion pays special attention to the aspects of the environment that may be directly affected by construction and operation of the proposed wind energy generation facility. The physical setting of the project is described in detail in the *Final KWP II EIS* for the project (Planning Solutions, Inc. 2010).

3.1 Location and Vicinity *-NO CHANGE*

The proposed KWP II project is located on the southwestern slopes of the West Maui Mountains. The lowest of the proposed WTGs is approximately 0.8 miles inland from Honoapiʽilani Highway along the existing access road; the uppermost is approximately 2.1 road-miles inland. The settlements nearest the proposed KWP II project area are Olowalu, which is over five miles (8 km) to the southwest, and Māʽalaea, which is approximately 1.5 miles (2.4 km) to the east of the nearest WTG (both are straight-line distances).

3.2 Land Use Designation *-NO CHANGE*

The proposed KWP II project area is in the General subzone of the State Conservation District as established and regulated by Chapter 205, Hawaiʽi Revised Statutes. Lands within the Conservation District are typically used for protecting watershed areas, preserving scenic and historic resources, and providing forest, park and beach reserves [subsection 205-2(e) HRS]. The entire project area is owned by the State of Hawaiʽi. As with other Conservation District lands, the two parcels on which project-related work would be done are not subject to any County of Maui zoning or community plan designations or restrictions.

3.3 Topography and Geology *-NO CHANGE*

The proposed WTGs would be constructed on the lower part of a broad interfluve between Manawainui Gulch on the west and Malalowaiaʽole Gulch on the east. The proposed baseyard (substation, battery energy storage system and support facilities) would be constructed in Kaheawa Pastures adjacent to the upper electrical transmission corridor. Kealaloloa Ridge, another broad interfluve, lies immediately northeast of Malalowaiaʽole Gulch and separates the proposed facilities from the isthmus of Maui to the east. The gulches are steep and rocky. Several small puʽu are present in the area, including Puʽu Lūʽau, which is near the uppermost of the two existing MECO transmission line corridors at an elevation of about 2,300 feet (701 m) above mean sea level (msl).

The ground slope along the length (i.e., the mauka-makai axis) of the area where the WTGs would be constructed varies, but averages about 14%. The WTGs and other facilities would be constructed on an interfluve with cross-slopes that are variable, but typically are no more than 2% to 3%.

The project area lies on the flank of the extinct West Maui volcano, which evolved through shield (1.6 to 2.0 million years ago), post-shield (1.2-1.5 million years ago), and rejuvenated stages. While each of the flows was relatively thin, the accumulation during each stage was thousands of feet thick. Nearly a half-million years passed between the post-shield and rejuvenated phases with no evidence of volcanic activity. The rejuvenated-stage eruptions involved several small cones and ended about 385,000 years ago. The oldest of the small cones is Kīlea, which lies a short distance inland from Olowalu on the southwest side of West Maui. The youngest cone, Puʽuhele, lies approximately 1.6 miles (2.5 km) north of Māʽalaea along the road to Wailuku. There are no known unique or unusual geologic resources or conditions in the area.

3.4 Soils *-NO CHANGE*

Soils in the area where the proposed WTGs would be constructed are exclusively characterized as rock lands (rRK) by the National Resource Conservation Service (Foote *et al.* 1972). This substrate consists of thin soils formed from gray trachyte lavas of the Honolua Series which overlay the foundational lavas of the West Maui volcano. These lavas weather to platy gray blocks that extend across the entire ridge. Kaheawa Pastures, where the new base yard would be constructed, is mostly underlain by deep, well-drained volcanic soils that transition into the steep, rocky gulches to the east, south and west of the project area. Table 3.1 lists the characteristics of the major soil types that occur in the proposed KWP II project area.

Table 3.1. Characteristics of Soil Types within the Project Area. -*NO CHANGE*

Soil Type	Slope (%)	Permeability	Runoff	Erosion Hazard	Land Uses
Nāʻiwa silty clay loam	3-20	Moderately Rapid	Medium	Moderate to Severe	Pasture, woodland, and wildlife habitat
Oli silt loam	3-10	Rapid	Medium	Moderate	Pasture and wildlife habitat
Rock land	-	-	-	-	Pasture, wildlife habitat, water supply, urban development
Source: General Soil Survey of Hawaiʻi, Foote *et al.* 1972 (U.S. Soil Conservation Service).					

3.5 Hydrology and Water Resources *-NO CHANGE*

Average annual rainfall in the general project area ranges from less than 15 inches (38 cm) per year at the Honoapiʻilani Highway/site access road intersection to slightly over 40 inches (102 cm) per year at the uppermost of the existing KWP I WTGs. The area where the proposed WTGs would be constructed is quite arid with annual rainfall totaling only about 12 to 20 inches per year. Most of the rainfall occurs during winter months (more than 80%) from November through April (Planning Solutions, Inc. 2010).

The land on which the proposed WTGs would be developed consists of rocky ridges; the proposed KWP II base yard is on grasslands near the middle of the existing KWP I wind farm. There are no wetlands or other aquatic habitats (Hobdy 2004a, 2004b, 2006a, 2006b, and 2009). No perennial streams flow through the area, though storm runoff is present in Malalowaiaole Gulch just to the east of the proposed WTGs during rainy periods. On-site drainage is in a southeasterly direction toward Malalowaiaole Gulch and the Pacific Ocean.

The State of Hawaiʻi Commission on Water Resource Management (Letter from CWRM to Perry White, dated March 14, 2008) has determined that Manawainui Gulch does not have sufficient water to support in stream uses. Therefore, it is not considered a stream and is not subject to CWRM regulation. The U.S. Army Corps of Engineers (USACE) concluded that the KWP I project (including the access road along which the proposed WTGs are located) is entirely within an upland area and does not contain or convey waters of the U.S. subject to authorization by USACE permit (Young 2004).

The project area is located over the Ukumehame Sector of the Lahaina Aquifer (Aquifer Code 60206 as designated by the State of Hawaiʻi Water Use Commission). The estimated depth to basal groundwater varies throughout the project area and is likely to be approximately 1,500 to 2,500 feet (457 to 762 m) below the surface. Groundwater likely flows in a southerly direction. Perched groundwater may also underlie the project area (VEC 2005). The KWP II project area is located mauka of the Underground Injection Control (UIC) line, which is the designated boundary that divides protected inland areas situated over drinking water sources from seaward areas located over non-potable groundwater.

3.6 Terrestrial Flora *-NO CHANGE*

In pre-Contact times the area on which the proposed facilities would be constructed is believed to have been entirely covered with native vegetation of low stature, with dry grass and shrub lands below and mesic to wet windblown forests above. Native Hawaiians made some uses of forest resources here and had a cross-island trail cresting the ridge at 1,600 feet elevation (Hobdy 2006a). This trail was upgraded during the mid-1800s and used as a horse trail to Lahaina. It was reopened in recent years and is the present Lahaina Pali Trail (Hobdy 2006a).

Cattle ranching in the area began in the late 1800s and continued for over 100 years. During this time, grazing animals consumed most of the native vegetation, which was gradually replaced by hardy non-native weed species. During the 1950s, MECO installed high voltage transmission lines and maintenance roads through this area. Increased traffic brought more disturbances and weeds (Hobdy 2006a). Fires became more frequent, further eliminating remnant native vegetation (Hobdy 2006a). Grass and weed species have proliferated since cattle grazing ceased, creating a heightened fire hazard. A large fire swept across the mountain in 1999 consuming more than 2,500 acres (1,012 ha), including most of the project area. Another fire burned the same area in September 2006, scorching about 75% of the project area and affecting nearly 4,000 acres (1,619 ha) of rangeland in the adjacent region.

In the 2009 survey of the KWP II area, Hobdy (2009) identified 62 plant species, 15 of which are native to the Hawaiian Islands. During the supplemental 2010 survey, a total of 57 species were identified. This 2010 survey documented 16 native species, nine of which were not recorded during the 2009 survey. Thus, the entire KWP II area contains 24 plants native to the Hawaiian Islands; 15 of these are endemic and nine are indigenous (Appendix 9 and 15, Table 3.2). No State or Federal listed threatened, endangered or candidate plant species were found during either survey (Hobdy 2009, 2010).

Kalamalō (*Eragrostis deflexa*), which was recorded as rare throughout the project area by Hobdy in August 2009, was presumed extinct in the early 1990s, but has since be documented on West Maui, Lāna‘i, Moloka‘i, and Kaho‘olawe. Based on the statewide distribution of this native grass, the species is not likely to be listed as Federal endangered (Hobdy 2009a).

Six populations of kalamalō were recorded within the project area along the rocky edges of Manawainui and Malalowaia‘ole Gulches in August 2009 (Hobdy 2009a). These populations were affected during the fire that swept through the area in June 2010. Currently, two clumps of kalamalō are known in the northern portion of the project area near WTG 2 along the steep edges of Manawainui Gulch and two additional discrete clumps occur farther makai in the rocky crevices and outcroppings along Manawainui Gulch. All individuals were observed just outside of the project area on the steep outer portions of the gulch, making them inaccessible to foot and vehicular traffic. Each cluster ranges between 6-10 ft. (2-3 m.) in size.

The vegetation in the KWP II area is mostly grasses and low-growing shrubs, with occasional small trees in the wetter gullies. The most abundant species in the project area is buffelgrass (*Cenchrus ciliaris*), which proliferated after the fires in 1999. Other common species in the vicinity of the proposed WTGs are natal redtop (*Melinis repens*), ‘ilima (*Sida fallax*), ‘uhaloa (*Waltheria indica*), lesser snapdragon (*Antirrhinum orontium*), and Jamaican vervain (*Stachytarpheta jamaicensis*). In the two small areas of the existing KWP I area proposed to be developed under Alternative 1 and within the proposed trenching corridor, the most common species include molasses grass (*Melinis minutiflora*), ‘ūlei (*Osteomeles anthyllidifolia*), lantana (*Lantana camara*), natal redtop, and ‘a‘ali‘i (*Dodonaea viscosa*).

Of the 24 native plant species documented on-site, 15 are endemic and nine are indigenous to the Hawaiian Islands (Table 3.2). The botanical surveys indicate that native plant species are most prevalent in the rocky habitat bordering Manawainui and Malalowaia‘ole Gulches (Hobdy 2009a). These habitats are the most protected from grazing and fire. The three hardiest species ‘ilima,

ʻuhaloa and ʻaʻaliʻi are also present on the flatter grassy ridge tops. Native vegetation is less prevalent at the lower, drier parts of the area where fires have more recently occurred (Hobdy 2009b). Most of these native plants are common at Kaheawa and throughout the main Hawaiian Islands. Only one species found within Alternative 1, *Bidens micrantha*, is found only on Maui and Lānaʻi, but is common in West Maui (Hobdy 2010).

Table 3.2. Native Hawaiian Plants Observed in the KWP II Project Area by Hobdy (2009). ***- NO CHANGE***

Scientific Name	Common Name	Status[1]	Abundance (at site)[2]
FERNS			
DENNSTAEDTIACEAE (Bracken Family)			
Pteridium aquilinum (L.) Kuhn var.decompositum (Gaud.) R.M. Tryon	kilau	E	rare
PTERIDACEAE (Brake Fern Family)			
Doryopteris decipiens (Hook.) J. Sm.	kumuniu	E	rare
MONOCOTS			
CYPERACEAE (Sedge Family)			
Carex wahuensis C. A. Meyen subsp. *wahuensis*	--------------	E	uncommon
Cyperus phleoides Nees ex Kunth subsp. *phleoides*	--------------	E	rare
POACEAE (Grass Family)			
Eragrostis deflexa Hitchc.	kalamalō	E	rare
Heteropogon contortus (L.) P. Beauv. ex Roem. and Schult.	pili	I	uncommon
Trisetum inaequale Whitney	-----------	E	--
DICOTS			
AMARANTHACEAE (Amaranth Family)			
Chenopodium oahuense (Meyen) Aellen	ʻāheahea	E	rare
ASTERACEAE (Sun Flower Family)			
Bidens micrantha subsp. *micrantha* Gaud.	koʻokoʻolau	E	uncommon
Lipochaeta lobata (Gaud.) DC. var. *lobata*	nehe	E	rare
Melanthera lavarum (Gaud.) Wagner and Rob.	nehe	E	uncommon
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea indica (J. Burm.) Merr.	koali awahia	I	rare
ERICACEAE (Heath Family)			

Leptecophylla tameiameiae (Cham. and Schlect.) C.M. Weiller	pūkiawe	I	uncommon
EUPHORBIACEAE (Spurge Family)			
Chamaesyce celastroides (Boiss.) Croizat Degener var. *amplectens* (Sherff) Degner and I. Degener	ʽakoko	E	uncommon
GOODENIACEAE (Goodenia Family)			
Scaevola gaudichaudii Hooker and Arnott	naupaka kuahiwi	E	rare
MALVACEAE (Mallow Family)			
Sida fallax Walp.	ʽilima	I	common
MENISPERMACEAE (Moonseed Family)			
Cocculus orbiculatus (L.) DC.	huehue	I	rare
MYOPORACEAE (Myoporum Family)			
Myoporum sandwicense A. Gray	naio	I	rare
MYRTACEAE (Myrtle Family)			
Metrosideros polymorpha Gaud. var. *glaberrima* (H. Lev.) St. John	ʽōhiʽa	E	uncommon
Metrosideros polymorpha Gaud. var. *incana* (H. Lev.) St. John	ʽōhiʽa	E	rare
PAPAVERACEAE (Poppy Family)			
Argemone glauca (Nutt. ex Prain) Pope	puakala	E	rare
ROSACEAE (Rose Family)			
Osteomeles anthyllidifolia (Sm.) Lindl.	ʽūlei	I	uncommon
SANTALACEAE (Sandalwood Family)			
Santalum ellipticum Gaud.	ʽiliahialoʽe	E	rare
SAPINDACEAE (Soapberry Family)			
Dodonaea viscosa Jacq.	ʽaʽaliʽi	I	uncommon
STERCULIACEAE (Cacao Family)			
Waltheria indica L.	ʽuhaloa	I	common
THYMELAEACEAE (ʽAkia Family)			
Wikstroemia oahuensis (A. Gray) Rock.	ʽakia	E	rare
E= endemic (native only Hawaiʽi); I= indigenous (native to Hawaiʽi and elsewhere). Common= widely scatted throughout or locally abundant; uncommon= scattered sparsely throughout or occurring in a few small patches; rare= only a few isolated individuals.			
Source: Hobdy 2009a, b, 2010.			

3.6.1 Plant Sanctuaries, Critical Habitats and Plants of Interest in the Vicinity of KWP II

Although no federally listed plant species, plant species of concern, and/or rare Hawaiian plants have been recorded on the KWP II site, several have been documented upslope of the existing KWP I facility, specifically within Manawainui Gulch, Pāpalaua Gulch, and Kealaloloa Ridge (including the Manawainui Plant Sanctuary). The endangered species include *Remya mauiensis*, ʻiliahi (*Santalum freycinetianum* var. *lanaiense*), *Diellia erecta*, pauoa (*Ctenitis squamigera*), *Cystopteris douglasii*, *Cyanea obtuse*, haʻiwale (*Cyrtandra oxybapha*), *Schiedea pubescens*, koʻokoʻolau (*Bidens campylotheca* subsp. *pentamera*) and kokiʻo ʻulaʻula (*Hibiscus kokio*) (Hobdy 2006b). All plant species with designated critical habitat are more than 1.6 miles (2.5 km) from the KWP II property boundary and are not expected to be impacted by the project (Hobdy 2009). Many other native species occur within these two gulches, but are not rare enough to be protected by federal or state laws (Hobdy 2006b).

3.7 Non-listed Wildlife Species *-NO CHANGE*

In addition to the Covered Species discussed in the following section, the mixed grassland/shrub land vegetation in the project area provides habitat to one endemic mollusk, endemic, indigenous or migratory birds and several, mostly introduced, mammals.

No Federally listed species of snails were found in a recent molluscan survey conducted at the KWP II area (Severns 2009, Appendix 9). One native species of snail was found, *Succinea mauiensis* (Family: Succinidae). *S. mauiensis* is found in dry habitat and has a wide range on Maui. At the proposed KWP II down road site, specimens were found only on the undersides of undisturbed rock outcroppings or in the root mat of grasses beneath rocks. The species was uncommon in the pasture where most of the development activity is proposed, and more common at the upper edges of the gulches.

Succinea mauiensis is also likely to be present in similar habitats within Kaheawa Pastures; thus careful planning and caution during construction activity in the vicinity of the upper edges of the gulches should be sufficient to protect the species within the project area (Severns 2009). This species may also benefit and increase in numbers with the stabilization of the pasture and protection from fire as a result of the development of KWP II (Severns 2009). The species tentatively identified as *Nesopupa* in Appendix 9 has been confirmed as *Gastrocopta lyonsiana/servilis*, which is a widespread Indo-Pacific species and therefore introduced (Severns pers. comm.).

Thirteen bird species have been observed by KWP I biologists for the KWP II area (Table 3.3). Two other introduced species documented by Nishibayashi (1997, 1998) in the KWP I area could also occur at the KWP II area. The two species are the northern cardinal (*Cardiinalis cardinalis*) and the house finch (*Carpodacus mexicanus*). Two native or endemic species occur on site, the endangered nēnē (*Branta sandvicensis*) and the Hawaiian short-eared owl (*Asio flammeus sandwichensis*). The indigenous white-tailed tropicbird has been observed flying overhead (*Phaethon lepturus*) and one migratory species, the Pacific golden-plover (*Pluvialis fulva*), is present on-site during the migratory season (late August to May). All the native species and migratory species present at KWP II are also protected by the MBTA.

Cooper and Day (2009) report nine observations of Hawaiian short-eared owls at the proposed project site during five nights of surveys in July 2009. Hawaiian short-eared owls are present year-round at Kaheawa Pastures and are observed regularly in the vicinity of KWP I. Most owl activity is concentrated in the nearby gulches, although individuals also forage over the open, flatter parts of the KWP II area. One Hawaiian short-eared owl fatality associated with a turbine collision has been reported after nearly four years of operation. One fatal vehicular collision has also occurred. In the vicinity of turbines, most observations of the Hawaiian short-eared owl have been below the rotor swept zone of the turbines and thus their susceptibility to collision appears to be low despite a regular presence in the area (Spencer, pers. comm.). One Hawaiian short-eared owl fatality was also found at the base of existing transmission lines and was not associated with KWP I.

At Wolfe Island, Ontario, it was observed that short-eared owls were most vulnerable to colliding with turbine blades during predator avoidance and during aerial flight displays (Stantec Consulting Ltd. 2007). Short-eared owls on Maui have no aerial predators and thus may only be vulnerable to colliding with turbines during flight displays. Four total fatalities of short-eared owl (*Asio flammeus flammeus*) have been recorded at operating wind farms, one each at McBride Lake, Alberta, Canada; Foote Creek Rim, Wyoming; Nine Canyon, Wyoming; and Altamont Wind Resource Area, California (Kingsley and Whittam 2007).

White-tailed tropicbirds (*Phaethon lepturus*) are sometimes seen near the project area by KWP I staff but usually remain associated with the deep gulches adjacent to the site. This species is known to nest in steep valley faces and canyon walls which are common features in nearby Ukumehame, Manawainui, and Malalowaiʻole Gulches. Six fatalities attributable to turbine collisions have been observed at KWP I as of November 2011. One fatality of a great frigate bird has also been reported.

Thus far, four ringed-necked pheasants, six black francolins, two gray francolins, two Eurasian skylarks, two spotted doves, one barn owl and one Japanese white-eye have collided with the towers or turbine rotors at KWP I.

Based upon information provided by Maui DLNR staff and KWP I biologists, mammals occurring in the vicinity of the project area likely to include the house mouse (*Mus musculus*), rats (*Rattus* sp.), axis deer (*Cervus axis*), small Indian mongoose (*Herpestes auropunctatus*), feral cat (*Felis silvestris*), and feral dog (*Canis lupus*), although no evidence of dogs has been documented in the project area since KWP I began operations in June 2006 and only a few reports of deer have been received during the same period.

Table 3.3. Avian Species Identified in the Project Area by KWP I Biologists (2006 to present). -*NO CHANGE*

Scientific Name	Common Name	Status (Protection)
Branta sandvicensis	Hawaiian goose, nēnē	E (MBTA, Endangered)
Phaethon lepturus dorotheae	White-tailed tropicbird	N (MBTA)
Francolinus pondicerianus	Gray francolin	I
Francolinus francolinus	Black francolin	I
Phasianus colchicus	Ring-necked pheasant	I
Pluvialis fulva	Pacific golden-plover	M (MBTA)
Streptopelia chinensis	Spotted dove	I
Geopelia striata	Zebra dove	I
Asio flammeus sandwichensis	Hawaiian short-eared owl	N (MBTA, State Endangered on Oahu)
Tyto alba	Barn owl	I (MBTA)
Alauda arvensis	Eurasian skylark	I (MBTA)
Acridotheres tristis	Common myna	I
Lonchura punctulata	Nutmeg manikin	I

E = endemic, I = introduced, M = migratory, N = native, MBTA = Migratory Bird Treaty Act

3.8 Listed Wildlife Species *-UPDATED*

To date, no portion of the project area has been designated as critical habitat for any listed species. Of the four Covered Species, the nēnē~~,~~ and Hawaiian hoary bat use the habitats in or near the project area based on observed fatalities and visual or acoustic observations. Nēnē are known to be resident in the project area and acoustic bat detectors stationed in the KWP I and KWP II project areas have recorded low levels of seasonal bat activity. Hawaiian petrels and Newell's shearwaters nest in the West Maui Mountains; individuals of these species may occasionally fly through the airspace of the KWP II project area. Hawaiian petrel and Newell's shearwater take are not being amended.

The WTGs and met tower associated with the KWP II project would present collision hazards to all four of the Covered Species. Lighting these structures pursuant to FAA regulations may increase the risk of avian collisions (Gehring and Kerlinger 2007). Table 3.4 lists the Federally listed species with potential to be adversely impacted by operation of the KWP II project and for which Federal and State authorization of incidental take is being sought. Information on each of these species is provided following Table 3.4.

Table 3.4. State and Federally Listed Species with Potential to be Impacted by the KWP II Project (E = endangered, T = threatened). -*NO CHANGE*

Scientific Name	Common, Hawaiian Name(s)	Date Listed	Status
Birds			
*Puffinus newelli**	Newell's shearwater, ʻaʻo	10/28/1975	T
*Pterodroma sandwichensis**	Hawaiian petrel, ʻuaʻu	3/11/1967	E
Branta sandvicensis	Hawaiian goose, nēnē	3/11/1967	E
Mammals			
Lasiurus cinereus semotus	Hawaiian hoary bat, ʻōpeʻapeʻa	10/13/1970	E

* these species are outside the scope of this amendment

3.8.1 Hawaiian Petrel *–NO CHANGE*

3.8.1.1 Population, Biology and Distribution of the Hawaiian Petrel

Hawaiian petrel was once abundant on all main Hawaiian Islands except Niʻihau (Mitchell *et al.* 2005). The population was most recently estimated to be approximately 20,000, with 4,000 to 5,000 breeding pairs (Mitchell *et al.* 2005). Today, Hawaiian petrels continue to breed in high- elevation colonies on Maui, Hawaiʻi, Kauaʻi and Lānaʻi (Richardson and Woodside 1954; Simons and Hodges 1998; Telfer *et al.* 1987). Radar studies conducted in 2002 also suggest that breeding may occur on Molokaʻi (Day and Cooper 2002). It is believed that breeding no longer occurs on Oʻahu (Harrison 1990).

Survey work at a recently re-discovered Hawaiian petrel colony on Lānaʻi, that had been previously thought to be extirpated, indicates that thousands of birds are present, rather than hundreds of birds as first surmised, and that the size of the breeding colony approaches that at Haleakalā, Maui, where as many as 1,000 pairs have been thought to nest annually (Mitchell *et al.* 2005; Tetra Tech EC, Inc. 2008a, b). Radar counts of petrels on the perimeter of Maui and recent colony detections by KWP I researchers suggest that the Maui population may be much higher than the 1,000 pairs previously estimated (Cooper and Day 2003).

Hawaiian petrels are nocturnal and subsist primarily on squid, fish and crustaceans caught near the sea surface. Unlike shearwaters, Hawaiian petrels are not known to dive or swim below the surface (Pitman 1986). Foraging may take place thousands of kilometers from their home islands during both breeding and non-breeding seasons (Spear *et al.* 1995). In fact, recent studies conducted using satellites and transmitters attached to Hawaiian petrels have shown that they can range across more than 6,200 miles (10,000 km) during two-week foraging expeditions (Adams 2008).

Hawaiian petrels are active in their nesting colonies for about eight months each year. The birds are long-lived (ca. 30 years) and return to the same nesting burrows each year between March and April. Present-day Hawaiian petrel colonies are typically located at high elevations above 2,500 meters (8,200 ft.). The types of habitats used for nesting are very diverse and range from xeric habitats with little or no vegetation, such as at Haleakalā National Park on Maui, to wet forests dominated by ʽōhiʽa with uluhe understory as those found on Kauaʽi (Mitchell *et al.* 2005). Females lay only one egg per year, which is incubated alternately by both parents for approximately 55 days. Eggs hatch in June or July, after which both adults fly to sea to feed and return to feed the nestling. The fledged young depart for sea in October and November. Adult birds do not breed until age six and may not breed every year, but pre-breeding and non-breeding birds nevertheless return to the colony each year to socialize.

3.8.1.2 Current Threats to the Hawaiian Petrel

The most serious land-based threat to the species is predation of eggs and young in the breeding colonies by introduced mammalian predators such as small Indian mongoose, feral cats, owls, pigs, dogs and rats. Population modeling by Simons (1984) suggests that this species could face extinction in a few decades if predation is not controlled. Intensive trapping and habitat protection has helped to improve nesting and fledging success (Ainley *et al.* 1997). Hodges and Nagata (2001) found that nesting activity (signs of burrow activity) in sites protected from predators on Haleakalā ranged from 37.25% to 78.13% while nesting activity in unprotected sites ranged from 23.08 to 88.17%. Nesting success (proportion of active burrows that showed signs of fledging chicks) in protected sites ranged from 16.97% to 50.00%, while nesting success in unprotected sites ranges from 0.00 to 44.00% averaging 42.4% and 27.1% respectively (Table 6.2; Hodges and Nagata 2001).

Ungulates can indirectly affect nesting seabirds by overgrazing and trampling vegetation, as well as facilitating erosion. Climatic events such as El Niño can also impact the reproductive success of seabirds (Hodges and Nagata 2001). Other threats include occasional mortality from collisions with power lines, fences, and other structures near breeding sites or attraction to bright lights. In addition, juvenile birds are sometimes grounded when they become disoriented by lights on their nocturnal first flight from inland breeding sites to the ocean. A few, mostly juvenile, Hawaiian petrels have landed in brightly lighted areas at scattered locations on Maui most years. The problem is much smaller than the one involving Newell's shearwaters (see following section), and Simons and Hodges (1998) conclude that it is probably not a threat to remaining populations.

Three Hawaiian petrel fatalities, presumed to have collided with WTGs, have been recorded at KWP I since the beginning of operations in January 2006 (Kaheawa Wind Power LLC 2008b, 2008c).

3.8.1.3 Occurrence of the Hawaiian Petrel on Maui

Simons and Hodges (1998), and recent observations of birds calling and performing aerial displays consistent with breeding behavior, indicate the presence of Hawaiian petrel nesting colonies in West Maui (Kaheawa Wind Power, LLC 2007a, 2007b). Cooper and Day (2003) also observed Hawaiian petrels flying inland over the northern coast toward the mountainous interior of West Maui.

Research and field investigations in support of the KWP I HCP confirmed that Hawaiian petrels congregate in West Maui over the lower portion of Kahakuloa Valley. These observations were corroborated by DLNR/DOFAW wildlife biologists from Maui and seabird researchers from the USGS and H.T. Harvey and Associates in early July 2007. Subsequent investigations have shown that the area was likely once an active seabird colony (see Section 6.3.1.1). A small nesting colony likely exists in the West Maui Mountains in the upper portions of Kahakuloa and Honokōhau Valleys (G. Spencer, First Wind, pers. comm.; see Figure 3.1).

Mount Haleakalā, which defines East Maui, supports the largest known nesting colony of Hawaiian petrels (USFWS 2005; Hodges and Nagata 2001). Approximately 1,000 known nests are within the crater of the dormant shield volcano, with the highest concentration on the western rim between 2,400 and 3,055 m elevation. The highest densities of nests (15-30 burrows per hectare) occur within

Haleakalā National Park. Predator trapping is conducted year-round to reduce predation pressure on these burrows. Lower densities of nesting burrows occur elsewhere in the crater and beyond the park boundaries, but these are currently not actively managed (Hodges and Nagata 2001).

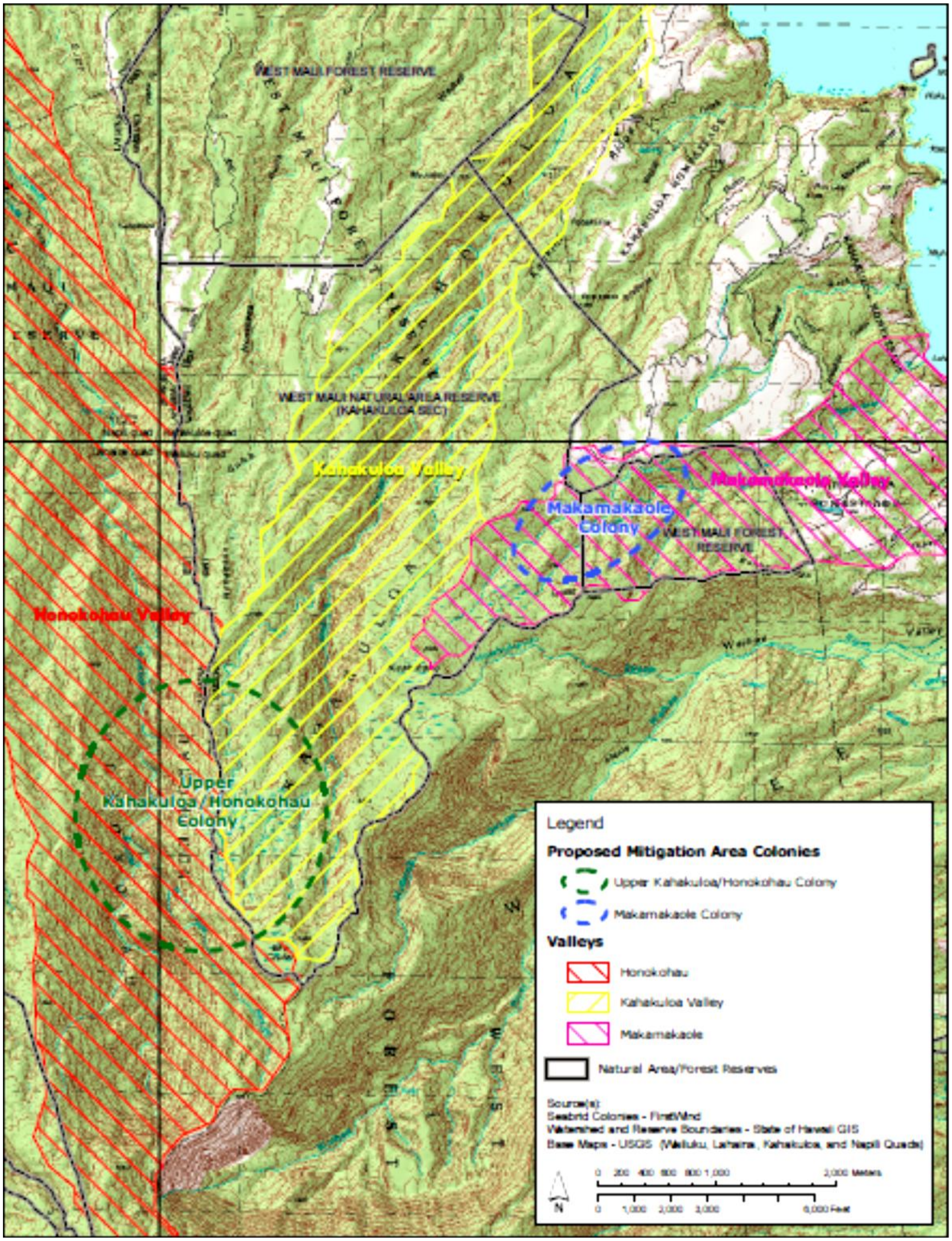


Figure 3.1. Seabird Colonies and Seabird Congregation Areas on West Maui. -*NO CHANGE*

3.8.1.4 Occurrence of the Hawaiian Petrel in the Project Area

ABR Inc. conducted radar and night-visual observations in July and October 2009 to document passage rates of seabirds over KWP II during the nesting season (Appendix 13). The estimated number of Hawaiian petrels passing through the airspace of KWP II is 6.3 birds/night for the spring/summer season and 4.12 birds/night during the fall fledging season. Passage rates in the fall are lower because the visitation rates by adults to feed their chicks decline as much as 80% in the last quarter of the nestling period (Simons 1985).

Spring/summer and fall passage rates of seabirds (Hawaiian petrels and Newell's shearwaters combined) at KWP II are within the range of variability of passage rates observed upslope at KWP I over the last 10 years (Figure 3.2a). However, when comparing passage rates over other areas and islands of Hawaiʽi, passage rates over the KWP I and KWP II project area are lower than the mean rate measured for West Maui (8.7 ± 3.9 targets/hr. Fig. 3.2a), East Maui (52.8 ±16.6 targets/hr., Cooper and Day 2003, Figure 3.2b) and are less than 2.5% of the mean passage rates measured on Kauaʽi (131 ± 35 targets/hr., Day and Cooper 2001).

3.8.2 Newell's Shearwater ***–NO CHANGE***

3.8.2.1 Population, Biology, and Distribution of the Newell's Shearwater

The Newell's shearwater is an endemic Hawaiian sub-species of the nominate species, Townsend's shearwater (*Puffinus a. auricularis*) of the eastern Pacific. The Newell's shearwater is considered "Highly Imperiled" in the Regional Seabird Conservation Plan (USFWS 2005) and the North American Waterbird Conservation Plan (Kushlan *et al.* 2002). Species identified as "Highly Imperiled" have suffered significant population declines and have either low populations or some other high risk factor.

The most recent population estimate of Newell's shearwater was approximately 84,000 birds, with a possible range of 57,000 to 115,000 birds (Ainley *et al.* 1997). Radar studies on Kauaʽi show a 63% decrease in detections of shearwaters between 1993 and 2001 (Day *et al.* 2003a). The largest breeding population of Newell's shearwater occurs on Kauaʽi (Telfer et al*.* 1987; Day and Cooper 1995; Ainley et al*.* 1995, 1997b; Day et al*.* 2003). Breeding also occurs on Hawaiʽi Island (Reynolds and Richotte 1997; Reynolds et al*.* 1997; Day *et al.* 2003a) and almost certainly occurs on Molokaʽi (Pratt 1988; Day and Cooper 2002). Recent radar studies suggest the species may also nest on Oʽahu (Day and Cooper 2008). On Maui, radar studies and visual and auditory surveys conducted over the past decade suggest that one or more small breeding colonies are present in the West Maui Mountains in the upper portions of Kahakuloa Valley (G. Spencer, First Wind, pers. comm.; see Figure 3.1).

Newell's shearwaters typically nest on steep slopes vegetated by uluhe fern (*Dicranopteris linearis*) undergrowth and scattered ʽōhiʽa (*Metrosideros polymorpha*) trees. Currently, most Newell's shearwater colonies are found from 525 to 3,900 feet (160 to 1,200 m) above mean sea level, often in isolated locations and/or on slopes greater than 65 degrees (Ainley *et al.* 1997). The birds nest in short burrows excavated into crumbly volcanic rock and ground, usually under dense vegetation and at the base of trees. A single egg is laid in the burrow and one adult bird incubates the egg while the second adult goes to sea to feed. Once the chick has hatched and is large enough to withstand the cool temperatures of the mountains, both parents go to sea and return irregularly to feed the chick. The closely related Manx shearwater is fed every 1.2-1.3 days (Ainley *et al.* 1997). Newell's shearwaters arrive at and leave their burrows during darkness and birds are seldom seen near land during daylight hours. During the day, adults remain either in their burrows or at sea some distance from land.

First breeding occurs at approximately six years of age, after which breeding pairs produce one egg in a given year. A high rate of non-breeding is found among experienced adults that occupy breeding colonies during the summer breeding season, similar to some other seabird species (Ainley *et al.* 2001). No specific data exist on longevity for this species, but other shearwaters may reach 30 years of age or more (see for example Bradley *et al.* 1989; del Hoyo *et al.* 1992). The Newell's shearwater breeding season begins in April, when birds return to prospect for nest sites. A pre-laying exodus follows in late April and possibly May; egg-laying begins in the first two weeks of June and likely continues through the early part of July.

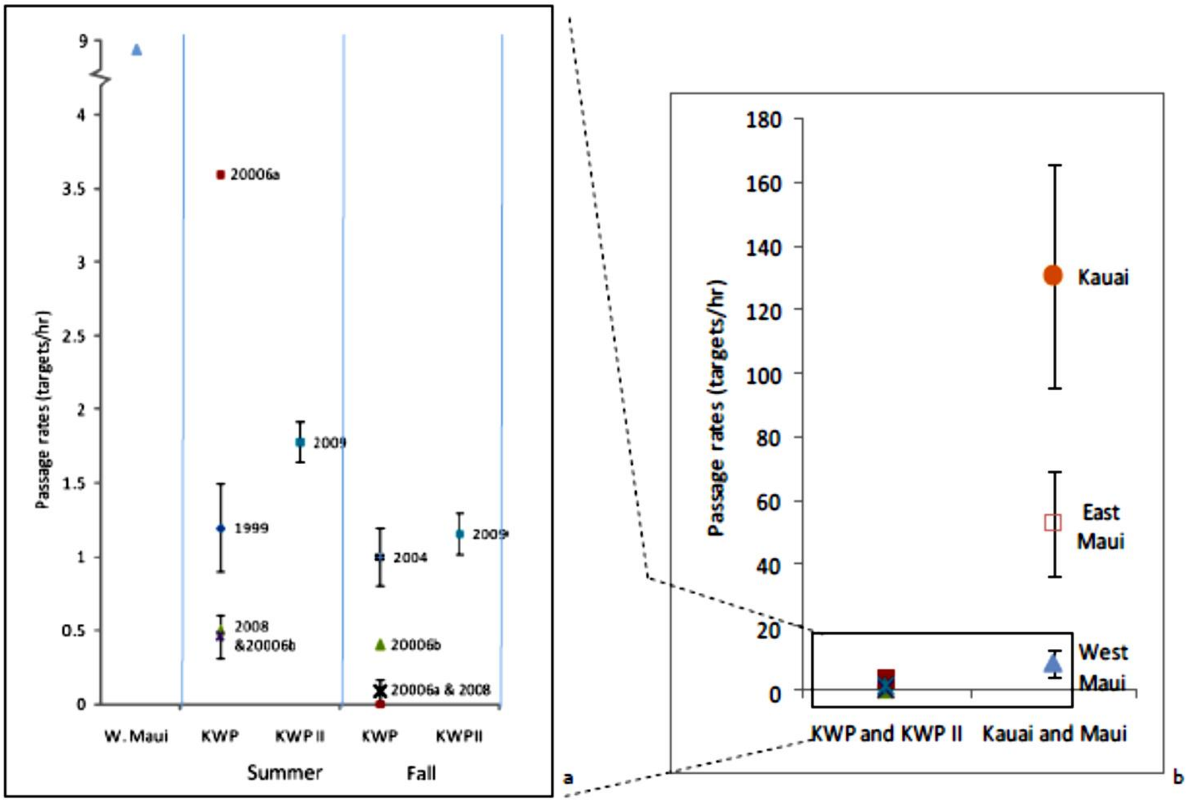


Figure 3.2. Comparison of passage rates of seabirds over KWP I and KWP II with (a) West Maui and (b) East Maui and Kaua'i. Error bars are SE. Data points are labeled with the year the surveys were conducted. 2006 had two survey locations at KWP I. -*NO CHANGE*

Pairs produce one egg, and the average incubation period is thought to be approximately 51 days (Telfer 1986). The fledging period is approximately 90 days, and most fledging takes place in October and November, with a few birds still fledging into December (SOS Data).

3.8.2.2 Current Threats to the Newell's Shearwater

As stated above, radar studies on Kaua'i showed a 63% decrease in detections of shearwaters between 1993 and 2001 (Day *et al.* 2003a). It was presumed that the decrease in detections corresponded to an actual decrease in population, rather than simply a shift in areas used for breeding.

Declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley *et al.* 1997; Mitchell *et al.* 2005; Hays and Conant 2007).

No Newell's shearwater fatalities have been recorded at KWP I since the ITP and ITL were issued in January 2006 (Kaheawa Wind Power LLC 2008b, 2008c).

3.8.2.3 Occurrence of Newell's Shearwater on Maui

Radar and night-visual observations by Day and Cooper (1999) and (Cooper and Day 2004) indicate that Newell's shearwater nests somewhere in the West Maui Mountains, and that low numbers of these birds regularly fly over or near the proposed KWP II project area at night, to and from nesting colonies either in the West Maui Mountains or (occasionally) on Haleakalā. The size of the West Maui nesting population is unknown at this time.

3.8.2.4 Occurrence of Newell's Shearwater in the Project Area

As stated in Section 3.8.1.4., ABR Inc. conducted radar and night-visual observations over the KWP II project area in July and October 2009 (Cooper and Day 2009). The estimated number of Newell's shearwaters passing through the airspace of KWP II is 4.2 birds/night for the spring/summer season and 2.75 birds/night for the fall. Visitation rates by adults to feed their chicks decline in the last quarter of the nestling period much like Hawaiian petrels.

Passage rates of seabirds (Hawaiian petrels and Newell's shearwaters combined) at KWP II are within the range of variability of passage rates observed upslope at KWP I over the last 10 years (Figure 3.2a). However, when comparing passage rates over other areas and islands of Hawai'i, passage rates over the KWP I and KWP II project area are lower than the mean rate measured for West Maui (8.7 ± 3.9 targets/hr., Figure 3.2a), East Maui (52.8 ±16.6 targets/hr., Cooper and Day 2003, Figure 3.2b) and are less than 2.5% of the mean passage rates measured on Kaua'i (131 ± 35 targets/hr.; Day and Cooper 2001).

3.8.3 Nēnē *-UPDATED*

3.8.3.1 Population, Biology, and Distribution of the Nēnē

The nēnē is adapted to a terrestrial and largely non-migratory lifestyle in the Hawaiian Islands with negligible dependence on freshwater habitat. Compared to the related Canada goose (*Branta canadensis*), nēnē wings are smaller by about 16% in size and their flight capability is comparatively weak. Nonetheless, nēnē are capable of both inter-island and high altitude flight (Miller 1937; Banko *et al.* 1999).

After nearly becoming extinct in the 1940s and 1950s, the nēnē population slowly has been rebuilt through captive-breeding programs. Wild populations of nēnē occur on Hawai'i, Maui, Kaua'i, and most recently Oahu. The species population estimate in 2015 was 3,034 individuals (Nēnē Recovery Action Group 2017, unpub.). The primary release site on Maui is located at Haleakalā National Park on East Maui where 511 nēnē were released between 1962 and 2003.

Since 1995, the majority of Maui releases have been from a release pen in the Hana'ula region of West Maui in an effort to establish a second population on Maui on this part of the island (F. Duvall, Maui DOFAW, pers. comm.). This pen is located near the upper end of the Kaheawa Pastures project area. The Maui population in 2015 was estimated to be 521 birds (Nēnē Recovery Action Group 2017, unpub.).

KWP I has worked with Maui DOFAW and USFWS to establish a new nēnē release pen on land owned by Haleakalā Ranch in East Maui. This pen was completed in 2011. Thirty-two nēnē fledglings have been successfully produced from this pen between 2012 and 2016 (DOFAW 2016, unpub.).

The nēnē has an extended breeding season with eggs reported from all months except May, June and July, although the majority of birds in the wild nest during the rainy (winter) season between October and March (Banko *et al.* 1999; Kear and Berger 1980). Nēnē nest on the ground in a shallow scrape in the dense shade of a shrub or other vegetation. A clutch typically contains three to five eggs and incubation lasts for 29 to 31 days. The female incubates the eggs, with the male standing guard nearby, often from an elevated location. Once hatched, the young remain in the nest for one to two days (Banko *et al.* 1999). Fledging of captive birds occurs at 10 to 12 weeks, but may occur later in the wild. During molt, adults are flightless for a period of 4 to 6 weeks. Molt occurs after hatching of eggs, such that the adults generally attain their flight feathers at about the same time as their offspring. When flightless, goslings and adults are extremely vulnerable to predators such as dogs, cats, and mongoose. From June to September, family groups join others in post-breeding aggregations (flocks), often far from nesting areas.

Nēnē occupy various habitat types ranging from beach strand, shrub land and grassland to lava rock, at elevations ranging from coastal lowlands to alpine areas (Banko 1988; Banko *et al.* 1999). The geese eat plant material, and the composition of their diet depends largely on the vegetative composition of their surrounding habitats. They appear to be opportunistic in their choice of food plants as long as the plants meet their nutritional demands (Banko *et al.* 1999; Woog and Black 2001).

3.8.3.2 Current Threats to Nēnē

Current threats to nēnē include predation by non-native mammals, exposure in high-elevation habitats, insufficient nutritional resources for both breeding females and goslings, a lack of lowland habitat, human-caused disturbance and mortality (e.g., road mortality, disturbance by hikers), behavioral problems related to captive propagation, inbreeding depression, and infectious/inflammatory diseases of which toxoplasmosis predominated (USFWS, unpubl.; USFWS 2004a, Work *et al.* 2015). Predators of nēnē eggs and goslings include dogs, cats, rats and mongoose. Dogs and mongoose are also responsible for most of the known cases of adult predation (USFWS 2004a). Nēnē have also been negatively impacted by human recreational activities (e.g., hikers and hunters). In recent years, nēnē have been struck and killed by golf balls and vehicles (USFWS 2004a).

Starvation and dehydration can be major factors in gosling mortality. Approximately 81.5% of gosling mortality in Haleakalā National Park during the 1994 to 1995 breeding season was due to starvation and dehydration (USFWS 2004a). From 2005 to 2007, between 30 to 50% of the goslings at the Hakalau Forest Unit died due to drought and/or exposure (USFWS, unpubl.). A lack of adequate food and water supplies also seems to be a limiting factor in Hawai'i Volcanoes National Park (USFWS 2004a, Work *et al.* 2015).

For nēnē populations to survive they must be provided with generally predator-free breeding areas and sufficient food resources; human-caused disturbance and mortality must be minimized; and, genetic and behavioral diversity maximized. At the same time, it is recognized that nēnē are highly adaptable, successfully utilizing a gradient of habitats ranging from highly altered to completely natural, which bodes well for recovery of the species.

Twenty-three nēnē fatalities at KWP I have been observed in the search area since the beginning of operations at KWP I in 2006 and through June 2017 (Kaheawa Wind Power LLC 2008b, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, and 2017). Four nēnē fatalities at KWP II have been observed in the search area from July 2012 through June 2017 (Kaheawa Wind Power II LLC 2013, 2014, 2015, 2016, and 2017).

3.8.3.3 Occurrence of Nēnē in West Maui and the Project Area

The Hana'ula release pen is located near the upper end of the existing KWP I project area, approximately 1,800 feet (550 m) from the nearest KWP I wind turbine and 12,011 feet (3,707 m) from KWP II turbine 1. DOFAW has suspended using this release pen for future releases. A number of nēnē from the Hana'ula release site have remained as residents within or near the KWP I and KWP II project area. Little is known about the exact distribution and movements of the birds released at the Hana'ula release pen, although they have been recorded as far west as Lahaina (approximately 7.7 miles or 12.3 km from the project area) and as far east as Haleakalā National Park, indicating that at least some birds from this release site move extensively around the island (J. Medeiros, Maui DOFAW, pers. comm.). The nēnē population in this region (Hana`ula/West Maui) is estimated at 169 birds (Nēnē Recovery Action Group [NRAG] 2017, unpub.). This population is monitored under the KWP I and KWP II HCP's and survey effort is now well coordinated between DOFAW and KWP I and KWP II biologists.

In 1998, four goslings were successfully fledged from the first nest reported in the area since reintroduction began (DOFAW 2000). Monitoring studies at KWP I and KWP II have resulted in discovery of a few nēnē nests annually only in the vicinity KWP I.

Nēnē presence has been monitored regularly in the KWP I and KWP II project area prior to and after commencing operation of KWP I and KWP II. Data collected from incidental surveys and the WEOP program (December 2006–June 2009), have provided information about nēnē distribution and behavior at KWP I and KWP II. Monitoring of nēnē during the construction period at KWP I (January to June 2006) also documented nēnē use of the KWP I area and down road KWP II area. Both these data sets combined provide over 800 observations (n = 820 individuals) on nēnē distribution and span over three and a half years[3].

Results show that nēnē are seen almost twice as frequently (n = 532 individuals) at the KWP I area than at the KWP II down road area (n = 288, Figure 3.3). Most of the down road observations are in the upper elevations of the KWP II area, near the Pali Trail Junction (Mile Marker 1.75) and in the vicinity of MECO's 64kV overhead transmission route crossing (Mile Marker 2.25). The birds periodically use the area for browsing and socializing (Spencer pers. comm.). No nesting is expected to occur within the KWP II project area (see above).

In addition to the Wildlife Education and Observation Program (WEOP) observations, systematic surveys were also conducted at KWP I and consisted of 116.8 hours (hr)of observation time from June 2006 to June 2007. The primary purpose of the systematic surveys was to record nēnē flight behavior around the existing KWP I wind facility. Surveys were conducted in the mornings (6-10 a.m.), afternoons (10 a.m.–2 p.m.) and evenings (2 p.m.–6 p.m.). Systematic surveys show that flight activity did not vary with time of day (range= 0.29 – 0.38 flocks in flight/hr.; $X^2 = 0.464$, degrees of freedom (*df*) = 2, probability (p) = 0.79).

Data from the WEOP surveys and systematic surveys combined document that nēnē frequently fly within the rotor-swept zone (RSZ) of the turbines at KWP I (66.1% of all flights observed, n=97) with 16.9% occurring below the RSZ and also 16.9% above.

[3]To standardize effort spent surveying both KWP I and KWP II areas, data were chosen only from time periods when the entire stretch of road leading from the base of KWP II to KWP I was surveyed. For WEOP observations, the two time periods that fit this criterion were 6:30 to 9:00 a.m. and 3:30 to 7:00 p.m. As the entire roadway was surveyed during the construction period, all nēnē observations were used from that dataset.

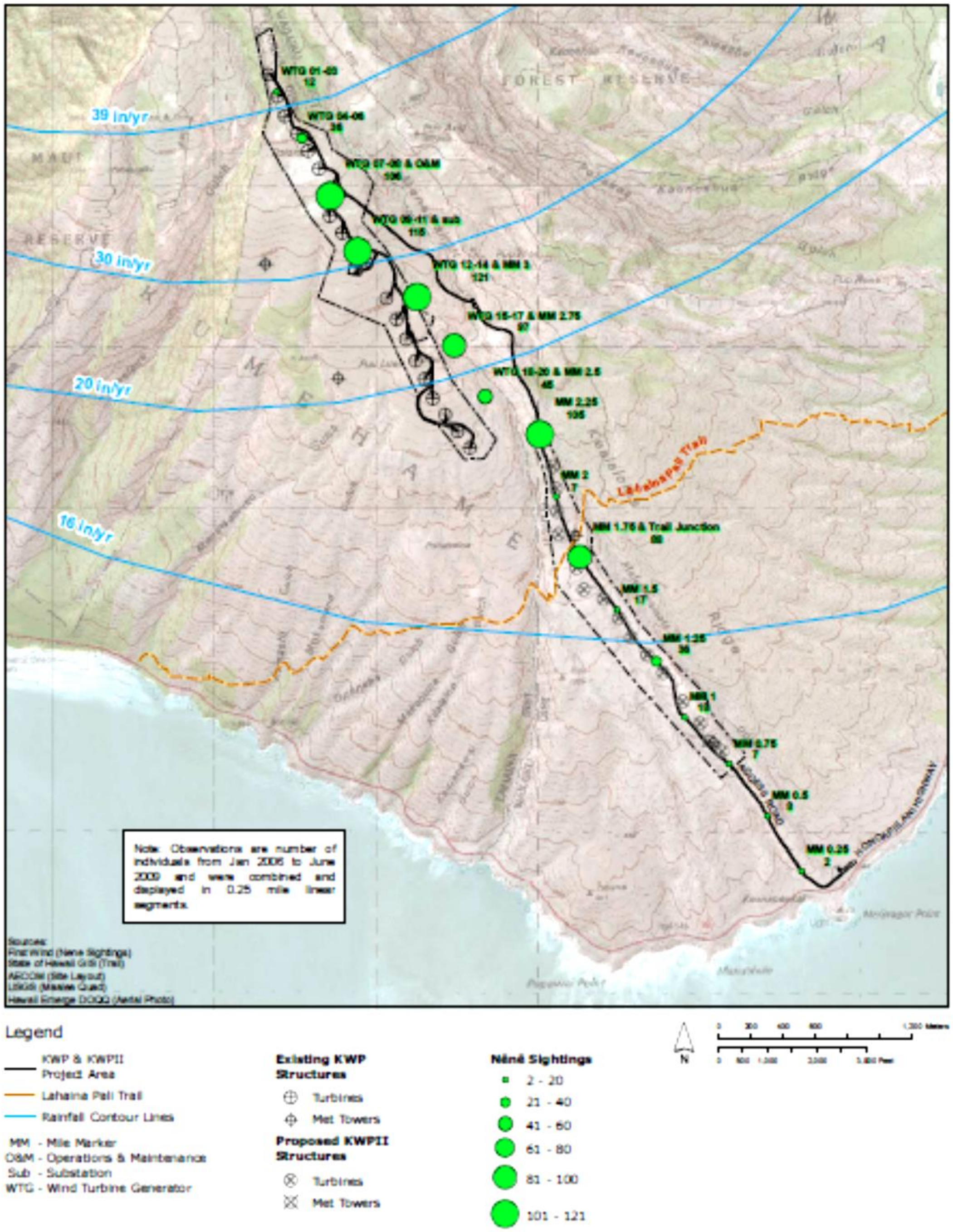


Figure 3.3. Distribution of nēnē at KWP I and KWP II areas. -*NO CHANGE*

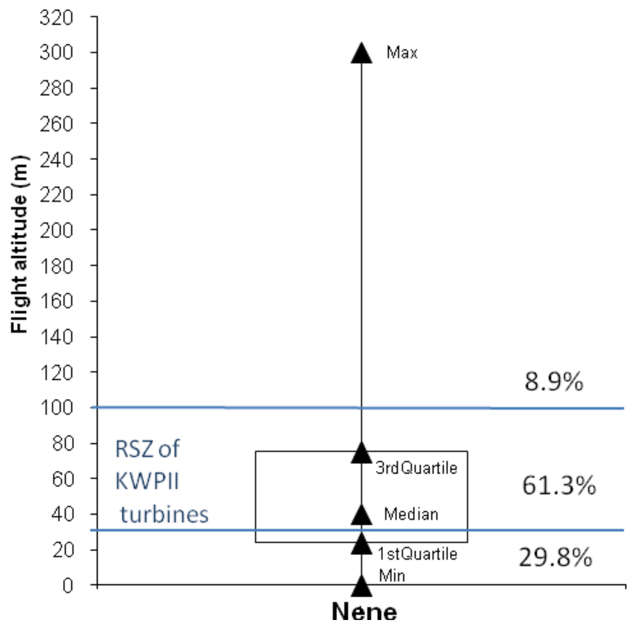


Figure 3.4. Flight altitudes of nēnē from WEOP and systematic observations (n=97), imposed on the RSZ of turbines at KWP II. Percentages on the right are the percentages of nēnē flights expected to occur at, below and above the RSZ. -*NO CHANGE*

As turbine towers at KWP II are 10 m taller, the RSZ height is also raised by 10 m (the area remains the same). If flight characteristics of nēnē at KWP II are similar to those observed at KWP I, slightly fewer nēnē (61.3%) are expected to be flying at RSZ height at KWP II, further reducing collision risk (Figure 3.4). In addition, the KWP II site is situated at an elevation that reduces its propensity for dense cloud cover that may improve the avoidance behavior of nēnē encountering turbines in their airspace. Flock sizes in flight averaged 2.7 birds.

In summary, fewer nēnē are seen in the KWP II down road area compared to KWP I. Applying nēnē behavioral observation at KWP I to KWP II, nēnē may transit through the KWP II area at any time during daylight hours. As KWP II turbine towers are 10 m taller than the KWP I turbines, fewer nēnē flocks will fly within the RSZ of the KWP II turbines (61% vs. 66%) and the flight avoidance behavior observed at KWP I is expected to further lower the risk of take at KWP II. The greater visibility on site due to the lower elevation, and due to the decrease in the frequency and extent of cloud cover of KWP II, could also potentially decrease the risk of turbine collision for nēnē.

3.8.4 Hawaiian Hoary Bat -*UPDATED*

3.8.4.1 Population, Biology and Distribution of the Hawaiian Hoary Bat

The Hawaiian hoary bat is the only existing native terrestrial mammal from the Hawaiian Archipelago (USFWS 1998). The species has been recorded on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i, but no historical or current population estimates exist for this subspecies. ~~Menard (2001) has suggested that population estimates for all islands in the State in the recent past have ranged from hundreds to a few thousand bats, although these guesses are not based on any formal collection of population data, comprehensive assessment or analysis.~~ The Hawaiian hoary bat is believed to occur primarily below an elevation of 4,000 feet (1,220 m). This subspecies has been recorded between sea level and approximately 9,050 feet (2,760 m) in elevation on Maui, with most records occurring at or below approximately 2,060 feet (628 m) (USFWS 1998, Gorresen *et al.* 2013).

Hawaiian hoary bats roost in native and non-native vegetation from 3 to 29 feet (1 to 9 m) above ground level. They have been observed roosting in 'ōhi'a, hala (*Pandanus tectorius*), coconut palms (*Cocos nucifera*), kukui (*Aleurites moluccana*), kiawe (*Proscopis pallida*), avocado (*Persea americana*), mango (*Mangifera indica*), shower trees (*Cassia javanica*), pūkiawe (*Styphelia tameiameiae*), ironwood trees (*Casuarina equisetifolia*) and fern clumps; they are also suspected to roost in eucalyptus (*Eucalyptus* spp.) and Sugi pine (*Cryptomeria japonica*) stands. The species is rarely observed using lava tubes, cracks in rocks, or man-made structures for roosting. While roosting during the day, Hawaiian hoary bat is solitary, although mothers and pups roost together (USFWS 1998).

Preliminary study of a small sample of Hawaiian hoary bats (n= 25) on the Island of Hawaiʽi has estimated a mean, short term (3-13 calendar days) core use area of 63.0 acres (25.5 ha). The size of home ranges and core areas varied widely between individuals. Core areas included feeding ranges that were actively defended, especially by males, against conspecifics. Female core ranges overlapped with male ranges. Bats typically feed along a line of trees, forest edge or road and a typical feeding range stretches around 300 yards (yds) (275 m). Bats will spend 20 to 30 minutes hunting in a feeding range before moving on to another (Bonaccorso 2011, Bonaccorso *et al.* 2015).

Breeding has been confirmed so far on the islands of Hawaiʽi, Kauaʽi and O'ahu (Baldwin 1950; Kepler and Scott 1990; Menard 2001, D. Johnston, pers. comm. 2014). From these observations, the breeding period is considered to be from April through September. Seasonal changes in the abundance of Hawaiian hoary bats at different elevations indicate that altitudinal migrations occur on the Island of Hawaiʽi (Gorresen *et al.* 2013). During the breeding period, Hawaiian hoary bat occurrences increase in the lowlands and decrease at high elevation habitats. Hawaiian hoary bat occurrences are especially low from June until August in high elevation areas. In the winter, especially during the post-lactation period in October, bat occurrences increase in high elevation areas and in the central highlands, possibly receiving bats from the lowlands (Menard 2001).

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, Todd 2012). They appear to prefer moths ranging between 0.60 and 0.89 inches (16 to 20 millimeters) 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 a food source (Banko *et al.* 2015). Prey is located using echolocation. Water courses and edges (e.g., coastlines and forest/pasture boundaries) appear to be important foraging areas. In addition, the species is attracted to insects that congregate near lights (USFWS 1998; Mitchell *et al.* 2005). They begin foraging either just before or after sunset depending on the time of year (USFWS 1998; Mitchell *et al.* 2005).

3.8.4.2 Current Threats to the Hawaiian Hoary Bat

Primary threats to the Hawaiian hoary bat are unknown; possible threats are hypothesized from studies of other species. The main observed mortality of the Hawaiian hoary bat in Hawai`i has been from bats snagging on barbed wire and colliding with wind turbines. The extent of the impact of barbed wire fences is unknown. Well documented intensive monitoring at wind farms informs the extent of bat mortality from wind turbine collision.

The availability of roosting sites is believed to be a major limitation in many bat species in general. Possible threats to the Hawaiian hoary bat include pesticides (either directly or by impacting prey species), predation, alteration of prey availability due to the introduction of non-native insects, and roost disturbance (USFWS 1998). Management of the Hawaiian hoary bat is also limited by a lack of information on key roosting and foraging areas, food habits, seasonal movements and reliable population estimates (USFWS 1998, DOFAW 2015). In their North American range, hoary bats are known to be more susceptible to collision with wind turbines than most other bat species (Johnson *et al.* 2000; Erickson 2003; Johnson 2005, O'Shea *et al.* 2016). Most mortality has been detected after the summer breeding season, during the fall migration period. Hoary bats in Hawaiʽi do not migrate in the traditional sense, although as indicated breeding is believed to be seasonal, and some seasonal altitudinal movements occur. Currently, it is not known if Hawaiian hoary bats are more susceptible to turbine collisions during their altitudinal migrations as hoary bats are during their migrations in the continental U.S.

3.8.4.3 Occurrence of the Hawaiian Hoary Bat in West Maui and the Project Area

On Maui, this bat is believed to occur primarily in moist, forested areas, although little is known about its exact distribution and habitat use on the island, especially in the West Maui Mountains. No Hawaiian hoary bats were recorded in the area of the proposed wind turbines during nighttime visual studies using night vision equipment conducted in summer 1999 (Day and Cooper 1999) or fall 2004 (Cooper and Day 2004).

~~Hawaiian hoary bats are not expected to breed or roost in the project area due to the lack of trees in the grassland dominated landscape.~~

KWP I and KWP II have carried out regular bat monitoring using ultrasonic bat detectors in accordance with the provisions of their HCPs and confirmed that the species is present in low numbers in the KWP I and KWP II project areas. ~~Bat activity determined from acoustic recordings indicate they are present at KWP II in relatively low numbers year round with a peak presence in early fall (Figure 3.5).~~

Visual Surveys for Flying Bats at KWP I. In accordance with the provisions of the KWP I HCP, KWP I biologists carried out regular crepuscular and nocturnal surveys aimed at recording bat activity at Kaheawa Pastures from June 2006 through June 2007. During this period, KWP I biologists performed 32 surveys totaling nearly 116 hours of observation effort in and around the KWP I site and adjacent countryside. Initially, surveys were conducted in the vicinity of each of the wind turbines on the site; however, the survey area was extended to include some of the adjacent gulches (Kaheawa Wind Power LLC 2007). The sites were surveyed during winter and spring seasons and under a range of weather and survey conditions. Though there often appeared to be abundant aerial insect prey and favorable wind conditions for flight in the sheltered gulch areas (and occasionally on the plateaus), no positive observations of Hawaiian hoary bats were made during either survey period (Kaheawa Wind Power LLC 2007, 2008a). Two separate bat sightings were reported by contractors between July 2007 and June 2008. One observation occurred on the access road below the Pali Trail on February 20, 2008 and the other at the Operations and Maintenance building on April 5, 2008 (Kaheawa Wind Power LLC 2008b; Appendix 4). KWP I biologists conducted interviews and in both cases identification of these individuals could not be confirmed, but these sightings are consistent with other confirmed records of occurrence in the project area.

Visual Surveys for Downed Bats. KWP I biologists also looked for bats as part of their year-round monitoring aimed at documenting all downed (i.e., injured or dead) Covered Species in the project area. On September 26, 2008, a single dead bat was found near WTG 8. Injuries to the bat suggested it had died of physical trauma, presumably having collided with a turbine rotor or the tower. The second downed bat was found in April 2011. As of June ~~2017~~2018, a total of ~~nine~~ eight Hawaiian hoary bat fatalities have been documented within the search area at KWP I and three have been documented within the search area at KWP II.

Acoustic Monitoring of Bat Activity at KWP I. ~~Since~~ From August 2008 to October 2013~~to June 2010~~, four to eight Anabat detectors (Titley Electronics, NSW, Australia) ~~have been~~ were deployed at various locations in Kaheawa Pastures (Figure 3.5; Kaheawa Wind Power LLC 2009) including in areas where KWP II ~~would~~ was to be constructed. Bat detectors were placed from ground level to 15 ft (4.6 m). On average Anabat detectors are considered to have a detection radius of approximately 98 ft (30 m) although it can often be less depending on site conditions, weather, and other factors. Given the paucity of data on bat distribution in Hawaiʻi, the primary goal of these detectors was to determine bat absence/presence in the area and subsequently quantify relative bat activity if detected. These detectors ~~do~~ did not document bat activity in the rotor swept zone which typically begins at heights above 98 ft (30 m). Surveys conducted at wind farms in the continental U.S. typically exhibit notably higher frequencies of detection of migratory tree-roosting bat from detectors placed at tree height (<20 m or 66 ft) versus those placed within the RSZ (>40 m or 131 ft), particularly where surveys have been conducted throughout the spring through fall seasons, and not just during migration periods (Robert Roy, unpublished data). For example, at the Sheffield Wind in Vermont, where detectors were deployed year-round in 2006, a total of 881 calls were recorded from detectors at tree height, while only 68 calls were recorded within the RSZ. Calls at tree height were over an order of magnitude more than calls detected within the RSZ. This dataset extends beyond the migration period and thus captures the foraging activity of tree-roosting bats at different heights, which is an area of greater concern in Hawai'i. Most other studies typically only sample for migratory tree-roosting bats during the migration period, these data provide good information on the causes of bat mortality during migration, but may be less applicable to Hawai'i. During the fall migration season, Baerwald and Barclay (2009) documented that hoary bats are more active at 30m (98 ft) than at ground level; however, in a Wisconsin study, Redell *et al.* (2006) reported no significant difference in activity levels of so-called "low-frequency" species (including hoary bats) with increasing height above ground level.

At KWP I and KWP II, bat call sequences were mostly detected between the months of May and November (~~Table 3.5;~~ Figure 3.5). Between August 2008 and June 2012, between four and eight bat detectors recorded bat detections (Figure 3.5). Detections were recorded using Titley Anabat detectors in eight of 12 months and the highest rate occurred in October 2011 at 13.8% of total detector nights.

~~Thirty-nine bat passes, were recorded by the four to seven detectors over the sampling period from August 2008 to June 2010 (see Table 3.5 for data and definitions). This equates to a detection rate of 0.011 passes/detector/night (39 bat passes/3436 detector nights). This is less than 2% of the detection rates measured during a study being conducted by U.S. Geological Survey (USGS) at Hakalau National Wildlife Refuge on the Island of Hawai'I (0.66 bat passes/detector/night) (Bonaccorso, unpub. 2008).~~

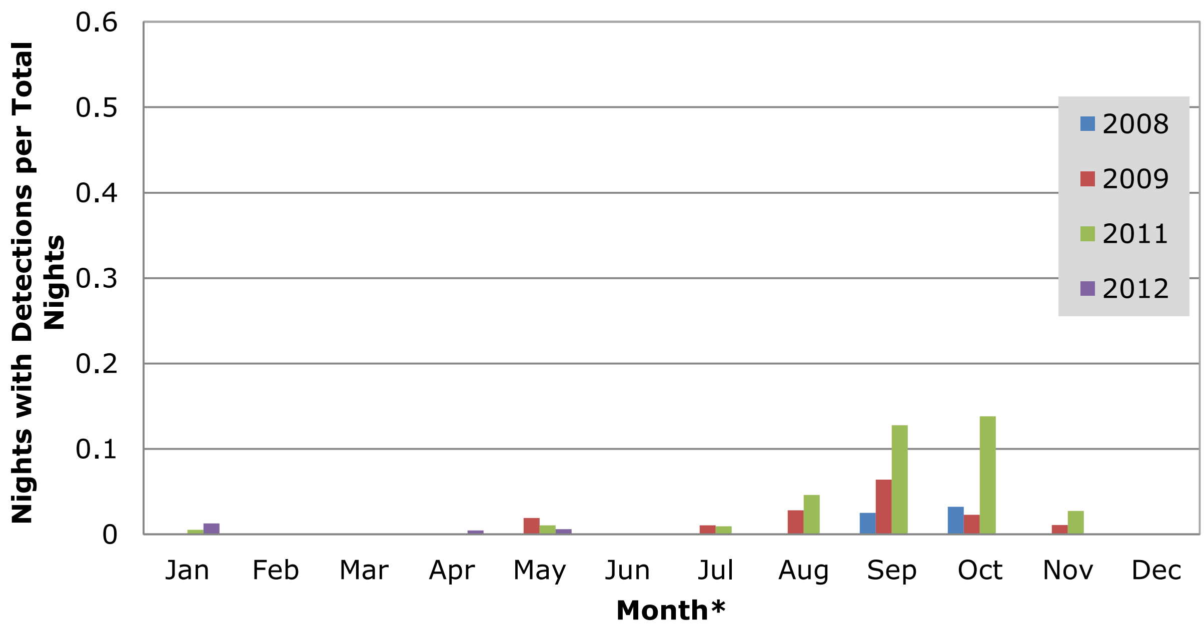


Figure 3.5. Pre-operations at KWP II Temporal Distribution of Anabat Detections at KWP I and KWP II from August 2008 to June 2011 depicted as "nights with detections per total nights". (The vertical scale is intentionally the same as the scale for Figure 3.6 for ease of comparison. * no data for January through July 2008 and July through December 2012). - *UPDATED*

~~Table 3.5. Results of Acoustical Bat Monitoring at KWP I.~~

~~Detector ID #~~	~~Location~~	~~Survey dates~~	~~Operation Days~~	~~Total Rate~~	~~Total Passes~~
~~1~~	~~KWP I~~	~~08/08/08-11/11/08~~	~~86~~	~~2~~	~~0.02~~
~~2~~	~~KWP I~~	~~08/08/08-11/05/08~~	~~86~~	~~3~~	~~0.03~~
~~3~~	~~KWP I~~	~~08/07/08-11/05/08~~	~~82~~	~~2~~	~~0.02~~
~~4~~	~~KWP I~~	~~08/07/08-11/12/08~~	~~89~~	~~0~~	~~0~~
~~5~~	~~KWP I~~	~~11/12/08-04/07/09~~	~~138~~	~~0~~	~~0~~
~~6~~	~~KWP I~~	~~11/12/08-04/15/09~~	~~138~~	~~0~~	~~0~~
~~7~~	~~KWP I~~	~~11/14/08-04/16/09~~	~~159~~	~~0~~	~~0~~
~~8~~	~~KWP I~~	~~11/14/08-04/04/09~~	~~72~~	~~0~~	~~0~~
~~9~~	~~KWP I~~	~~04/28/09-05/27/10~~	~~343~~	~~1~~	~~0~~
~~10~~	~~KWP I~~	~~05/17/09-06/30/10~~	~~394~~	~~12~~	~~0.03~~
~~11~~	~~KWP I~~	~~05/07/09-05/27/10~~	~~307~~	~~0~~	~~0~~
~~12~~	~~KWP I~~	~~04/28/09-05/27/10~~	~~366~~	~~4~~	~~0.01~~
~~13~~	~~KWP I~~	~~06/02/09-05/27/10~~	~~324~~	~~1~~	~~0~~
~~14~~	~~KWP II~~	~~06/03/09-06/30/10~~	~~375~~	~~12~~	~~0.03~~
~~15~~	~~KWP II~~	~~06/03/09-05/27/10~~	~~314~~	~~2~~	~~0.01~~
~~16~~	~~KWP I~~	~~06/03/09-10/23/09~~	~~66~~	~~0~~	~~0~~
~~17~~	~~KWP I~~	~~06/24/10-06/30/10~~	~~7~~	~~0~~	~~0~~
~~18~~	~~KWP II~~	~~05/27/10-06/30/10~~	~~35~~	~~0~~	~~0~~
~~19~~	~~KWP I~~	~~06/27/10-06/30/10~~	~~5~~	~~0~~	~~0~~
~~20~~	~~KWP II~~	~~05/27/10-06/30/10~~	~~16~~	~~0~~	~~0~~
~~21~~	~~KWP II~~	~~05/28/10-06/30/10~~	~~34~~	~~0~~	~~0~~
		~~Total detector nights~~	**~~3,436~~**		
		~~Total passes~~	**~~39~~**		
		~~Overall detection rate~~	**~~0.011~~**		

From October 2013 to the present, 17 Wildlife Acoustic bat detectors (SM2BAT+™) were deployed at KWP I and KWP II at ground level (and replaced Anabat detectors). Due to differences in the sensitivity of the acoustic detectors and microphones used for the different equipment, the data from October 2013 to the present cannot be directly compared with the data collected using up to eight Titley Anabat SD2™ detectors from 2008 to 2012. Wildlife Acoustics detectors are more sensitive than the older Titley detectors and detect relatively more bats.

Bat activity collected at KWP II using Wildlife Acoustics SM2BAT+ in more recent years (October 2013 through June 2017) indicate they are present at KWP II in relatively low numbers year-round with a peak presence in early fall (Figure 3.6). Detections were recorded in every month and the highest rate occurred in September 2015 with 58% of total detector nights having bat activity. Compared to activity rates prior to 2013, activity rates are noticeably higher and bats are detected throughout the year (Figure 3.5). As an example of how different the measured activity rates are using the two different detector types, the nightly presence rate during the month with the highest detected rate (in September 2015, rate = 58%, Figure 3.6) was four times higher than during the highest rate in the period prior to 2013 (in October 2011, rate = 14%, Figure 3.5).

In general bats have been detected at KWP II at every turbine either on the ground or at nacelle height and bats have been detected in every month of the year (KWP II 2013, 2014, 2015, 2016, 2017 and 2018). The three observed bat takes at KWP II were found in the upper half of the 14 turbines (turbines 2, 6 and 7). In FY 2017 at KWP II 8.3% and 8.4% of nights with detections occurred at ground detectors at turbines 1-7 and 8-14, respectively, suggesting turbine specific bat detection rates generally do not predict where fatalities are likely to occur. There is a higher level of bat detections at KWP II in the late summer-early fall months but the three bat fatalities observed at KWP II did not occur during these months with relatively higher detection rates.

The detection patterns found at KWP I were similar to patterns observed at KWP II; at every turbine and in every month (KWP I 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 and 2018). Of the 11 observed bat takes found at KWP I only four were found during July through October, approximately what would be expected if bat take occurs randomly throughout the year. Four were found in April and May and three in November, December and February. Six of 11 (55%) observed bat takes at KWP I were found at three turbines (turbines 8, 16 and 18). The other five bat takes were found at turbines 2, 6, 9, 10 and 14. Six of 11 observed bat takes at KWP I were found at turbines 1-10 and five of 11 at turbines 11-20. In FY 2017 at KWP I 5.2% and 5.1% of nights with detections occurred at ground detectors at turbines 1-10 and 11-20, respectively, suggesting that generally bat fatalities correlated with nightly bat detection rates.

Acoustic monitoring will continue throughout the 20-year permit period.

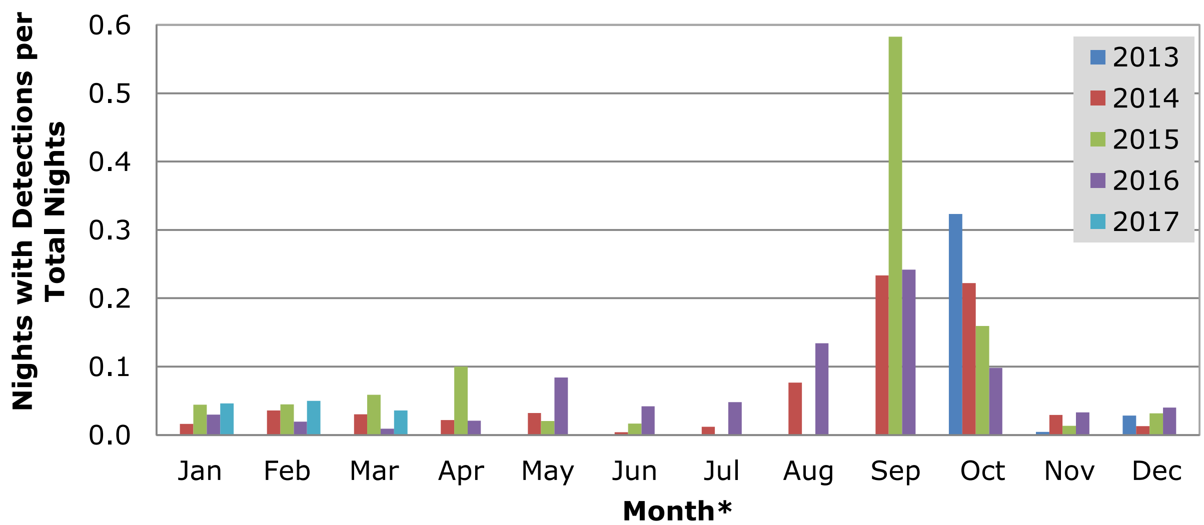


Figure 3.6. KWP II Operations, Hawaiian Hoary Bat Activity at KWP II, Wildlife Acoustics only Ground Detectors by Month from October 2013 through June 2017 (*no data for Jan-Sep 2013, Jul–Aug 2015, Jul-Dec 2017). *-NEW*

3.8.5 Recently Listed Species –*NEW*

Except for the Covered Species, no other Federally or State-threatened or endangered species have been documented in the project area. Species recently listed that are potentially present were also reviewed (Table 3.6). However, these species would not use resources on the site, and project actions would not rise to the level of incidental take. Therefore, these species are not carried forward for analysis.

Table 3.6. Recently Listed Species with Potential to Occur in the KWP II Project Area-NEW

Common, Hawaiian Name(s)	**Scientific Name**	**Listing Status; Date Listed**	**Presence in Project Area**
Band-rumped storm petrel (`ake`ake)	*Oceanodroma castro*	Endangered; 10/31/16	Potential; individual petrels could fly over the project area, but the risk of take is extremely low.
Orangeblack damselfly	*Megalagrion xanthomelas*	Endangered; 10/31/16	No; required slow or standing water sources are absent.
Yellow faced bees	*Hylaeus anthracinus, H. assimulans, H. facilis, H. hilaris, H. longiceps*	Endangered; 10/31/16	No; host plants are absent.

4.0 BIOLOGICAL GOALS AND OBJECTIVES

4.1 General –*NO CHANGE*

KWP II LLC has worked cooperatively with USFWS and DLNR to assess the potential for the proposed project to cause adverse impacts to the four Covered Species through site-specific studies, and has taken all appropriate and practicable steps to avoid and minimize the potential for adverse impacts. Where the potential for impacts is unavoidable, this HCP provides means to minimize and mitigate any adverse impacts to Covered Species that may occur, and to provide a net conservation benefit.

This HCP has goals and objectives based on the species populations rather than their habitats. The proposed wind energy generation facility is anticipated to directly or indirectly impact individuals of the four Covered Species, but will have only minor, negligible impacts on the amount or quality of habitats for these species.

Specific biological goals of this HCP are to:

- 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 four Covered Species' occurrence and behavior in the project vicinity.
- Contribute to the goals of USFWS nēnē draft revised recovery plan and DOFAW's Nēnē Restoration Project.
- Contribute to goals of the recovery plans for the other three species, considering the most recent updated information and goals.
- Provide a net conservation benefit to each of the four Covered Species.

4.2 Project Alternatives –*UPDATED*

The project design was described in Section 1.4. The original alternatives listed in the HCP (original sections 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.2.5 ~~in this HCP~~ (SWCA 2011)) related to project construction and are no longer applicable because the project has been built and is operating. As stated in the original HCP Alternatives Analysis the current location and project turbine number and output size (the "Proposed Action") was selected. At the time of the selection the Proposed Action was considered optimal for fossil fuel reduction, most efficient location and turbine size, and minimal impact to wildlife given the known population status of the species potentially impacted and the net benefit expected from successful mitigation of those impacts. Current alternatives to amending the State ITL and Federal ITP are considered below.

4.2.1 No Action Alternative (No Issuance of Amendment) –*NEW*

Under the No Action Alternative for the project, an ITL/ITP amendment would not be issued by the Board of Land and Natural Resources (BLNR) or the USFWS, and KWP II, LLC's amended HCP would not be in effect. An ITL/ITP amendment is not legally required for continued operation of the project, but any incidental take occurring because of project operation that exceeds the existing ITL/ITP would not be authorized, i.e., take exceeding the current ITL/ITP would violate the ESA and the Applicant would assume all legal liability for operating the Project without additional take coverage. Because the Conservation District Use Permit (CDUP) for KWP II, issued by the Hawaii DLNR, requires an approved HCP for the project to operate and failure to comply with the permit would lead to a shut-down or even decommissioning, the ability to continue operating without an amended permit would be dependent on additional curtailment activities such as temporary, long-term or nighttime-only shut-down that would ensure the existing take permit for Covered Species was not exceeded. Nighttime-only shutdown eliminates bat take and temporary or long-term complete shutdown would reduce or eliminate any further nēnē take. Existing mitigation measures established in the current HCP would continue to be implemented for take already accrued.

As indicated in the original HCP and Final Environmental Impact Statement (FEIS) (Planning Solutions, Inc. 2010) for KWP II, partially or completely ceasing WTG operations would increase dependence on fossil fuels for power production and increase emissions of greenhouse gases. Considering the same assumptions quoted in the FEIS and assuming nighttime generation equals approximately 50% of total daily generation (assumed to be approximately 70,000 MWh/year), ceasing operations at night would add approximately 53.5 million pounds of carbon dioxide (CO_2), 0.375 million pounds of sulfur dioxide (SO_2) and 97.5 thousand pounds of nitrogen oxides (NO_x) annually to Maui's environment from burning 69,000 more barrels of fossil fuels. To produce approximately 35,000 MWh annually from burning fossil fuels the National Renewable Energy Laboratory (NREL) indicates approximately 16.5 million gallons of water (470 gallons/MWh) would be evaporated in the cooling process (NREL 2003).

Full nighttime curtailment or complete turbine shutdown to eliminate bat or nēnē take, respectively, would reduce potential annual generation to less than 35,000 MWh (nighttime curtailment) or 0 MWh (full curtailment). KWP II would no longer be able to generate enough revenue to continue to be financially viable and would cease operations.

4.2.2 Alternative 2 (Proposed Action) –*NEW*

Under the Proposed Action, the BLNR and the USFWS would issue an amended ITL/ITP and approve an amended HCP for the remainder of the Project's 20-year permit term which would increase incidental take for the Covered Species and avoid, minimize, or mitigate that take to the maximum extent practicable. Adaptive management will be used toTo ensure maximum benefit to the species the final mitigation plan location, extent and duration will require approval by USFWS and DOFAW. The proposed mitigation project or actions within,proposed could be modified by USFWS or DOFAW based on new information. This change would take place under adaptive management and the No Surprises clause would not apply. Having flexibility to determine the final mitigation plan details allows the wildlife agencies and the ESRC to determine the best mitigation project location and then tailor which activities would provide the best results for the specific location and species. The mitigation options available for the final plan are listed in section 6.0.

The Proposed Action would include the following HCP/ITL/ITP changes:

- Increase authorized take of Hawaiian hoary bat from 11 adults [as revised by the USFWS and DLNR] to a maximum of 48 38 adults during the 20-year permit (27 more adult bats)
- Increase authorized take of nēnē from 30 (of any age class) to a maximum of 41 44 adults (or juveniles converted to adult nēnē equivalents) during the 20-year permit (14 more adult nēnē)
- Restore bat habitat or implement other mitigation measures at an approved conservation site that will offset the authorized take
- Include mitigation that will support bat research on life history, occupancy, habitat usage, and/or foraging information, and aid in the recovery of the species
- Include mitigation options for bat take that conserves and protects bat habitat that would otherwise be at risk of development or continuing degradation from invasive species encroachment
- Include a mitigation option for bat take that would be contributing an approved level of funds for an "in-lieu fee program" managed by either DLNR or USFWS or both

- Continue to provide additional funding for nēnē mitigation at an the existing Pi'iholo Ranch pen or at a site where nēnē regularly forage or nest to increase survival rates and productivity, and thereby mitigate take of nēnē

- Continue current Low Wind Speed Curtailment regime; 5.5 m/s from February 15 through December 15 from sunset to sunrise and begin to implement LWSC from December 15 through February 15 to 5.5 m/s from sunset to sunrise~~.~~

KWP II, LLC, is responsible for ensuring that incidental take of Covered Species is fully mitigated. Mitigation would fully offset impacts to nēnē, so no adverse impacts would be anticipated for the Proposed Action. For the Hawaiian hoary bat, mitigation to the maximum extent practicable for the first tier (Tier 3) of this amendment is expected to provide research results that will facilitate long-term recovery and protection for the Hawaiian hoary bat. The research itself, while not directly producing replacement bats, specifically focuses on improving understanding of bat biology so that bat survival and productivity can be enhanced into perpetuity. Mitigation options that fully offset take are not known or not well characterized which is the driving force behind conducting the proposed high priority research to identify appropriate fully offsetting options for bat mitigation. Mitigation for the additional tier (Tier 4), if reached, is expected to fully offset take through a land acquisition or a land restoration or protection project informed by research results of Tier 3 mitigation.~~ through fire management of occupied bat habitat.~~

As mentioned previously KWP II increased LWSC in August 2014 from 5.0 to 5.5 m/s, between February 15 and December 15 from sunset to sunrise. The EoA software can produce and evaluate the results of a Likelihood Ratio test (LR test) that tests the plausibility of the assumed relative mortality rate (ρ) designated for each of two periods being compared. The null hypothesis for this test is that the two period's relative mortality rates are statistically the same. The two periods tested for KWP II are from July 2012 thru June 2014 or state fiscal years 2013 and 2014 when LWSC was to 5.0 m/s and from July 2014 thru June 2018 or state fiscal year 2015 through 2018 when LWSC was to 5.5 m/s (Table 4.1). The input values that were used to calculate the probabilities of detection in Table 4.1 are detailed in Appendix 27.

The null hypothesis assumes the relative fatality rate is the same for similar length periods. We provide the results of this test when comparing periods before and after LWSC was increased at KWP II. The results of the LR test for KWP II show the two periods' ρ is statistically different ($p = 0.013$). The probability that the fatality rate is the same before and after LWSC was implemented at KWP II is 1.3%, suggesting the null hypothesis ***is not supported,*** i.e. the mortality rate after LWSC was increased is statistically lower than before increasing LWSC. However, it is not possible to reliably determine from this test how *much* different were the relative fatality rates between periods. According to Dalthorp *et al*. (2017) "results of the tests for the validity of the assumed relative mortality weights (ρ) and for potential bias are given because mortality estimates may not be accurate if ρ_i's are significantly mis-specified."

Table 4.1. KWP II Input for the Likelihood Ratio Test of ρ Before and After LWSC was Increased. -*NEW*

	Fiscal Year	rho (relative weight)	Observed Fatality	Ba	Bb	g	g 95% CI	
Before (LWSC 5.0 m/s)	2013	1	1	9.08	11.41	0.443	0.241	0.656
	2014	1	2	18.5	33.02	0.359	0.235	0.493
	Before	2	3	23.89	35.67	0.401	0.281	0.527
After (LWSC 5.5 m/s)	2015	1	0	10.95	21.68	0.336	0.187	0.503
	2016	1	0	35.09	61.84	0.362	0.27	0.46
	2017	1	0	87.96	111.1	0.442	0.374	0.511
	2018	1	0	26.69	47.44	0.351	0.247	0.463
	After	4	0	104.49	175.87	0.374	0.317	0.432

The LR test suggests that increasing the LWSC to 5.5 m/s did provide additional minimization of take (and if search conditions remain similar will continue to reduce take relatively). It is not clear yet whether additional increases in LWSC would further minimize bat take. The results available from LWSC studies conducted in North America to date do clearly show that implementing nighttime LWSC along with full feathering below the cut-in speeds can dramatically reduce fatality rates. However, these studies varied in method, targeted LWSC levels, number of total fatalities detected (sample size), bat species affected, whether controls were included, and whether inter-turbine variation, chronological trends and inter-annual variation were accounted for.

Nonetheless, the range of average reductions in bat fatality rates for LWSC treatments for these studies is: for only full feathering, 30 to 70%; LWSC to 4.0 m/s, 20%; to 4.5 m/s, 47 to 57%; to 5.0 m/s, 33 to 87%; to 5.5 m/s, 60 to 73%; to 6.0 m/s, 33 to 60 %; to 6.5 m/s, 74 to 78 %; and to 6.9 m/s, 73% (Appendix 33; Arnett *et al*. 2009, 2010, 2013; Baerwald *et al*. 2009; Good *et al*. 2011, 2012, 2013, 2015, 2016, 2017, 2018; Martin *et al*. 2013, 2017; Stantec Consulting Ltd. 2012; Tidhar *et al*. 2013; Young *et al*. 2010, 2011, 2013) (Table 4.2 and Appendix 33). If just these results were considered then the maximum reduction in take would occur at 5.0 m/s (87% reduction) and higher LWSC would not produce any additional reductions in take compared to LWSC to 5.0 m/s.

Table 4.2. Range of Reductions in Fatalities for Different LWSC Levels (percent). *-NEW*

LWSC	Low %	High %
Feathering only	30	70
to 4.0 m/s	No data	20
to 4.5 m/s	47	57
to 5.0 m/s	33	87
to 5.5 m/s	60	73
to 6.0 m/s	33	60
to 6.5 m/s	74	78
to 6.9 m/s	No data	73

To offset take of nēnē that results from project operations, KWP II, LLC, will continue to implement Tier 1 and Tier 2 mitigation measures as described in the original HCP for the authorized take of 30 nēnē. However, KWP II, LLC, will also implement additional mitigation (Tier 3 ~~and 4~~) for the estimated take of an additional ~~11~~ 14 adult nēnē over the remainder of the 20-year permit.

Mitigation for nēnē will consist of ~~implementing or~~ continuing predator control, vegetation management and fence maintenance at an already established pen at Pi`iholo Ranch on Maui ~~or nesting site(s) on Maui, Molokai, or Lanai. These activities will protect sites where nēnē regularly forage or nest.~~ The proposed mitigation is expected to result in long-term species benefits through increased adult and juvenile survival as well as increased productivity and ~~will be~~is administered by DOFAW. The predator control is expected to provide sufficient benefits to a population of nēnē ~~that will greatly~~ to exceed ~~projected take~~the mitigation obligation. The specific mitigation plan for nēnē has been determined (Appendix 31) and may be modified to continue beyond the current scope or include additional sites where predator control could be successfully implemented.~~will be finalized in advance of take.~~

Other than avoiding creating new vegetation that could attract nēnē to forage and avoiding vehicle related disturbance that could lead to nēnē take through driver education and awareness, there are not options to further minimize take of nēnē at KWP II. Fortunately, mitigation to offset nēnē take has been proven successful for KWP I mitigation efforts and we expect mitigation for nēnē take at KWP II to also be successful.

KWP II, LLC, ~~would~~ works with the USFWS and DLNR to assess the success of proposed mitigation measures and implement adaptive management measures, if the USFWS and/or DOFAW deem them necessary to meet the specific success criteria of the mitigation. Triggers for adaptive management ~~will be~~ are based on monitoring results or other scientific knowledge that becomes available to the wildlife agencies. For these reasons, no adverse impacts to the nēnē population ~~would be~~ are anticipated for the Proposed Action. As noted above, this alternative would provide additional species benefits when compared to the No Action Alternative because of the increase in productivity and protection of ~~a large population~~ nesting of nēnē and their offspring.

4.2.3 Alternative 3 (Additional Low Wind Speed Curtailment to 6.5 m/s) –*NEW*

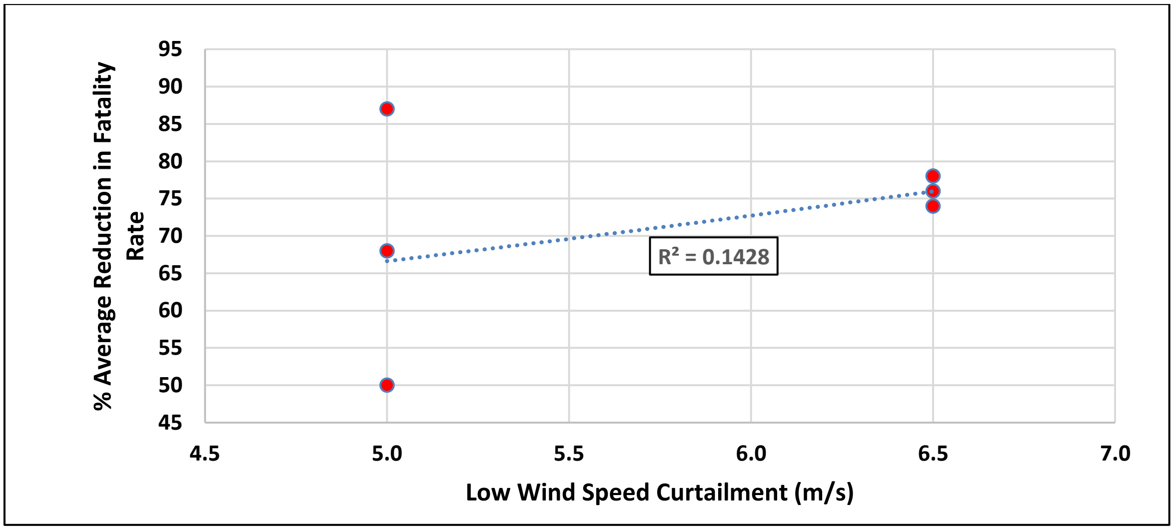
Under this Alternative, the direct and indirect effects associated with general project operation, decommissioning, and implemented avoidance and minimization measures from the initial HCP would generally be as described for Alternative 2. However, all KWP II facility turbines would be curtailed up to 6.5 m/s from sunset to sunrise ~~from February 15 to December 15 of each~~ year-round. This change in curtailment regime (i.e. curtailment in addition to what the Project has already committed to, which is 5.5 m/s) may positively affect bats but not nēnē.

~~KWP II, LLC, would offset take to the maximum extent practicable by providing funding to restore bat foraging or roosting habitat, as well as conducting surveys to document bat occupancy at different habitats. However, future compensatory~~ Compensatory mitigation measures could be reduced commensurate with the reduction in the amount of incidental take of bats that may result from increased curtailment.

This alternative assumes that there would be a significant and measurable reduction in take compared to the status quo. Although existing research (Arnett *et al*. 2009, 2010, 2013; Baerwald *et al*. 2009; Good *et al*. 2011, 2012, 2013, 2015, 2016, 2017, 2018; Martin *et al*. 2013, 2017; Stantec Consulting Ltd. 2012; Tidhar *et al*. 2013; Young *et al*. 2010, 2011, 2013; Appendix 33~~Arnett *et al*. 2013~~) indicates that increases in curtailment (from "no curtailment") ~~are likely to~~ reduces take there is insufficient research evidence to conclude that there is a reliable additional benefit ~~from~~ when increasing curtailment above 5.5 m/s.

Only three studies have been designed to specifically test statistical significance between the two experimental treatments of adding LWSC to 5.0 m/s and to 6.5 m/s (Casselman Wind in 2008 and 2009 and Fowler Ridge Wind in 2010). One of these three studies, at Fowler Ridge Wind in 2010, showed a statistically significant decrease in fatality rates between LWSC to 5.0 m/s and to 6.5 m/s (Figure 4.1). There are no studies to date that tests whether mortality rates decrease significantly when LWSC is raised from 5.5 m/s to 6.5 m/s. Given the scarcity of studies showing further fatality rate reductions when increasing LWSC further to 6.5 m/s, increasing the curtailment from 5.5 m/s to 6.5 m/s for KWP II to produce a measurable additional reduction in fatality rates is not sufficiently supported. The recent decision by the Hawai'i state Board of Land and Natural Resources to approve the Na Pua Makani Wind Power HCP (DLNR News Release May 18, 2018) did not include increasing LWSC above 5.5 m/s to minimize potential bat take expected at that wind site.

Figure 4.1. Average Reduction in Fatality Rate Between 5.0 m/s and 6.5 m/s for Three Studies. -*NEW*



Research investigating the relationship between wind speed and bat activity does suggest that generally bats are detected much less frequently as wind speed increases and that a majority of bats fatalities are recorded only when wind speeds are less than 6.0 m/s (Arnett *et al.* 2008). In an analysis of ultrasonic bat detections at nacelle height (100m) at all turbines at a wind generation site on Oahu, 100% of detections occurred at less than or equal to 8.0 m/s wind speeds and 95% of detections occurred at less than or equal to 6.0 m/s (oral presentation by Mitchell Craig at the North American Society for Bat Research Symposium, 2015). This analysis also showed that at ground level detectors (6.7 m) no bats were detected at wind speeds greater than 11 m/s while 65% of detections near the ground occurred when wind speeds were less than 6.0 m/s and also suggested that activity rates at the ground detectors was higher than at the nacelle detectors. Gorresen *et al.* (2015) also shows that bat activity decreases with higher wind speeds. 84% and 92% of bat activity was recorded when wind speeds were less than 5.5 m/s and 6.5 m/s, respectively. Considering just the Gorresen *et al.* (2015) study could suggest that increasing LWSC to 6.5 m/s might decrease bat take by 8%. If direct take is estimated to be 35.2 adult bats then increasing the LWSC to 6.5 m/s might decrease estimated direct take by three bats. Increasing LWSC to 6.5 m/s, even if effective, may still not substantially decrease the take projected or the take request.

A general analysis of generation and income lost for KWP II for different LWSC regimes suggests that increasing the LWSC from 5.5 m/s to 6.0 or 6.5 m/s (year-round) would not jeopardize the project financially *assuming* wind resources are sufficient to meet minimum expectations of the Power Purchase Agreement between MECO and KWP II and the MECO priority position for KWP II on Maui that determines which wind site's power generation MECO accepts first, second and third, does not change. If observed take continues to be zero as it has been since LWSC was increased to 5.5 m/s in August 2014, it would be very difficult to show any decrease in fatality rate from any additional change in LWSC regime or deployment of sonic deterrents on turbines.

Compared to maintaining the status quo, increasing curtailment from 5.5 m/s to 6.5 m/s would reduce renewable energy generation from the project by approximately ~~230~~ 328 MWh annually (or ~~0.328~~ 47% of 70,000 MWh produced annually), and would increase energy production from fossil fuels and increase greenhouse gas emissions. ~~Lost generation of 230 MWh could cost KWP II between $44,000 and $57,000 in annual revenue.~~ AWS Truepower LLC determined the generation losses based on the wind resource study conducted prior to operations (unpublished report to Terraform Power). Fossil fuel generation of ~~230~~ 328 MWh generation annually from petroleum based fuels whose emissions would add ~~350,960~~ 500,499 pounds of CO_2, ~~2,460~~ 3,508 pounds SO_2 and ~~640~~ 913 pounds of NOx. To produce approximately ~~230~~ 328 MWh annually from burning fossil fuels the National Renewable Energy Laboratory indicates approximately ~~108.1 thousand~~ 154,160 gallons of water (470 gallons/MWh) would be evaporated in the cooling process (NREL 2003).

Based on research at mainland US wind farms at this time, the benefit of increasing LWSC from 5.5 m/s to 6.5 m/s is not sufficiently supported to be a reliable source of bat take minimization. Therefore, at this time, the Alternative to increase LWSC to 6.5 m/s is not considered a reliable method to increase take minimization.

~~Although 230 MWhs of power is only approximately 0.3% of an average total annual production, reducing annual production could contribute to a scenario that would jeopardize KWP II's continued operation. Investment in KWP II was based on commitments to generate sufficient revenue to support operations and to be profitable. If generation falls below commitment levels capital investment in the project would be jeopardized.~~

~~The Power Purchase Agreement (PPA) between MECO and KWP II defines allowable annual energy production limits for the project. If energy production falls below 56 GWh per year for three years MECO would no longer have to abide by the "Maui Operating Measures" (MOMs) enacted in 2013, and KWP II would lose its priority position relative to other operating renewable energy projects on Maui. At that point, per the PPA at least 43% of total generation capacity would likely be heavily curtailed and KWP II would no longer be financially viable. Given the uncertainty in how energy production may be affected by natural variation in the wind resource or curtailment by MECO, a loss of even 230 MWhs could have serious negative consequences for the continued operation of KWP II.~~

4.2.1 No-Action Alternative: "No Build" *–NO LONGER APPLICABLE*

4.2.2 Alternate Project Location *–NO LONGER APPLICABLE*

4.2.3 Alternate WTG Locations at Kaheawa Pastures *– NO LONGER APPLICABLE*

4.2.3.1 Upwind Siting Area

4.2.3.2 Downwind/Downstring Siting Area

4.2.3.3 Individual WTG Locations at Kaheawa Pastures

4.2.4 Greater or Fewer Number of WTGs *- NO LONGER APPLICABLE*

4.2.4.1 Reduced Scale Project (<21 MW)

4.2.4.2 Increased Scale Project (>21 MW)

4.2.5 Turbine Design and Size *–NO LONGER APPLICABLE*

4.3 Avoidance and Minimization of Impacts *-UPDATED*

4.3.1 Site-Specific Project Design Considerations *-UPDATED*

The analysis of project design alternatives supports the conclusion that the Proposed Action is preferred when all impacts on the human and natural environment are considered. Because complete avoidance of risk to the four Covered Species is impossible under the Proposed Action, the Applicant has sought to avoid and minimize the risk of collisions to the greatest extent practicable and supported by available research by making the turbines less attractive, more visible, and/or more likely to be avoided by birds and bats. Avoidance and minimization ~~after construction was complete ongoing~~ measures include:

- Employing relatively few turbines situated in two single rows, rather than many staggered turbines or multiple rows.

- Using "monopole" steel tubular towers for turbines, rather than lattice towers, to virtually eliminate perching and nesting opportunities. The tubular towers may also reduce collision risk because they are considerably more visible.

- Utilizing a rotor with a rotational speed (11-20 revolutions per minute) that makes the rotor visible during operation.

- Choosing a site in proximity to existing electrical transmission lines to reduce the length of overhead transmission line needed from the project to the interconnect location.

- Selecting a site in proximity to the existing KWP I facility so key infrastructure can be shared, thereby minimizing the need for new disturbance and development. Also, the considerable body of data that has been collected on endangered species at the KWP I site informs KWP II site selection and avoidance/minimization measures, as well as likely mitigation requirements.

- Placement of all new power collection lines underground as far as practicable to minimize the risk of collision with new wires; overhead collection lines ~~will be~~ are fitted with marker balls to increase visibility. All overhead collection lines ~~will be~~ are spaced per Avian Power Line Interaction Committee (APLIC) guidelines to prevent possible electrocution of native species. Species most at risk at those likely to perch on power poles or lines (APLIC 2006). Only one species is identified to be at risk at KWP II, the Hawaiian short- eared owl. Using the barn owl as a surrogate species, the horizontal spacing ~~will be~~ is more than 20 inches (51 cm) to accommodate the wrist-to-wrist distance of the owl. If a vertical arrangement is chosen, a vertical spacing of more than 15 inches (38 cm, head- to-foot length) ~~will be~~is used (APLIC 2006). Any jumper wires ~~will be~~are insulated.

- Placement of the overhead power collection line ~~will be~~is as close to the existing MECO transmission line as practicable (see 1.3). These lines will fall within the height range of the existing transmission lines (currently arranged as a vertical array of four lines) and also parallel their alignment across the gulch to reduce the cumulative cross-sectional area presented. Marker balls, which will be present on both lines, should increase their visibility to Covered Species and minimize risk of collisions.

- Designing and installing the site substation and interconnect to MECO's transmission lines using industry-standard measures to reduce the possibility of wildlife electrocutions.

- Installing un-guyed met towers as opposed to guyed met towers to avoid potential for avian collision with guy wires.

- Restricting construction activity to daylight hours as much as practicable during the seabird breeding season to avoid the use of nighttime lighting that could be an attraction to seabirds.

- Requesting FAA endorsement of a lighting plan designed to reduce the likelihood of attracting or disorienting seabirds.

- Having minimal on-site lighting at the operations and maintenance building and substation, using fixtures that are shielded and/or directed downward and only utilized on infrequent occasions when workers are at the site at night. In addition, timers, motion sensors and similar devices have been employed where feasible to minimize the risk of unintended light emissions. These three lighting measures not only minimize impacts to wildlife, but also ~~to~~ reduce the visual impact as viewed from local communities at night.

- Conducting pre-construction surveys for nēnē and their nests prior to roadway and site clearing and construction to identify and avoid harming or harassing (as defined under the

ESA) any active nests, eggs, young, or adults; an improved survey protocol based on the successful model implemented at KWP I will be used for this HCP (Appendix 12).

- Implementation of a daily search protocol during construction to minimize the risk of direct impacts to nēnē and their nests (Appendix 12).

- Should construction begin and nēnē and/or a nest(s) are subsequently discovered, designated environmental personnel ~~will be~~are immediately notified and construction activities ~~will be~~ modified or curtailed until appropriate measures are implemented, with approval of DLNR and USFWS, which ~~will~~ reduces or eliminates adverse risk to nēnē or their nests (Appendix 12).

- Clearing of trees above 15 ft. in height between June 1 and September 15 will not occur as it is the period when non-volant Hawaiian hoary bat juveniles may occur in the project area.

- Low wind speed curtailment has been implemented since the project was operational to reduce the risk of bat take. Recent studies on the mainland indicate that most bat fatalities occur at relatively low wind speeds, and consequently the risk of fatalities may be significantly reduced by curtailing operations on nights when winds are light and variable. Research suggests this may best be accomplished by increasing the cut-in speed of wind turbines from their normal levels (usually 3.5 or 4 m/s, depending on the model) to at least 5 m/s. Two years of research conducted by Arnett *et al.* (2009, 2010) found that bat fatalities were reduced by an average of 82% (95% CI: 52–93%) in 2008 and by 72% (95% CI: 44– 86%) in 2009 when cut-in speed was increased to 5 m/s. No significant additional improvement over this level was detected when the cut-in speed was increased to 6.5 m/s.

~~Therefore, l~~Low wind speed curtailment ~~will be~~ currently is implemented at night from February 15 through December 15 annually by raising the cut-in speed of the project's wind turbines to ~~5.0~~ 5.5 m/s between sunset and sunrise. ~~Bat activity has been consistently documented during months of May to November from 1900 – 0600 hrs (see Section 3.8.4.3). However, the two fatalities that were observed at KWP occurred in April and September; bats can therefore be expected to be at the KWPII in April as well. Thus for KWPII the curtailment will initially occur between the months of April and November.~~ Curtailment will be extended if fatalities are found outside the initial proposed curtailment period with approval of USFWS and DLNR. Curtailment may also be modified with the approval of DOFAW and USFWS if site-specific data demonstrate a lack of bat activity during certain periods, or if experimental trials are conducted that demonstrate that curtailment is not reducing collision risk at the project during the entire curtailment period.

- A speed limit of ~~10~~ 15 mph will also be enforced to reduce possible vehicular collisions with nēnē and the Hawaiian short-eared owl.

4.3.2 USFWS Guidelines *–NO CHANGE*

While wind energy has been utilized for centuries, it has expanded rapidly rather recently in the U.S. and worldwide with advances in technology and increased interest in renewable and alternative energy sources. In recognition of the growing wind energy industry in the United States, the USFWS has prepared *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2004b) available through the USFWS website, http://www.fws.gov. The guidelines were published simultaneously with a Federal Register Notice of Availability and request for comments on the guidelines.

After reviewing the comments received, the Secretary of the Interior established a Wind Turbine Guidelines Advisory Committee to provide advice and recommendations to the Secretary of the Interior on developing effective measures to avoid or minimize impacts to wildlife and their habitats related to land-based wind energy facilities. To date, no updates to the *Interim Guidelines* have been released, and compliance with them is considered voluntary. Nonetheless, the Applicant believes that these guidelines provide several substantive recommendations that are relevant and applicable to the proposed wind energy generation facility.

Table 4.1 below lists the recommendations from the *Interim Guidelines* relating to site development and turbine design and operation and discusses how the Applicant plans to comply with these recommendations. It should be noted that these recommendations relate to all wildlife, whether or not they are protected under the ESA or MBTA, and the benefits of following these recommendations, where applicable, extend beyond the implementation of this HCP.

Table 4.1. Compliance of the Proposed KWP II Facility with the USFWS Interim Voluntary Guidelines for Wind Projects (USFWS 2004b). -*NO CHANGE*

USFWS Interim Voluntary Guidelines Site Development Recommendations	Proposed KWP II Facility
Avoid placing turbines in documented locations of any species of wildlife, fish, or plant protected under the Federal Endangered Species Act.	There are no locations on Maui that are both: (a) suitable for a financially viable wind energy generation facility and (b) unlikely to be visited by listed species. Data from the existing KWP I facility indicates that occurrence of the Covered Species on the site is relatively low, and take is commensurately at or below Tier 1 identified in the KWP I HCP. The proposed KWP II project minimizes habitat disturbance by sharing key infrastructure with KWP I and likewise incorporates measures to avoid and minimize risk to Covered Species as much as possible while still meeting the basic project purpose.
Avoid locating turbines in known local bird migration pathways or in areas where birds are highly concentrated, unless mortality risk is low (e.g., birds present rarely enter the rotor-swept area). Examples of high concentration areas for birds are wetlands, State or Federal refuges, private duck clubs, staging areas, rookeries, leks, roosts, riparian areas along streams, and landfills. Avoid known daily movement flyways (e.g., between roosting and feeding areas) and areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.	This recommendation has been followed as much as practicable while still meeting the basic project purpose. Survey data collected to date has shown that birds do not occur in the area in high concentrations.
Avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas.	This recommendation has been followed, based on the little information available on Hawaiian hoary bats. The species is not known to hibernate or occur colonially. While a few bats have been confirmed to fly through the project area, no habitat considered suitable for roosting or breeding is present in or adjacent to the project area.

Configure turbine locations to avoid areas or features of the landscape known to attract raptors (hawks, falcons, eagles, owls). For example, golden eagles, hawks, and falcons use cliff/rim edges extensively; setbacks from these edges may reduce mortality. Other examples include not locating turbines in a dip or pass in a ridge, or in or near prairie dog colonies.	This recommendation has been followed, to the extent that it is applicable, by situating the turbines on high ground, outside of the Manawainui Gulch and Malalowaiaʻole Gulch where most Hawaiian short- eared owl activity has been observed; much like what is observed at KWP I, Hawaiian short-eared owls at KWP II are expected to be observed occasionally flying over grasslands of the proposed wind farm, but at low risk of collision with the turbines and associated structures (see Section 3.7).
Configure turbine arrays to avoid potential avian mortality where feasible. For example, group turbines rather than spreading them widely, and orient rows of turbines parallel to known bird movements, thereby decreasing the potential for bird strikes. Implement appropriate storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species (e.g., sage grouse).	Turbines have been arranged as closely as feasible, given wind resource and terrain considerations, and in a linear fashion that is generally parallel to the direction of birds moving to and from the ocean. No potentially attractive water features will be constructed for the project.
Avoid fragmenting large, contiguous tracts of wildlife habitat. Where practical, place turbines on lands already altered or cultivated, and away from areas of intact and healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas.	The majority of the natural environment in the project area has been previously disturbed by wildfires, pasturing and grazing uses. Existing areas of native cover types are fragmented and interspersed with disturbed, non-native dominated cover. Nēnē do utilize open areas and rock outcrops, and the Applicant has micro-sited the proposed WTGs so as not to disturb the features that are most attractive to nēnē.
Avoid placing turbines in habitat known to be occupied by prairie grouse or other species that exhibit extreme avoidance of vertical features and/or structural fragmentation. In known prairie grouse habitat, avoid placing turbines within five miles of known leks (communal pair formation grounds).	Not applicable - no such species occur in the area.
Minimize roads, fences, and other infrastructure. All infrastructure should be capable of withstanding periodic burning of vegetation, as natural fires or controlled burns are necessary for maintaining most prairie habitats.	This recommendation will be followed. A Wild Land Fire Contingency Plan is in place for KWP I and will be administered at KWP II as well (see Appendix 18, note that controlled burn and prairie considerations are not applicable).

Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. For example, avoid attracting high densities of prey animals (rodents, rabbits, etc.) used by raptors.	This recommendation will be followed. Re-vegetation of disturbed areas and other habitat improvement measures will be coordinated with DLNR staff.
Reduce availability of carrion by practicing responsible animal husbandry (removing carcasses, fencing out cattle, etc.) to avoid attracting golden eagles and other raptors.	This recommendation is not applicable as golden eagles and other raptors are not species of concern in the vicinity of the project.

5.0 ASSESSMENT OF POTENTIAL IMPACTS

5.1 Assessment of Potential Impacts to Covered Species *-UPDATED*

Generation of electrical energy from wind is a renewable, clean, environmentally friendly technology. It reduces greenhouse gas emissions and water use in electricity generation. At the same time, the potential for wind energy turbines to adversely affect birds and bats is well-documented in the continental United States (e.g., Horn *et al.* 2008; Kunz *et al.* 2007; Kingsley and Whittam 2007; Kerlinger 2005; Erickson 2003; Johnson et al*.* 2003a, b).

5.1.1 Impacts to Birds *–NO CHANGE*

Erickson *et al.* (2001) estimates that an average of 2.19 bird fatalities occurs per wind turbine annually in the United States. Based on 12 wind projects in the U.S., the National Wind Coordinating Collaborative (2004) estimated an average annual avian fatality rate of 2.3 birds per turbine. Though avian fatality rates differ by region, projects in California presently account for the highest wind-related avian mortality in North America. Certain types of birds in certain settings seem to have a higher risk of collision with wind energy facilities than others. When abundant in open country, as in California, raptors (hawks, eagles, falcons and owls), have had comparatively high fatality rates, though passerines as a class generally comprise the majority of fatalities at wind facilities nationwide (Erickson *et al.* 2001; NWCC 2004; Kingsley and Whittam 2007). Although some impacts to avian species may occur as a result of habitat alteration and disturbance or operation of vehicles, most fatalities at wind facilities are attributed to collisions with wind turbine rotors, met towers, or guy wires (Kerlinger and Guarnaccia 2005).

Numbers of avian fatalities at wind energy facilities are very low compared to the numbers of fatalities resulting from some other human-related causes. Known sources of anthropogenic bird losses outside of wind energy sites include: lighted buildings, windows, communications towers, power lines, smokestacks, vehicles, cat predation, pesticides and hunting (Podolsky *et al.* 1998; Erickson *et al.* 2001; Martin and Padding 2002; Woodlot Alternatives, Inc. 2003; Federal Register 2004; Mineau 2005). Mortality from these other sources is many orders of magnitude higher than that which occurs at wind facilities.

5.1.2 Impacts to Bats *-UPDATED*

The number of bat fatalities at wind energy facilities has often exceeded the number of avian fatalities. Studies in the continental U.S. have shown that annual fatality rates vary by region with an average of 1.2 bat fatalities per turbine in the Pacific Northwest and Rocky Mountains, 1.7 bat fatalities per turbine (0.1 - 7.8 bats per turbine) in the Upper Midwest, and as many as 46.3 bat fatalities per turbine (range 15.54 – 69.6 bats per turbine) in certain areas of the eastern U.S. (Johnson 2005). Differences are likely due to variations in local habitat conditions and population sizes of the most susceptible species. Facilities studied in the eastern U.S. where fatalities are highest are primarily located along forested ridge tops as opposed to open areas, and where migratory tree-roosting species are most numerous. Geographic and topographic differences may also be factors. Most of the recorded bat fatalities in the U.S. (83.2%) are members of migratory tree-roosting species. Hoary bats, of which the Hawaiian hoary bat is a non-migratory (in the classic sense) subspecies, are the most frequently (45.5%) recorded fatalities (Johnson 2005; Cryan and Brown 2007).

Available evidence indicates that bat mortality at continental U.S. wind facilities peaks in late summer and fall, coinciding with mating and migration. Increased bat fatalities also tend to occur during periods of low wind speed (< 13.5 mph or 6 m/s) and passing weather fronts (Arnett *et al.* 2008). In contrast, observed bat collision mortality during the breeding season is rare (Johnson *et al.* 2003b). Similar to birds, bats are also known to collide with high, man-made structures (Johnson 2005).

The high number of fatalities of migratory tree-roosting bats at wind energy facilities has stimulated a cooperative research effort to explore how and why bats contact turbines (Arnett *et al.* 2008). Several possible explanations have been generated. Research has suggested that some fatalities may result from mating behaviors that center on the tallest trees in a landscape (Cryan 2008). Some have suggested that some bats may be attracted to audible sound, ultrasound, and movement of wind turbine structures (Horn *et al.* 2008). However, research on the sound emissions of various turbines found that ultrasonic emissions attenuated at short distances from the turbine and there was no evidence of unusual ultrasonic emissions that would attract bats (Szewczak and Arnett 2006). Other theories speculate that migratory behavior, such as stopovers, are responsible for observed fatality rates (Johnson 2005; Cryan and Brown 2007) or that forest edges produced by access roads create favorable foraging habitat (Horn *et al.* 2008). Baerwald *et al.* (2008) documented that some bats killed at wind turbines suffered from barotrauma, i.e., pulmonary hemorrhaging caused by a rapid reduction in air-pressure, such as occurs behind moving turbine blades rather than direct collision with blades (although a more recent assessment of injured bats has revealed that barotrauma was not the cause of most wind turbine related injury (Rollins *et al*. 2012)).

Impacts to bats, particularly migratory tree-roosting bats, as a result of collision with wind turbines are well-documented in the continental U.S. (Johnson & Strickland 2003, Kunz *et al.* 2007, Arnett *et al.* 2008, Cryan 2011, Cryan *et al.* 2014) and, as more facilities come online, are increasingly apparent in Hawai'i. Most mortality occurs during the fall migration period. Hoary bats in Hawai`i do not migrate in the traditional sense, although, as indicated, some seasonal altitudinal movements occur.

Baerwald *et al*. (2009) conducted a study during the peak period of migration (August 1– September 7, 2007) for hoary (*Lasiurus cinereus*) and silver-haired bats (*Lasionycteris noctivagans*) at a wind energy installation in southwestern Alberta, Canada, where the two bat species comprised the dominant fatalities. They tested three treatment groups (control turbines, treatment turbines with increased cut-in speed, and experimental idling turbines with the blades manipulated to be motionless during low wind speeds), combining the two experimental treatment results, and comparing them to control turbines. They conclude that the experimental turbines had lower fatality rates for each species.

Cryan *et al*. (2014) analyzed wind turbine activities at a facility in northwestern Indiana using thermal video-surveillance cameras, supplemented with near-infrared video, acoustic detectors, and radar. They found that wind speed and blade rotation speed influence the way that bats approached turbines. Bats approached turbines less frequently when their blades were spinning fast, and the prevalence of leeward versus windward approaches to the nacelle increased with wind speed at turbines with slow-moving or stationary blades.

Studies from 10 different operational mitigation wind farms in North America found reductions in fatality rates by altering turbine operations (Arnett *et al.* 2013). Most studies found at least a 50% reduction in bat fatalities when turbine cut-in speed increased by 1.5 m per second above the manufacturer's specified cut-in speed (typically 3-4 m/s). One study implementing a raised cut-in speed for temperatures above 9.5 degrees Celsius reported similar reductions in bat fatalities. Another study demonstrated equally beneficial reductions with a low-speed idling approach, whereas another discovered that simply feathering turbine blades (pitched to 80 -90 degrees, i.e. parallel to the wind and nearly stopped) below the manufacturer's cut-in speed resulted in up to 72% fewer bats killed. For further discussion see section 4.2.2 and 4.2.3.

5.2 Estimating Project-Related Impacts *-UPDATED*

Preconstruction Take Tier 1 and Tier 2 Estimates for Covered Species

In the State of Hawai'i, wind-powered generation facilities are relatively new; thus, few wildlife monitoring impact studies have been conducted to document the direct or indirect impact of wind energy facilities on particular species. However, post-construction monitoring to document downed wildlife has been conducted at the KWP I facility since operations began in June 2006 (Kaheawa Wind Power 2008b, 2008c) and suggests that avian mortality resulting from the proposed KWP II project may occur at a lower rate than has occurred at facilities in the continental U.S. This information is based upon the best available insight into the potential risk to wildlife posed by WTGs in the down road KWP II project area, as well as the take estimates made for the KWP I project. No Covered Species were found downed or dead during the first year of construction and operation of the KWP I project (Kaheawa Wind Power 2007a, 2007b). From the second to fifth years of monitoring, KWP I documented observed direct take of three listed species: three adult Hawaiian petrels, nine full-grown nēnē, and two Hawaiian hoary bats (Kaheawa Wind Power 2008b, 2008c, 2009). Other documented fatalities include six white-tailed tropic birds, two short- eared owls, one great frigate bird, four ringed-necked pheasants, six black francolins, two gray francolins, two Eurasian skylarks, two spotted doves, one barn owl and one Japanese white-eye have collided with the towers or turbine rotors at KWP I.

Estimated annual mortality resulting from the KWP II project for each of the Covered Species is provided in the following sections. Included for each species is an estimate of the amount of indirect take expected to occur based on the expected level of direct take. As discussed in Section 7.2 (Monitoring), The equations discussed are presented below:

Total Direct Take = Observed Take + Unobserved Take

Total Adjusted Take = Total Direct Take + Indirect Take

"Total direct take" will be calculated based on the best available estimator approved by the agencies at the time. An example of an estimator, proposed in Huso (2008) is presented below.

$$\hat{m}_{ij} = \frac{c_{ij}}{\hat{r}_{ij}\hat{p}_{ij}\hat{e}_{ij}}$$

where

m_{ij} Estimated mortality

r_{ij} Estimated proportion of carcasses remaining after scavenging

e_{ij} Effective search interval

p_{ij} Estimated searcher efficiency

c_{ij} Observed take

A detailed protocol of how monitoring will take place at KWP II (including methods of quantifying SEEF and scavenging rates) is provided in Section 7.2 and Appendix 2.

Sections 5.2.2 through 5.2.5 identify anticipated levels of direct and indirect take for each of the Covered Species. Due to the very low observed levels of activity at KWP II for most of the Covered Species, the mortality modeling provides very low estimated rates of direct take. For most species, based on the modeling, annual mortality is expected to average less than one individual per species per year over the life of the project. To account for the stochasticity of take over time, where take in any given year may be higher or lower than the expected long-term average, 1-year, 5-year, and 20-year take limits are proposed (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and not more than 10 individuals for 20 years). Short-term take limits (1-year and 5-year limits) also provide benchmarks for the monitoring of take and will enable mitigation efforts to be tailored to respond to more immediate events. Twenty-year limits, however, are believed to be a better reflection of the long-term amount of take expected.

Post-construction monitoring will be used to determine "total direct take" attributable to the project on an annual basis. "Total direct take" and "indirect take" of each Covered Species will be identified as "Tier 1," or "Tier 2." The amount requested to be authorized by the ITP and ITL will cover the "total adjusted take," essentially the sum of "total direct take" and "indirect take". For each species, the annual **Tier 1** level of take was estimated based on the expected average annual mortality, rounded up to the nearest whole integer, and then adjusted to account for expected levels of unobserved direct take. For example, modeling suggests nēnē mortality will occur at an average rate of approximately 0.5 adults per year. To identify the annual Tier 1 level of take requested to be authorized, this was first rounded up to one adult per year (i.e., almost 2x). Then, based on assumptions concerning unobserved direct take, it was expected that the discovery of one nēnē mortality in a given year would lead to an assessment of total direct take for that year of two nēnē. So, while the modeling suggests that nēnē mortality will occur at a rate of roughly one adult bird every two years, because it cannot be known if or in what year mortality will occur and because of assumptions concerning unobserved direct take, it is necessary to have the annual Tier 1 take authorization for nēnē allow the total direct take of a minimum of two adult birds in any given year. In addition, to allow for the uneven distribution of take over time, it is possible for two birds to be taken in any one year, followed by no take in the subsequent years. Hence, an observed take of two birds in one year is possible and likely to be rounded up to a total direct take of three to four birds after all the adjustments have been applied. Therefore, for some of the Covered Species, a direct take of up to four birds is requested for the *annual* Tier 1 level of take. The 5-year and 20-year Tier 1 levels, being of a longer-term duration, however, are expected to more closely reflect the expected *annual average* mortalities.

A **Tier 2** rate of take would be that which exceeds the authorized Tier 1rate. A Tier 2 rate of take is 1.5 to 2 times the Tier 1 rate of take over a **5-** or **20**-year period. Because of expected annual variability in actual rates of take, this HCP proposes that different levels of take be authorized. Any take occurring in excess of the one-year, 5-year, and 20-year Tier 1 limits could be considered a "Tier 2" rate. However, it would be possible for rates of take to occur so unevenly that take could qualify as "Tier 2" in one year and "Tier 1" over the corresponding 5-year term. Therefore, Tier 2 rates of take identified over 5-year and 20-year terms will be used to make adjustments to mitigation efforts because they will have incorporated some averaging of annual variability, while Tier 2 rates measured over one-year terms will be used as "early warnings" that adjustments to mitigation efforts may become necessary and to spur investigation into why a Tier 2 rate of take occurred and whether steps can be taken to reduce future take. If post- construction monitoring indicates that take has exceeded the 5-year or 20-year Tier 1 take limit for any species, the Applicant would be determined to be at a Tier 2 rate of take and would implement Tier 2 mitigation.

5.2.1 Post-Construction Incidental Take Estimates ~~for Nēnē and the Hawaiian Hoary Bat~~ *-NEW*

Year-round fatality monitoring of all 14 turbines at KWP II, conducted since operation of the project began in July 2012, and estimation modelling using the Evidence of Absence v.2.0 software (Dalthorp *et al.* 2017) indicate that the estimated rates of take of nēnē and the Hawaiian hoary bat are higher than originally anticipated (KWP II 2017). The Evidence of Absence software and input parameters are described in sections 1.4.5.1 and 1.4.5.2. The Tier 2 take levels for both species have been or are expected to be exceeded before the end of the ITP/ITL terms (Table 1.1). Therefore, increases in the take authorizations for nēnē and the Hawaiian hoary bat are being requested and additional take is added to the HCP for these two Covered Species. For the additional take, 20-year take limits are projected and proposed for each species (Table 1.1).

The proposed 20-year take limits are extrapolated based on rates of take estimated from the 2012-~~2017~~ 2018 period and are equivalent to the estimated Total Adjusted Take where:

Total Direct Take = Observed Take + Unobserved Take

Total Adjusted Take = Total Direct Take + Indirect Take

Construction and operation of the KWP II project have created the potential for the Covered Species to collide with the WTGs, temporary and permanent met towers, overhead collection lines and cranes used for construction of the turbines. The "total direct take" attributed to the KWP II project will be is the sum of observed direct take (actual individuals found or projected to be found for future estimations during post-construction monitoring) and unobserved direct take estimated based on modelling using required inputs to the Evidence of Absence software.

The unobserved direct take will accounts for individuals that may be killed by collision with project components but that are not actually found by searchers for various reasons described here.Estimating the potential for each Covered Species to that collide with these project components (i.e., "direct take") was done using the results of the on-site surveys, information about the proposed project design, and the results of post- construction monitoring at the adjacent KWP I facility. The fatality estimates for the Covered Species at KWP II considered the species occurrence at KWP II compared to KWP I and the average annual rate of take of that species known to be occurring at KWP I.

In addition to "direct take," collision with project components can also result in the "indirect take" of Covered Species. It is possible that adult birds directly taken during certain times of the year could have been tending to eggs, nestlings or dependent fledglings, or that adult bats could have been tending to dependent juveniles. The loss of these adults could then also lead to the loss of eggs or dependent young the adult was tending. Loss of eggs or young would beis "indirect take" attributable to the project.

If mitigation to replace take is delayed, loss of future productivity in years after when direct and indirect take occur can also accrue. This future loss of productivity is estimated based on adult and juvenile or fledgling survival rates, annual reproductive rate, and age to first reproduction. While loss of productivity requires additional mitigation, it is not considered incidental take and therefore does not affect the amount of take that is authorized under the permits. Loss of productivity is not calculated for bats.

For the purposes of this HCP amendment, an assessment of indirect take will beis added to any observed direct take based on the presumed breeding status of the taken individual and potential productivity as discussed below.

Hawaiian petrel, Newell's shearwater, and Hawaiian hoary bats have a well-defined breeding season. For these three species, breeding status will be assigned following the general principles identified below:

- If an adult female bat is found during breeding season (April 1 - September 15) and if an estimate of the average breeding rate of the species (percent of adult population breeding in each year) is available, the average population breeding rate will be used to determine the probability that the adult was breeding.
- If an adult female bat or adult bat of unknown sex is found during breeding season, and if an estimated breeding rate is not available for the species, the adult will be assumed to have been breeding unless a female bat is clearly determined to be neither pregnant nor with dependent young. Beginning in FY 2018 the sex of all bats found during the breeding season will be determined by the USGS and funded by the Project.
- If an adult is found outside of the breeding season, the adult will be assumed to have been non-breeding.
- Immatures will be assumed to be non-breeding regardless of season.
- If age cannot be determined, an individual will be assumed to have been an adult.

The nēnē has an extended breeding season (August to April), although the majority nest from October to March. In the case of assigning breeding status to the nēnē, the following principles are applied:

- If an adult is found during the months of October through March, the average population breeding rate (60%) will be used to determine the probability that the adult was breeding.
- If an adult is found in April, August or September, it will be assumed there was a 25% chance the bird had been actively breeding.
- If an adult is found in May, June or July, the bird will be assumed to have been non-breeding.
- Immatures will be assumed to be non-breeding regardless of season.
- If age cannot be determined, an individual will be assumed to have been an adult of breeding age.

Potential productivity ranges widely among the Covered Species. Newell's shearwaters and Hawaiian petrels are expected to produce no more than one young per pair per year. Nēnē produce average clutches of three to five eggs. While not all young hatched from a clutch of eggs can be expected to survive to fledging age, much less adulthood, if an incubating female bird is killed by collision with a turbine, that fatality may be held indirectly responsible for the loss of the eggs that were viable at the time of collision. On the other hand, if a female is killed during the time it is tending to recently fledged young, a reasonable expectation would exist that the number of fledglings lost because of loss of parental care would be fewer than the average clutch size of that species because of possible pre-collision natural losses to predation, disease, starvation, etc. that typically accrue through the breeding period.

The probability of the Covered Species colliding with WTGs also changes with time of year and/or breeding status. For example, Newell's shearwaters and Hawaiian petrels have potential to collide with turbines only during the breeding season because during non-breeding periods they remain at sea. Hawaiian hoary bats may preferentially reside at higher elevations during non-breeding periods. Nēnē become territorial during the breeding and molting season (when they become flightless) while caring for goslings. Thus, nēnē are very unlikely to collide with turbines and related structures while nesting or attending to goslings.

Finally, assessments of indirect take must consider parental contributions to care of the eggs and/or young. Male Hawaiian hoary bats take no role in raising of young, so death of a male bat cannot lead to indirect take. Males of some of the bird species do contribute significant effort to raising of young, so if a female of such a species were to be killed during the breeding season, the male of the pair may be capable of successfully raising some of their young, especially if the mortality were to occur when the young were closer to fledging age.

The requested 20-year take estimate consists of a requested authorized level of take for a certain number of individual bats or nēnē, and is not broken up into adults/immatures (total direct take) and fledglings/juveniles (indirect take). This single number was derived by assigning the number of young expected to be associated with the adults lost to collisions, and then estimating how many of those young would have survived to adulthood after accounting for natural mortality. This number of potential adults is then added to the estimated total direct take to yield the expected total adult adjusted take.

For example, if the total adjusted take is estimated to be four adult/immature bats (direct take) and two juvenile bats (indirect take), and if 30% of juveniles survive to adulthood, the two juveniles convert to 0.6 adults (2 x 0.30 = 0.6) which is rounded to one adult. This one adult is then added to the estimated direct take of four adult/immature bats resulting in a total adult adjusted take (and requested take) of five bats.

The following sections provide assessments of potential impacts to each of the Covered Species and identify estimates of the anticipated rates of take for each. The amount of annual take requested to be authorized in the ITP and ITL for each Covered Species may be divided into two categories. One category is the number of individuals directly taken and the other consists of the number of individuals that will be assumed to be indirectly taken in terms of eggs, juveniles or fledglings. Otherwise fledglings or weanlings are converted to adults at acceptable survival rates and only total adults is presented.

5.2.2 Hawaiian Petrel *–NO CHANGE*

5.2.2.1 Risk of Hawaiian Petrel Collision with WTGs

KWP I is the only operating wind energy generating facility in Hawai'i where potential mortality of Hawaiian petrels and Newell's shearwaters is consistently being studied. KWP I and KWP II have commissioned several independent studies using ornithological radar to estimate the movement rates for Hawaiian petrels and Newell's shearwaters through the site during the roughly eight- month spring-fall breeding season when these birds are present near Kaheawa Pastures. The earlier of these (Cooper and Day 2004; Day and Cooper 1999; Sanzenbacher and Cooper 2009) focused on the KWP I project area. KWP I biologists also independently conducted a radar study in the summer and fall of 2006. The most recent and comprehensive study was performed in summer and fall 2009 at the Downroad portion of the proposed KWP II project area (Cooper and Day 2009).

The primary objective of the 2009 summer and fall studies was to document movement rates of Hawaiian petrels and Newell's shearwaters over the proposed KWP II project area during the nesting and fledging period. The Cooper and Day (2009) report is provided as Appendix 3 and 13. The passage rates from the summer and fall studies were 116-148% higher than that previously documented at KWP I. For take estimates, it is assumed that the passage rates over KWP II are 1.3 times that over KWP I.

The total direct take of Hawaiian petrels at KWP I after 5.33 years of operation is 4.96 birds. The average annual total direct take of Hawaiian petrels at KWP I is approximately 0.93 birds (4.96/5.33 years= 0.93 birds/year) for the entire project site or 0.047 petrels/turbine/year. The take estimate for Hawaiian petrels at KWP II for all project components (primarily turbines and met towers) is calculated based on the average rate of take per turbine at KWP I, adjusted for the increased passage rate over the site. This results in an estimated take of 0.86 birds/year for the project (0.047 petrels/turbine *14 turbines * 1.3 time KWP I passage rate = 0.86 birds/year).

5.2.2.2 Other Direct Take of Hawaiian Petrels

In addition to collisions with turbines and met towers, some limited potential exists for Hawaiian petrels to collide with cranes during the construction phase of the project. Cranes used during construction are typically comparable in height to the turbine towers (Kaheawa Wind Power LLC 2006). However, the construction phase is expected to last six to eight months, with cranes on- site for only three to four months and, during that period, they will not always be vertical. The potential for Hawaiian petrels to collide with construction cranes is considered to be negligible given the brevity of the construction period and the low occurrence rate of the species onsite.

A crane will permanently be available for KWP II (probably shared with KWP I) for maintenance purposes and will be present at KWP II as needed. Except for emergencies, this crane would be used only during the day and stored in its horizontal position at ground level when not in use and at night. Consequently, this crane is not considered to pose a collision threat to Hawaiian petrels. No Hawaiian petrels collided with cranes used to construct KWP I.

Potential also exists for Hawaiian petrels to collide with the 1,225-foot (374 m) section of the collection line that crosses the gulch at the upper portion of the project area (see Section 1.4 for details). This line will be mounted on poles approximately 60-90 feet (18-25 m) above ground level and will be a maximum of 340 ft. (104 m) above the deepest part of the gulch. Precautions to minimize collisions include installing marker balls on the collection line to enhance visibility and placing the collection line in close proximity to an existing transmission line of the same height that also crosses the gulch and is similarly marked (see Section 4.3.1). Observation of Hawaiian petrels on Kaua'i by Day *et al.* (in review) suggests that collision avoidance rates of powerlines by Hawaiian petrels is very high (207 observed birds with 40 birds exhibiting collision avoidance responses and zero resultant collisions). Thus, the collision rate of Hawaiian petrels with overhead collection lines is considered very small and assigned a value of 0.05 birds/year (one bird every 20 years) given the low occurrence rate of species on the site, their avoidance capabilities and the minimization measures that will be emplaced.

Construction or maintenance vehicles have potential to strike downed petrels (birds already injured by collision with turbines or towers) while traveling project roads. Project personnel will be trained to watch for downed petrels and other wildlife and speed limits (10 mph or 16 kph) will be enforced to minimize potential for vehicular strikes to result in death of birds that otherwise might have been able to be rehabilitated. Despite this, it is assumed that day-to-day maintenance of the wind facility may very occasionally result in the fatality of a petrel. This source of potential mortality does not result in an increase in the amount of direct take expected from the proposed project because such birds would be those not avoiding the WTGs or met tower and, thus, have been accounted for in the mortality modeling.

Therefore, for this HCP, it is projected that take of Hawaiian petrels as a result of collision with project components and vehicle strikes will occur at the average rate of 0.91 petrels/year (0.86 (turbines and met towers) + 0.05 (collection line) = 0.91).

5.2.2.3 Indirect Take of Hawaiian Petrel

Adult and immature birds have potential to collide with turbines and associated structures while commuting between nesting and feeding grounds during the pre-laying period (March to April) and incubation or chick-feeding periods (May through October). Indirect take accounting for possible loss of eggs or chicks would be assessed to any direct take of adult Hawaiian petrels occurring during the breeding period of May through October, but would not be assessed if direct take of this species occurs during the pre-laying period or at other times of year. The risk of collision outside the pre-laying period or breeding season is considered minimal as these birds do not return to land during that time.

Potential for survival of offspring following a collision appears dependent upon the time at which the parent is lost. Both parents alternate incubating the egg (May-June), allowing one or the other to leave the colony to feed. Therefore, during the egg-laying/incubation period it is expected that both parents are essential for the successful hatching of the egg (Simons 1985). Both parents also contribute to the feeding of chicks. Chicks are fed 95% of the total food they will receive from their parents within 90 days of hatching (Simons 1985). Because hatching generally occurs in late June, chicks should have received 95% of their food by the end of September. After this time, it is likely that many chicks could fledge successfully without further parental care as some chicks have been seen abandoned by their parents up to three weeks prior to fledging (Simons 1985). Consequently, it is considered probable that after this time many chicks would also be capable of fledging if subsequent care was provided by only one parent. Based on this, for the purposes of this HCP and assessing indirect take, both parents are considered essential to the survival of a Hawaiian petrel chick through September, but it is assumed that a chick has a 50% chance of fledging successfully if adult take occurs in October.

Not all adult Hawaiian petrels visiting a nesting colony breed every year. Simons (1985) found that 11% of breeding-age females at nesting colonies were not breeding. Eggs are laid and incubated between June and July, of which an average of 74% successfully hatch (Simons 1985). Therefore, it appears there would be an 89% chance (100% - 11% = 89%) that an adult petrel taken from May through June was actually breeding or incubating, a 66% (0.89 x 0.74 = 0.66) chance in July and August that the individual had successfully produced a chick. Most non- breeding birds and failed breeders leave the colony for the season by mid-August (Simons 1985) therefore there is nearly a 100% chance that birds taken in September or October would be tending to young. Based on the above life history parameters and as identified in Table 5.1 below, indirect take would be assessed at the rate of 0.89 eggs per adult taken between May and July, 0.66 chicks per adult in August, 1.00 chick per adult taken in September, and 0.50 chick per adult taken in October (life history data presented can also be found in Appendix 5).

Table 5.1. Calculation of Indirect Take for Hawaiian Petrel. -*NO CHANGE*

Hawaiian petrel	Season	Average no. of chicks per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Adult	Mar - Apr	--	0	--	0.00
Adult	May - July	1	0.89	1.0	0.89 eggs
Adult	August	1	0.66	1.0	0.66 chicks
Adult	Sept	1	1.00	1.0	1.00 chick
Adult	Oct	1	1.00	0.5	0.50 chicks
Adult	Nov - Apr	--	0.00	--	0.00
Immature	All year	--	0.00	--	0.00

5.2.2.4 Estimating Total Take for the Hawaiian Petrel

The estimated average mortality rate of Hawaiian petrel allowing for potential collisions with WTGs and permanent met towers and adjusted for potential for collection line strikes is 0.91 petrel/year, or essentially one petrel per year. Based on estimated rates of direct and indirect take, take of this species resulting from project operations is expected to average no more than approximately two birds per year (0.91 adult/year + maximum of 0.91 chick/year = 1.82 birds). Because of assumptions concerning unobserved direct take, any one Hawaiian petrel found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one, with total direct take then likely to be rounded up to two birds (based on expected results from take monitoring and subsequent adjustments for searcher efficiency and scavenging rates).

Moreover, as take may be distributed unevenly over the years (see Section 5.2), the Applicant proposes that the ITP and ITL allow for a total direct take of at least four Hawaiian petrels and the indirect take of three chicks for any given year for the duration of the project (see below for calculations on indirect take). Five-year and 20-year take limits based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every five years and 15 adults every 20 years). See Section 5.2 for a detailed explanation.

Birds "taken" through assessment of "unobserved direct take" will be assumed to have been of the same age and breeding status as the individual that was found. As the amount of indirect take assessed is dependent upon when the direct take occurs during the breeding season, for the purposes of calculating the expected indirect take, it was assumed that direct take has an equal probability of occurring anytime between March and November. This period includes the pre- laying period (March to April), the breeding season (May to October) and fledging period (November). It is expected that only adults will be taken from March to October and only fledglings will be taken in November. This distribution of fatality over the breeding season (nine months long) was used to determine the expected amount of indirect take. For example, for a total direct take of 8 petrels, a total direct take of two individuals would be expected to occur from March to April (=8 x 2 months/9 months) over the life of the project (Table 5.2). Table 5.2 shows the expected distribution of direct take over the breeding season and the indirect take that would be subsequently assessed (derived from Table 5.1) for the **Tier 1** requested take levels.

Table 5.2. Allocation of Indirect Take for Hawaiian Petrel for the Requested Tier 1 Level of Take. -*NO CHANGE*

Hawaiian petrel	Adult					Fledgling	Total
	(March-April)	(May-Aug)	(Aug)	(Sept)	(Oct)	(Nov)	
Direct Take	5	6	2	2	2	2	19
Indirect take	0	5.3	1.3	2	1	0	9 (= 9.6)

Expected rates of take and rates of take requested to be authorized by the ITL and ITP through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as "Tier 2."

Expected Rate of Take

Annual average — 0.91 adults/immatures and 0.91 chicks /eggs
1.82 birds/year
20-year project life — 19 adults/immatures and 9 chicks/eggs

Requested Tier 1 ITL Authorization

Annual limit of take — 4 adults/immatures and 3 chicks/eggs
7 birds/year
5-year limit of take — 8 adults/immatures and 4 chicks/eggs
20-year limit — 19 adults/immatures and 9 chicks/eggs

Tier 2 Take Rate

One-year period — 8 adults/immatures and 4 chicks/eggs
5-year period — >8-16 adults/immatures and >4–8 chicks/eggs
20-year limit — >19-29 adults/immatures and >9-14 chicks/eggs

As indicated in Section 3.8.1.1, the current population of Hawaiian petrel is estimated to be approximately 20,000 birds, with 4,000 to 5,000 breeding pairs (Mitchell *et al.* 2005). Thus, the Tier 1 rate of take (28 birds/20 years or 1.4 birds per year) represents 0.007% of the population annually or approximately 0.14% of the estimated Hawaiian petrel population if all the take occurs at once, and the higher rate (43 petrels/20 years or 2.15 adults per year) represents approximately 0.01% of the population annually or 0.22% in the unlikely event that all the take occurs at once. Given these very low percentages, it is considered extremely unlikely that take of Hawaiian petrel caused by the proposed project would result in significant adverse effects to Hawaiian petrel at the population level. The seabird colony at Haleakalā, Maui, is composed of as many as 1,000 nesting pairs or approximately one-fifth to one-quarter of the total breeding population (Mitchell *et al.* 2005; Tetra Tech EC, Inc., 2008a, b). The number of birds breeding in West Maui is not known. The Tier 1 and Tier 2 yearly take rates could represent from 0.07% to 0.1% of the minimum (1,000 pairs) Maui population annually if all birds taken were breeding birds rather than non-breeding visitors to their colonies. In the very unlikely event that all the take occurs at once, it would represent 1.4% of the population at Tier 1 and at Tier 2, 2.15% of the Maui population. These percentages for both Tier 1 and Tier 2 take rates are low and the loss of Hawaiian petrels as a result of the proposed project is considered unlikely to result in a biologically significant reduction in the Maui population of this species.

Predation by introduced mammals and downing due to urban lighting are considered the primary threats to recovery of Hawaiian petrel. The proposed mitigation measures described in the following chapter are expected to more than offset the anticipated take and contribute to recovery of the species. For this reason, no significant adverse impacts to the species' overall populations, and no significant cumulative impacts to the species, are anticipated. With the low expected rate of take, the proposed mitigation measures are expected to produce a measurable net benefit in the form of a marginal increase in the population of Hawaiian petrels.

5.2.3 Newell's Shearwater *-NO CHANGE*

5.2.3.1 Risk of Newell's Shearwater Collision with WTGs

No take of Newell's shearwater has been documented at KWP I since the start of project operations (KWP I LLC 2011). This would result in a projected 20-year take of zero at KWP II if the same method for calculating take for Hawaiian petrels (Section 5.2.2.1) is applied t Newell's shearwaters. However, some risk of take for Newell's shearwater may exist and a low level of take may occur over the 20-year period. Fatality estimates for Hawaiian petrels and Newell's shearwaters were originally based on radar data, and seabird targets recorded flying over the KWP I site were proportioned based on a 60% petrel to 40% shearwater ratio). New data has shown that the proportion of Hawaiian petrels flying over the site compared to Newell's shearwaters is likely to be much greater than previously estimated. The most recent data suggests that 90% or more of the seabirds flying over KWP I are likely to be Hawaiian petrels with possibly only 10% Newell's shearwaters (Cooper *et al.* 2011, Appendix 2.3). Thus 90% of the seabird fatalities are expected to be Hawaiian petrels and 10% Newell's shearwaters. By this reasoning, with an expected direct take of 19 petrels for KWP II, the direct take of Newell's shearwater at KWP II for turbines and met towers over 20 years is 2.1 individuals (19 petrels/9 x 1 = 2.1) or 0.1 individuals per year.

5.2.3.2 Other Direct Take of Newell's Shearwaters

In addition to collisions with turbines and met towers, some limited potential exists for Newell's shearwaters to collide with cranes during the construction phase of the project. As discussed for Hawaiian petrel, potential for Newell's shearwaters to collide with construction cranes is considered negligible, given the brevity of the construction period and the low rate of occurrence of the species onsite. Also, the permanently stationed maintenance crane is not expected to constitute a collision threat to Newell's shearwater because it is expected to be used only during the day and stored in a horizontal position at night. No Newell's shearwaters collided with cranes used to construct the KWP I facility.

Potential also exists for Newell's shearwaters to collide with the 1,225-foot (374 m) section of the collection line that crosses the gulch at the upper portion of the project area (see Section 1.4 for details). This line will be mounted on poles approximately 60-90 feet (18-25 m) above ground level and will be a maximum of 340 ft. (104 m) above the deepest part of the gulch. Precautions to minimize collisions include installing marker balls on the collection line to enhance visibility and placing the collection line in close proximity to an existing transmission line of the same height that also crosses the gulch and is similarly marked (see Section 4.3.1). Observation of Newell's shearwaters on Kaua'i by Day *et al.* (in review) suggests that collision avoidance rates of power lines by Newell's shearwaters may be approximately 97% (392 observed birds with 29 birds exhibiting collision avoidance responses and one resultant collision [=1/30]). Thus, the collision rate of Newell's shearwaters with the overhead collection line is expected to be low. Given that the collision rate with overhead collection lines for Hawaiian petrels is estimated to be 0.05 birds/year (one bird every 20 years), and only 10% of the seabirds transiting the site are Newell's shearwaters, the estimated collision rate of Newell's shearwaters with overhead collection lines is 0.1 birds in 20 years (1 bird/9= 0.1 birds). Given the low occurrence rate of species on the site, their avoidance capabilities, the minimization measures that will be emplaced, the risk of collision for Newell' shearwater on the overhead lines is considered negligible.

As with Hawaiian petrels, some potential also exists for construction or maintenance vehicles to strike downed shearwaters (birds already injured by collision with turbines, towers or collection lines) while traveling project roads. Project personnel will be trained to watch for downed shearwaters and other wildlife and speed limits (10 mph) will be emplaced and enforced to minimize potential for vehicular strikes to result in death of birds that otherwise might have been able to be rehabilitated. Despite this, it is assumed that day-to-day maintenance of the wind facility may very occasionally result in the fatality of a shearwater. This source of mortality does not result in an increase in the amount of direct take expected from the proposed project because the collisions by these birds are accounted for in the mortality modeling.

Therefore, for this HCP, it is projected that take of Newell's shearwater as a result of collision with project components and vehicle strikes will occur at the average rate of 0.1 shearwaters/year.

5.2.3.3 Indirect Take for Newell's Shearwater

As with Hawaiian petrels, adult and immature shearwaters are most likely to collide with turbines or associated structures while commuting between nesting and feeding grounds during the pre- laying period (April to May), incubation and chick-feeding periods (June to October) and fledging period (October to November). Newell's shearwaters are not expected to be flying across the project area at other times of year. Based on the above, an indirect take assessment would be applied to any adult shearwaters found directly taken from June through October. Indirect take would not be assessed to adult shearwaters found at other times of year or applied to immature shearwaters. As with Hawaiian petrels, both shearwater parents care for their eggs and chicks. As little information is available for Newell's shearwaters on nestling growth and development or adult visitation rates, it is conservatively assumed that both parents are necessary throughout the breeding season for successfully fledging a chick.

Not all Newell's shearwaters visiting a nesting colony breed. It was estimated by Ainley *et al.* (2001) that only 46% of all active burrows produced an egg or chick. Therefore, it appears there would be a 46% chance that an adult petrel taken from June through August was actually breeding. Most non-breeding birds and failed breeders leave the colony for the season by August (Ainley *et al.* 2001), therefore there is nearly a 100% chance that birds taken in September or October would be tending to young. Based on the above life history parameters and as identified in Table 5.3 below, indirect take would be assessed at the rate of 0.46 eggs or chicks per adult taken between May and August, 1.00 chick per adult taken in September through October (life history data presented can also be found in Appendix 5).

Table 5.3. Calculation of Indirect Take for Newell's Shearwater. -*NO CHANGE*

Newell's shearwater	Season	Average no. of chicks per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Adult	Apr-May		0		0
Adult	Jun-Aug	1	0.46	1	0.46 eggs/chicks
Adult	Sept-Oct	1	1	1	1 chick
Adult	Nov-May		0		0
Immature	All Year		0		0

5.2.3.4 Estimating Total Take for Newell's Shearwater

The estimated average mortality rate of Newell's shearwater allowing for potential collisions with WTGs and permanent met towers and adjusted for potential for overhead collection line strikes is 1.1 shearwaters/year. Based on estimated rates of direct and indirect take, annual take of this species resulting from project operations is expected to average 0.2 birds/year (0.1 adults/year + (1 chicks/year x 0.1) = 0.2 birds/year).

Because of assumptions concerning unobserved direct take, any one Newell's shearwater found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one, with total direct take then likely to be rounded up to two birds (based on expected results from take monitoring and subsequent adjustments for searcher efficiency and scavenging rates). Based on the above, the Applicant suggests the ITP and ITL should allow for a total direct take of up to two Newell's shearwaters and the indirect take of two chicks for any given year for the duration of the project (see below for calculation of indirect take). Due to the low expected take over the project term, the one-year, 5-year and 20-year limits are identical.

Birds "taken" through assessment of "unobserved direct take" will be assumed to have been of the same age and breeding status as the individual that was found. As the amount of indirect take assessed is dependent upon when the direct take occurs during the breeding season, for the purposes of calculating the expected indirect take, it was assumed that direct take has an equal probability of occurring anytime between April and November. This period includes the pre-laying period (April to May), the breeding season (June to October) and fledging period (November). It is expected that only adults or immatures will be taken from April to October and only fledglings will be taken in November. This distribution of fatality over the breeding season (eight months long) was used to determine the expected amount of indirect take. Due to the low expected rate of take, it was assumed that all adults may be taken during the breeding season. Table 5.4 shows the possible distribution of direct take over the breeding season and the indirect take that would be subsequently assessed (derived from Table 5.1) for the **Tier 1** requested take levels.

Table 5.4. Allocation of Indirect Take for Newell's Shearwater for Tier 1 Requested Take Levels. -*NO CHANGE*

Newell's shearwater	Adult (April-May)	Adult (June-Aug)	Adult (Sept-Oct)	Fledgling (Nov)	Total
Direct take	0	1	1	0	2
Indirect	0	0.46	1	0	2 (=1.46)

Actual expected rates of take and rates of take of Newell's shearwaters requested to be authorized by the ITL and ITP through the expected 20-year life of the project are summarized below. Also, provided below are rates of take proposed to qualify as "Tier 2" for purposes of identifying when it would be appropriate or necessary to consider adaptive management practices.

Expected Rate of Take

Annual average	0.1 adults/immatures and 0.1 chicks/eggs	1.2 birds/year
20-year project life	2 adults/immatures and 2 chicks/eggs	

Requested Tier 1 ITL Authorization

Annual limit of take	2 adults/immatures and 2 chicks/eggs	4 birds/year
5-year limit of take	2 adults/immatures and 2 chicks/eggs	
20-year limit	2 adults/immatures and 2 chicks/eggs	

Tier 2 Take Rate

One-year period	>2–5 adults/immatures and >2–3 chicks/eggs
5-year period	>2–5 adults/immatures and >2–3 chicks/eggs
20-year period	>2–5 adults/immatures and >2–3 chicks/eggs

As indicated in Section 3.8.2.1, the most recent population estimate of Newell's shearwater was approximately 84,000 birds, with a possible range of 57,000 to 115,000 birds (Ainley *et al.* 1997). However, radar studies and population modeling have indicated that the population of Newell's shearwater is likely on a decline, especially on Kaua'i (Ainley *et al.*. 2001; Day *et al.* 2003). Declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley *et al.* 1997; Mitchell *et al.* 2005; Hays and Conant 2007).

The Tier 1 take rate (0.2 birds/year) represents approximately 0.0004% of the estimated Newell's shearwater population annually (using the lower estimate of 57,000 birds), and the Tier 2 rate (8 shearwaters/20 years=0.4 adults per year) represents approximately 0.0007% of the population annually. In the unlikely event that all the take occurs at once, Tier 1 take represents 0.007% of the estimated population and Tier 2 take represents 0.01%. Given these very low percentages, it is considered extremely unlikely that take caused by the proposed project would result in significant adverse effects to Newell's shearwater at the population level at Tier 1 or Tier 2 rates of take. As such, the proposed mitigation measures (Section 6.3) are expected to more than offset the anticipated take and contribute to the species' recovery. For this reason, no significant adverse impacts to the species' overall population and no significant cumulative impacts to the species are anticipated.

5.2.4 Nēnē -UPDATED

~~Past surveys and extensive monitoring prior to and during the five-year operation of KWP I have established that a population of nēnē occurs in the general project area of KWP I and KWP II (Day and Cooper 1999; Cooper and Day 2004; Kaheawa Wind Power 2007a, 2007b, 2008b, 2008c).~~ DOFAW operation of the captive release and reintroduction pen at Hana'ula, near the upper end of the KWP I site, has for all intents established the population of nēnē in the Kaheawa area. As of 2006, 104 nēnē had been released from this pen since releases began in 1994. The ~~current~~ population in 2009 in West Maui including Hana'ula was estimated at 106 birds (DOFAW 2009). As of 2016 the population in West Maui including Hana'ula was estimated at 231 birds (NRAG 2017, unpub.). This represents 37.5% of the total Maui population size of 616 and 8.1% of the species total of 2,855. The total estimated nēnē population has increased from 1,900 to 2,855 in 2016 (NRAG 2017, unpub.) or a 50 % increase in seven years.

Observations at KWP I and KWP II confirm that nēnē are resident in and around the ~~KWP I and KWP II~~ project area and~~. At KWP I, birds~~ are observed on the ground browsing, socializing, nesting, and using habitat and terrain features for cover. Nēnē ~~are not expected~~have not been observed to nest at the KWP II area for lack of suitable nesting habitat (see Section 3.8.3.3 and 5.2.4.2). Nēnē commonly fly at altitudes that are within the RSZ of the KWP I and KWP II WTGs, with most birds observed during daylight and crepuscular periods.

5.2.4.1 Nēnē Collision Risk and Avoidance Behavior –Estimating Direct Take - UPDATED

~~Nēnē at KWP I are commonly observed displaying avoidance behavior and maneuverability in the vicinity of project structures and moving rotors (Spencer pers. comm.; Kaheawa Wind Power 2008b, 2008c). While this indicates that the geese generally see and avoid the WTGs, nine nēnē mortalities from wind turbine collisions have been observed since June 2006, when the 20 KWP I WTGs became operational. The first incident in October, 2007 occurred during an ordinary period of strong trade winds. The second and third incidents were closely correlated with abrupt changes in local weather that included increases in local wind speeds and cloud cover associated with large scale~~

~~weather events that may have significantly reduced visibility of the WTGs. This suggests that nēnē may be more vulnerable to collisions with turbines, met towers, and other structures during periods of strong winds and low visibility. Circumstances surrounding the fourth fatality are unknown; the carcass was in an advanced stage of deterioration by the time it was discovered. Five observed mortalities occurred in 2011, largely attributed to the increased number of nēnē present at one particular site where hydroseeding had taken place.~~

~~After adjusting the observed direct take at KWP I for the effects of searcher efficiency and carcass removal by scavengers, the estimated total direct take at this facility after five years of operation has been 12.8 birds (Appendix 10). However, the take has not been evenly distributed over the years, 2011 was an abnormally high year for nēnē take with more than twice the take of any of the previous years (Table 5.5). This has been attributed to the hydroseeding of a work area at KWP I which attracted nēnē to feed in this area which resulted in a greater number of collisions with the turbines in 2011. No future hydroseeding is expected in the coming years and based on the consequences observed, other alternatives will be implemented if erosion control is needed, to avoid attracting nēnē to the project area.~~

~~Table 5.5. Estimated Total Direct Take for Nēnē at KWP I.~~

~~Year~~	~~2007~~	~~2008~~	~~2009~~	~~2010~~	~~2011~~
~~Adjusted Direct Take for Nēnē~~	~~0~~	~~3.1~~	~~1.2~~	~~1.2~~	~~7.3~~

~~Consequently, to calculate the expected rate of take at KWP II the average rate of take at KWP I is calculated based only on years 2007 – 2010. The total adjusted direct take for 2007-2010 is 5.5 birds over 4 years, or 1.4 birds/year or 0.07 birds/turbine at KWP I. As nēnē are encountered less frequently the KWP II area than at KWP I (35% of all nēnē sightings have been made in the down road area vs. 65% of sightings at KWP I, see Section 3.8.3.3), the risk of nēnē colliding with the turbines is assumed to be 0.54 (=35/65) times the risk at KWP I per turbine. This results in an expected mortality of 0.04 birds/turbine/year or 0.5 birds/year for all 14 turbines combined at KWP II.~~

~~In addition to collisions with WTGs, some potential exists for nēnē to collide with the temporary and permanent met towers and construction equipment, such as cranes during the construction phase of the project. To date, no nēnē have been found to have collided with met towers at KWP I. Potential for the birds to collide with the met towers is essentially accounted for in the estimated rate of take extrapolated from the KWP I data since the rate of take at KWP I was developed by dividing the sum of all project-related take (take caused by met towers was zero) and dividing that by the number of turbines.~~

~~No nēnē collided with any cranes during the construction phase of that project. As discussed for the two seabird species, the one permanently stationed crane is not expected to pose a collision threat to the nēnē because it is expected to be used during the daytime and stored in a horizontal position at ground level when not in use. Nēnē are able to avoid collisions with the overhead collection lines while flying and the new collection lines are strung with marker balls to increase their visibility. No nēnē collisions with the overhead lines have been documented thus far. Because nēnē are comparatively large birds, the potential for vehicles to strike downed nēnē is considered to be negligible because of the proposed staff training measures and project road speed limit of 10 mph.~~

~~Based on observations by KWP I biologists, nēnē are attracted to grass used in immediate revegetation mainly during the early emergent phase of growth and hence revegetation measures will be a source of attraction for only a short period of time. Nēnē in flight have also been documented to exhibit avoidance behavior around turbines (Kaheawa Wind Power 2008b, 2008c), hence the risk to nēnē due to attraction resulting from revegetation with grasses is considered minimal.~~

~~Based on the above, it is estimated the total proposed KWP II project would result in an average direct take of 0.5 nēnē/year.~~

Some nēnē fatalities occurred at KWP I as a likely result of attraction to foraging opportunities near WTGs presented by new vegetation growth on the KWP I site following KWP II BESS construction. Nonetheless, future BMPs for any future ground-disturbing maintenance activity will include minimizing grass cover.

Since ~~FY~~ June 2011 KWP I observed 14 more nēnē fatalities in the searched area (23 total); one in 2012, six in 2013, two in 2014, three in 2015, one in 2016 and one in 2017 (KWP I 2012, 2013, 2014, 2015, 2016 and 2017). Considering the current take estimate of nēnē at KWP II after ~~5~~ six years of operations and projection of take through the 20-year permit of ~~41~~ 44 nēnē, the projected annual rate of take is ~~2.05~~ 2.3 nēnē/year (Section 5.2.4.5.).

5.2.4.2 Ground Displacement of Nēnē -NO CHANGE

In general, animal species can be indirectly and adversely affected by the clearing of their habitat in multiple ways. The most obvious is through displacement. For animal species with small home ranges, or for projects that result in disturbance to large areas, clearing of habitat can completely remove the home range of an individual animal and thus reduce the carrying capacity of the area affected. Such animals are then typically displaced to either compete for space with individuals in remaining habitat or forced to occupy sub-optimal or non-suitable habitat. In either case, the loss of habitat usually results in an overall decrease in the effective population size of the species because some individuals may no longer be able to establish territory, attract a mate, and reproduce.

Clearing of habitat can also adversely affect species through reduction of habitat patch sizes and through habitat fragmentation. Some animals will not utilize patches of habitat that are below some minimum threshold size even though that minimum size is larger than their own home range. Thus, while clearing for a development project might reduce in size but not completely eliminate a certain patch of habitat, the clearing could cause the remaining habitat to be rendered unsuitable for continued use by a particular species. Similarly, clearing could cause one larger patch of habitat to be divided or "fragmented" into two or more smaller patches, with these smaller patches then being incapable of supporting a species that requires large blocks of habitat.

Even in cases where clearing of vegetation may divide one large block of habitat into two smaller blocks that each remains large enough to continue to support a given species, the development that follows vegetation clearing can sometimes create a barrier to movement by that species between the habitat patches. In some cases, the population of the species occurring on one or both sides of the barrier could then be made at risk of extinction because the remaining population may be less able to withstand additional perturbations.

In addition to possibly causing deleterious reduction in habitat patch sizes, fragmentation of habitat can result in harmful changes to the quality of surviving habitat. Clearing of vegetation creates edges that can alter microclimatic conditions within habitat by exposing the habitat to wind and sun. Changes in microclimatic conditions have potential to alter habitat to a point where it becomes unsuitable for use by a particular species. This type of effect is typically realized in forested habitats (where, for example, a previously shaded, humid understory could through clearing be dried through new exposure to sun and wind) as opposed to open habitats.

With regard to nēnē and the proposed KWP II project, the KWP II project area supports vegetation that provides some (though limited) browsing and sheltering opportunities. Clearing for turbine pads, roads and other project-related facilities would cause the loss of approximately 43 acres (17.4 ha) of mostly grassy vegetation out of the 143-acre (58-ha) KWP II project area, with the clearing generally occurring in linear swaths or in circular areas around turbine locations. This clearing is not expected to result in adverse modification to the microclimate of surviving habitat in the KWP II project area since those types of habitat are already fully exposed to sun and wind.

Clearing for the project, while it would result in the presence of (mostly linear and narrow) barren areas within the otherwise rocky and vegetated landscape of KWP II, is also not expected to cause adverse effects to nēnē as a result of habitat fragmentation. Through the first five years of KWP I operations, KWP I and DOFAW biologists have observed nēnē using portions of the combined KWP I and KWP II area and, at KWP I, successfully nesting within and adjacent to the project area. Nēnē are frequently seen at KWP I utilizing the roads and turbine pads for loafing, walking and vigilance (behavioral categories from Woog and Black 2001). These observations suggest that nēnē readily adapt to the presence of WTGs and should continue to utilize available habitat in the vicinity of the KWP II wind facilities. These observations further indicate that nēnē incorporate clearings of the type constructed for a wind power project into their home ranges. As such, these clearings do not create barriers to movement between vegetated areas and do not cause habitat occurring on one side of a clearing to be reduced in size to a point where it could no longer be considered capable of supporting nēnē.

The remaining question is whether the magnitude of loss of the existing grassy habitat that provides limited feeding and sheltering opportunities would be sufficient to cause the displacement of geese from the KWP II area.

Differences in vegetation between the KWP I and KWP II project areas and observation of patterns of habitat usage by nēnē at KWP I and KWP II indicate that the quality of nēnē habitat is not consistent between the two project areas. Habitat such as that in the KWP I project area, which has proven capable of supporting nesting and the nutritional requirements of nēnē, does not appear to be present in the KWP II area. Unlike the KWP I project area, vegetation in the KWP II project area is dominated by non-native windblown, fire-adapted grasses with some scattered shrubs and trees in the gullies. The KWP II area is also drier than the KWP I area, with lower elevations of the KWP II area receiving as much as 20" less rainfall than the upper parts of KWP I (see Figure 3.3).

Hobdy (2009b) identified a total of 15 native species in the KWP II project area. Some of the native plant species present at KWP II are identified as species that nēnē can utilize either as a food source or shrubs to shelter or nest under (USFWS 2004a). The food species are ʻilima (*Sida fallax*), ulei (*Osteomeles anthyllidifolia*) and pili (*Heteropogon contortus*), and nēnē are known to shelter or nest under ʻaʻaliʻi (*Dodonaea viscosa*). ʻIlima, is widely scattered throughout the KWP II area, but of very short stature; pili and ulei, are scattered sparsely throughout the area or occur only in a few small patches (Hobdy 2009b, 2010). ʻIlima is one of the most common native dry land plants in all of Hawaiʻi (Hobdy 2009b, 2010).

Nēnē are most often seen at the upper project area of KWP II near the Lahaina Pali trail or slightly above the project area at the 2.25 Mile marker (see Figure 3.3). During the winter months, if rainfall is adequate, the bunch grass-dominated pastures at KWP II produce greater numbers of seed heads, creating a short-term source of browse for some birds. However, this is an unpredictable food source and likely only a temporary and supplemental resource for nēnē. Moreover, unmanaged grasslands are typically nutritionally poor in general, especially so when they occur in dry areas (Woog and Black 2001).

ʻAʻaliʻi is a common native shrub species scattered sparsely throughout the KWP II area. Over the years repeated wildfire events have severely affected this region and appear to have suppressed the growth of native shrubs, which do not seem to occur in large enough patches or high enough stature to provide adequate nesting or shelter for the nēnē in the area. In addition, given the poor nutritional quality of the surrounding habitat, it is unlikely to be used with any regularity. So far, evidence suggests that the higher elevation portions of the upper KWP II project area may only provide a temporary foraging habitat for nēnē particularly after the rains, and no nēnē thus far have been detected nesting in the proposed project area. The absence of suitable nesting/sheltering habitat and the low nutritional quality of most plant species common in the area have probably discouraged nēnē from becoming more established in the KWP II project area. The proposed conversion of approximately 43 acres of open field habitat for KWP II project-related purposes may reduce to some degree the amount of low-quality foraging habitat available for nēnē in the project area.

In addition, a very small area will be trenched for the underground cables which may temporarily eliminate a very limited number of native food plants or plants that have potential shelter or nesting functions. The trenched area is a 1,500 ft.-long corridor and nēnē food plants that may be impacted include naupaka kuahiwi (*Scaevola gaudichaudii,* pukiawe (*Leptecophylla tameiameiae*) and ʽilima (Hobdy 2010). All three species were either scattered sparsely throughout the area or occur only in a few small patches or consisted of a few isolated individuals (uncommon to rare in the area). Another two acres will be permanently disturbed for the construction of the maintenance building, BESS and substation. These two activities will result in the loss of some native food plants such as ulei which is common in the area and pukiawe, `ilima and ʽōhiʽa (*Metrosideros polymorpha*) which are either scattered sparsely throughout the area or occur only in a few small patches or consisted of a few isolated individuals (uncommon to rare in the area). ʽAʽaliʽi is also a common native shrub species in the area, and some individuals may be lost during clearing but are not expected to measurably displace the sheltering/nesting habits of the species. To date, no nēnē have been recorded nesting in the area planned for construction.

In conclusion, given the very limited function of the areas to be altered in the main KWP II project area, and the abundance of better quality habitat elsewhere, the construction of KWP II is not expected to measurably displace, or adversely reduce, foraging or nesting opportunities for any individuals of the resident population.

5.2.4.3 Indirect Take of Nēnē -UPDATED

It is assumed that adult nēnē are most likely to collide with turbines and associated structures during non-breeding periods (May through July) or at the end of their breeding period when the adults and young may travel as family groups. Nēnē are highly territorial during the breeding season (Banko *et al.* 1999) and males are likely to be defending nesting territories while the females are incubating. Upon hatching, both parents would be attending to heavily dependent young; adult nēnē also molt while in the latter part of their breeding period and are therefore flightless for four to six weeks (USFWS 2004a). These adults attain their flight feathers at about the same time as their goslings (USFWS 2004a). Consequently, such birds are more likely to be in flight within KWP II only when goslings have already fledged.

Indirect take to account for loss of dependent young ~~will be~~ is assessed for adult nēnē only when mortality occurs during the breeding season (August to April). Adults found during the months of October through March ~~will be~~ is assumed to have had a 60% chance of having been actively breeding because 60% of the population has been recorded to breed in any given year (Banko *et al.* 1999). Adult nēnē mortality that occurs outside the peak breeding season (April, August and September) ~~will be~~ is assumed to have had a 25% chance of breeding. Male and female nēnē care for their young fairly equally, so indirect take ~~would be~~ is assessed equally to the direct take of any male or female adult nēnē found during the breeding season. The number of young possibly affected by loss of an adult ~~would be~~is based on the average number of fledglings produced per pair (studies indicate that average number of fledglings produced annually per pair of nēnē is 0.3 (Hu 1998)).

Based on these assumptions, as indicated in Table 5.6 below, the amount of indirect take that ~~would be~~ is assessed for each direct take of an adult nēnē during the months of October through March is 0.09. Amount of indirect take assessed for each direct take of an adult bird during the remainder of the breeding season is 0.04 (life history data presented can be found in Appendix 5).

Table 5.6. Calculation of Indirect Take of Nēnē. -*NO CHANGE*

Nēnē	Season	No. fledglings per pair (A)	Likelihood of breeding (B)	Parental contribution C	Indirect (A*B*C)
Adult, any gender	Oct-Mar	0.3	0.6	0.5	0.09
Adult, any gender	Apr, Aug and Sep	0.3	0.25	0.5	0.04
Adult, any gender	May-Jul		0		0
Immature	All year		0		0

5.2.4.4 Estimating Total Adjusted Take for Nēnē -UPDATED

Preconstruction Tier 1 and Tier 2 Take Estimates

Based on estimated rates of direct and indirect take, annual take of this species resulting from project operations is expected to be no more than 0.55 birds or essentially one bird per year. This is based on the expected rate of 0.5 adults/year with assessment for indirect take (0.5 + (0.09 fledglings/year x 0.5) = 0.55).

The DLNR and ESRC have recommended that annual take limits allow for at least one **observed** take a year. Because of assumptions concerning unobserved direct take, any one nēnē found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one that likely would be rounded up to two birds (based on expected results from take monitoring and subsequent adjustments for SEEF and scavenging rates). Moreover, as take may be distributed unevenly over the years (see Section 5.2), based on the above, the Applicant suggests the ITP and ITL should allow for a total direct take of at least four adult nēnē and the indirect take of one fledgling for any given year for the duration of the project (see below for calculation of indirect take). The requested Tier 1 take is one and a half times the calculated expected take to accommodate any factors that have not yet been considered in the risk assessment (such as a slow increase in the resident nēnē population over time which may increase the risk of take).

While the birds attributed to unobserved take would be assumed and, therefore, of unknown age or gender, for the purposes of this HCP it ~~will be~~is assumed that all birds taken through "unobserved direct take" will be of adults. Because nēnē could be flying through the project area at any time of year, the likelihood of an "unobserved take" of nēnē being in breeding condition is 37.5% based on a breeding period of 4.5 months (a one-month incubation period followed by parental care for 3.5 months; 4.5/12 = 0.375).

Consequently, following the above table, indirect take is assessed to nēnē lost through "unobserved direct take" at the rate of 0.06 fledglings/nēnē (0.3 x 0.375 x 0.50 = 0.0563). A 5-year and 20-year take limit based on the expected multi-year average rate of take has been proposed. This calculation does not use a multiple of an annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every five years and 15 adults every 20 years). See Section 5.2 for a detailed explanation. Expected rates of take and rates of take authorized by the ITP and ITL through the expected 20-year life of the project for Tier 1 and Tier 2 prior to operations commencing are summarized below.

Expected Rate of Take

Annual average	0.5 adults/immatures and 0.05 fledglings 0.55 birds/year
20-year project life	11 adults/immatures and 1 fledgling

Requested Tier 1 ITL Authorization

Annual limit of take	4 adults/immatures and 1 fledgling	5 birds/year
5-year limit of take	8 adults/immatures and 1 fledgling	
20-year limit	18 adults/immatures and 2-3 fledglings	

Tier 2 Take Rate

One-year period	6 adults/immatures and 1 fledgling
5-year period	12 adults/immatures and 3 fledglings
20-year period	27 adults/immatures and 3 fledglings

5.2.4.5 Estimating Total Adjusted Take for Nēnē Based on Post-Construction Fatality Monitoring Data -NEW

Estimating Total Direct Take

As of June ~~2017~~2018, ~~four~~ five nēnē mortalities have been documented within the search area at KWP II. These were observed on April 22, 2014; December 22, 2014; February 23, 2015; ~~and~~ October 13, 2015, and February 6, 2018. Projection of these findings using the Evidence of Absence Model (versions 1.0 and 2.0; Huso *et al.* 2015, Dalthorp *et al.* 2017) results in a 20-year expected total direct take of not more than ~~39~~ 42.3 adults with 80% credibility (see Appendix 27 for calculations).

Estimating Indirect Take

Using Table 5.6 and considering in what month take was observed, indirect take for the ~~four~~ five observed take is assessed to be 0.31 fledglings (0.09 + 0.04 + 0.09 + 0.09 + 0.09 = 0.~~31~~40).

For the purposes of estimating indirect take for unobserved direct take, the projected 37.3 ~~35~~ adults/immatures that may have been directly taken or will be in the future (42.3 ~~39~~ estimated total – ~~4~~ 5 observed to date = 37.3 ~~35~~ projected) are treated as unobserved direct take. As described in Section 5.2.4.4, indirect take of nēnē lost through unobserved direct take is assessed at the rate of 0.06 fledglings/nēnē. Thus, the indirect take for 37.3 ~~35~~ adults would be 2.24 ~~2.1~~ fledglings (37.3~~35~~ * 0.06 = 2.24~~2.1~~). Adding the indirect take of 0.40~~31~~ fledglings from observed fatalities, the total fledglings indirectly taken is projected to be 2.64 ~~2.41~~ fledglings.

Estimating Total Adjusted Take (Direct Plus Indirect Take)

Nēnē mature at age two for males and age three for females and an annual mortality rate is estimated at 20% (i.e., an annual survival rate of 80%, see Appendix 5 for life history information). One fledgling is thus the equivalent of 0.64 adults (1 * 0.8 * 0.8 = 0.64). Assuming all fledglings mature at age two, and an annual survival rate of 80% for two years, 2.64~~2.41~~ fledglings would be expected to yield 1.69 ~~1.54~~ adults after two years (2.64~~2.41~~ * 0.64 = 1.69~~1.54~~). ~~Rounding this up to two adults, the~~ The addition of indirect take to the expected total direct take of 42.26 ~~39~~ individuals results in a total adjusted take with 80% credibility of no more than ~~41~~ 44 adult nēnē.

The take requested for the 20-year (Tier ~~4~~3) limit is ~~41~~ 44 adult nēnē or ~~11~~ 14 more adult nēnē than the currently authorized take of 30 nēnē (of any age). The amended annual rate of estimated take at the 80% credibility level therefore is expected to be 2.26~~2.05~~ nēnē per year (compared to the currently permitted rate of 1.5 nēnē per year). The Tier 3 take limit of 36 nēnē was determined simply by dividing the amended take request into approximately equal amounts.

At KWP I, the annual estimated mortality rate as of June 2018 over the 20-year period is expected to be 3.43.2 nēnē per year based on observed take so far (23) and the 20-year projected take of 64 nēnē at the 80% credibility level (unpublished report to DOFAW and USFWS).

Requested Additional ITL/ITP Take Authorization

Tier 3 (20-year take)——————————————————————————————— 36 44 nēnē

Tier 4 (20-year take)——————————————————————————— 41 nēnē

The most current statewide population estimate for nēnē (from 2016) is 2,855 individuals, with 616 birds occurring on Maui (NRAG 2017, unpub.). In 2010 the statewide estimate was between 1,888 and 1,978 individuals (DOFAW 2010) and for Maui was 366 individuals. Considering the current statewide population, the total amended estimated take (at an annual rate of 2.262.05 birds/yr. (41 44 / 20 19.5 = 2.052.26)) requested for nēnē over the 20-year period represents a take of 0.0708% (2.052.26 / 2,855 = 0.0708%) of the statewide population per year. In the unlikely event that the entire requested take was to occur at once, it would impact roughly 1.54% (41 44/ 2,855 = 1.54 %) of the species' population. This would not be expected to cause a decline in the status of the species. For the island of Maui, the annual rate of take represents 0.37% (2.052.26 / 616 = 0.37%) of the island's population per year. In the unlikely event that the entire requested take was to occur at once, it would impact roughly 6.77.14% (41 44 / 616 = 6.77.14%) of the Maui's population. The possibility of all take occurring within a year is unlikely given the rates of take observed as of June 2017 2018 at KWP II (5 6 years of operation) and KWP I (11 12.5 years of operation). Further, the mitigation is expected to fully offset the impacts of the take. Therefore, no adverse effect to the species population is expected.

5.2.5 Hawaiian Hoary Bat *-UPDATED*

Low rates of activity call detections by from Hawaiian hoary bats have had been measured at KWP I and KWP II prior to the start of operations at KWP II (see Section 3.8.4.3). However, following the replacement in 2013 of the original bat detector equipment with newer, more sensitive detectors, the measured activity detection rates increased four-fold (Figures 3.5 and 3.6). While it cannot be known whether these higher detection activity rates were occurring prior to 2013, if they had the predicted fatality rates would have been commensurately higher in the original permit request. At this point, the projected 20-year take is 4.43.45 times higher than the take projected in 2012 for the 20-year permit term (4838/11 = 4.43.45). The lack of visual observations and low recorded activity levels at KWP I suggest that only a small number of bats utilize the general area. Although present on a regular basis, bats are not expected to breed or roost at KWP II due to the lack of trees. Due to the similarity in terrain between KWP I and KWP II, the estimated mortality at KWP II is expected to be similar to the mortality rates at the existing KWP I site. There are various native and non-native trees in the gulches on either side of the ridge where the turbines are located and ironwood trees (*Casuarina equisetifolia*) are spreading over the hillsides all around the site and in nearby gulches; so, bats could roost nearby. On Oahu a mother and two pups used an ironwood tree for roosting, therefore bats could even use nearby trees for maternity roosts (pers.com. Mitch Craig, Terraform Power, LLC). Hawaiian hoary bats breed from 0 to 4,200 feet (1,280 m) in elevation (Menard 2001), so it is possible that volant juveniles also occur in the project area in the latter portion of the breeding season.

5.2.5.1 Collision Risk and Other Potential Causes of Take at KWP II –NO LONGER APPLICABLE [Collision risk is now determined based on actual fatality monitoring at KWP II]-UPDATED

The potential for take of the Hawaiian hoary bat is was believed to be very low based on the surveys that have had been conducted at the KWP and KWP II project areas prior to KWP II construction, the limited available information regarding the species occurrence on West Maui, and the apparent relatively low susceptibility of resident (versus migrating) bats to collisions with wind turbines in general for bat species found in other parts of the world. However, the occurrence of ~~at least a few~~ individuals in the project area has been documented, and ~~two~~ 14 observed fatalities have been recorded at the KWP I and KWP II ~~facility~~facilities over ~~five years~~these ~~of~~project's operation.

~~The two fatalities recorded at KWP equate to a total direct take of 6 bats after adjustments for unobserved take, resulting in an average of 1.2 bats/year for KWP or 0.06 bats/turbine/year (Kaheawa Wind Power 2011, Appendix 16). Extrapolating this rate to KWP II results in an average direct take of 0.84 bats/year for all 14 turbines at KWP II.~~

Potential for bats to collide with met towers or cranes is considered to be negligible because they would be immobile and should be readily detectable by the bats through echolocation. Of 64 wind turbines studied at Mountaineer Wind Energy Center in the Appalachian plateau in West Virginia, bat fatalities were recorded at operating turbines, but not at a turbine that remained nonoperational during the study period. This supports the expectation that presence of the stationary structures, such as an un-guyed lattice met tower and crane, should not result in bat fatalities (Kerns et al. 2005). No bats have been found to have collided with the guyed met towers at KWP after five years of operation or with any cranes during the construction phase of that project. No downed bats have been found during the weekly searches of the permanent met tower at the Kahuku Wind Power site which was erected in the winter of 2010. Potential for the bats to collide with met towers is also essentially accounted for in the estimated rate of take extrapolated from the KWP data since the rate of take at KWP was developed by dividing the sum of all project related take (take caused by met towers was zero) and dividing that by the number of turbines.

5.2.5.2 Indirect Take -UPDATED

Hoary bats are thought to move to higher elevations during the months of January through March (Menard 2001), and so may be less prevalent in the project area during those months. ~~However given the lack of data and for the purposes of the HCP, it is assumed that levels of bat activity on site remain constant throughout the year. Consequently, adult bats are considered to have equal potential to collide with turbines throughout the year and regardless of breeding status.~~ Based on measured detection~~activity~~ rates, bats around KWP I and KWP II are most prevalent in August through October (Figure 3.6) although they are found there in every month of the year (Table 5.8). These three months have also been found to have the highest detection~~activity~~ rates at other wind sites in Hawai`i (Auwahi 2017, Kahuku 2017 and Kawailoa 2017). During a five-year island-wide study of Hawaiian hoary bat occupancy on Hawai`i Island the habitat that had the highest detection~~activity~~ rates during the summer and fall was the coastal lowlands where female bats are thought to prefer for pupping (Gorresen *et al.* 2013). Considering all habitats on Hawai`i Island the peak detection rate ~~activity~~ during this study occurred in August and September.

Although detections peak in August through October~~during this period~~, only ~~23~~29% of ~~13~~ 14 observed fatalities (for KWP I and KWP II found within or outside of search areas) were found in the three months with highest detection rates ~~activity~~ while ~~54~~50% were found in February through May and ~~23~~21% in November and December (KWP I ~~2016~~2017, KWP II ~~2016~~2017). No fatalities have been observed in January, June, July and October. At Auwahi Wind Farm, the only other wind farm on Maui, in FY 2013 through 2017, 13 Hawaiian hoary bat fatalities were found (Auwahi 2017). One fatality was observed each in January, June, July, and November; two were observed in October, three in August and four in September. During the 2.5 years ~~of~~ when bat assessment occurred, between July 2013 and December 2015, the highest detection ~~activity~~ rates at Auwahi Wind Farm occurred in August, September and October with activity measured in all months (Auwahi 2016).

Months with highest detection~~activity~~ rates at KWP I and KWP II did not necessarily correlate with months when fatalities were observed. During September when bat ~~detector~~ detection ~~activity~~ rates were generally highest, only ~~15~~14% of fatalities were found at KWP (I and II); while ~~23~~29% of observed fatalities were found during August through October. However, at Auwahi Wind Farm 23% of fatalities were found in September and 54% were found in August through October.

Menard (2001) suggests Hawaiian hoary bats breed between April and August. Females are solely responsible for the care and feeding of young, and twin pups are typically born each year, although single pups sometimes occur. Any female bats or bats whose sex has not been determined and directly taken from April 1 through September 15 will be assumed to be pregnant or lactating unless proven otherwise and indirect take will be assessed 1.8 juveniles per adult as indicated in Table 5.7 below (life history data presented can be found in Appendix 5). No indirect take will be assessed for female bats found at other times of year, or for male or immature bats found at any time of year.

Table 5.7. Calculating Indirect Take for the Hawaiian Hoary Bat. -*NO CHANGE*

Hawaiian hoary bat	Season/ Breeding Condition	Average no. of juveniles per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Female or sex unknown	Apr 1 - Sep 15	1.8	1.0	1.00	1.80
Female	Sep 16 - Mar 31	--	0.0	--	0.00
Male	All year	--	0.0	0.00	0.00
Immature	All year	--	0.0	--	0.00

5.2.5.3 Estimating Total Take for the Hawaiian Hoary Bat -UPDATED

Preconstruction Tier 1 and Tier 2 Take Estimates

As indicated, the average rate of direct take of Hawaiian hoary bats as a result of project operations ~~is~~ was expected to be 0.84 bats/yr. The original implementation of low wind speed curtailment ~~is~~ was anticipated to further reduce take by an average of 70% (Arnett et al. 2009, 2010), thus the expected take ~~is~~ was 0.25 bats/yr. Indirect take associated with this level of direct take would result in a maximum of 0.45 juveniles per year (=0.25 x 1.8) resulting in a total adjusted take of 0.70 bats/year or essentially one bat per year (see Table 5.8, life history data presented can be found in Appendix 7).

As with the other species addressed in this HCP, the DLNR and ESRC ~~have~~had recommended that annual take limits allow for the possibility of at least one **observed** take a year. Again, because of assumptions concerning unobserved direct take, any one Hawaiian hoary bat found to have collided with a project component in a year may lead to an assessment of total direct take for that year of greater than one likely to be rounded up to between three and five bats (based on expected results from take monitoring and expected subsequent adjustments for SEEF and scavenging rates). ~~Existing literature on adjusting total direct take for bats suggests that a ratio of one observed take to three unobserved takes is not unreasonable and may be conservative (e.g., Arnett 2005; Jain *et al.* 2007; Fiedler *et al.* 2007).~~

~~As an example, indirect take assessed to a total direct take of 4 bats (1 observed direct take + 3 unobserved direct takes) is assumed to be no more than 2.5 juveniles. Consequently, the Applicant suggests the ITP and ITL should allow for a total direct take of up to four adult or volant juvenile Hawaiian hoary bats and the indirect take of up to three dependent juvenile bats for any given year for the duration of the project.~~ A 5-year and a 20-year take limit based on the expected multi-year average rate of take ~~are~~ were also proposed prior to operation. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every five years and 15 adults every 20 years); see Section 5.2 for a detailed explanation. Expected rates of take and rates of take requested to be authorized by the ITP and ITL through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as "Higher."

Expected Rate of Take

Average	0.25 adults and 0.45 juveniles	0.70 bats/year
20-year project life	5 adults and 3 juveniles (assuming half of all direct take is female)	

Requested Tier 1 ITL Authorization

Annual limit of take	5 adults[3]
Five-year limit of take	7 adults[4]
20-year limit	7 adults[4]

Tier 2 Take Rate

One-year period	11 adults[5]
5-year period	11 adults[5]
20-year period	11 adults[5]

The most recent population estimates for Hawaiian hoary bat have ranged from several hundred to several thousand (Tomich 1969; Menard 2001). The Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998) states "since no accurate population estimates exist for this subspecies and because historical information regarding its past distribution is scant, the decline of the bat has been largely inferred." Although overall numbers of Hawaiian hoary bats are believed to be low, they are thought to occur in the greatest numbers on the islands of Hawai'i and Kaua'i (Menard 2001). It is difficult to gauge the effect that take of Hawaiian hoary bat resulting from the proposed project may have on the population of this species because its population is not known. The identified Tier 1 level of take is low and so it seems unlikely that take at this rate would result in a significant impact on the overall population of the Hawaiian hoary bat. Tier 2 levels of take may begin to impact the Maui population, if the population is very small, although this seems unlikely to occur given the relatively low habitat availability on the site and low activity levels. In any case, such take would not likely impact the status of the species on other islands where populations are assumed to be more robust. The Applicant's proposed mitigation for the anticipated take (see Section 6.5) will has contributed to restoration of native bat habitat and is expected toshould result in an overall net conservation benefit for the species (see Appendix 32).

Based on fatality monitoring at KWP I from 2006 to 2017 2018 and at KWP II from 2012 to 20182017, and recent bat acoustic monitoring from 2013 to 2017 (see Section 3.8.4.3), Hawaiian hoary bats are likely to occur year-round at KWP II. Table 5.8 identifies the months where fatalities have been documented at KWP I and KWP II.

[3] This was revised to be equivalent to 5 adult bats in a clarification letter from USFWS and DOFAW (2014-TA0260), dated May 20, 2014. The annual take limit was also removed.

[4] This was revised to be equivalent to 7 adult bats in a clarification letter from USFWS and DOFAW (2014-TA0260), dated May 20, 2014. The annual take limit was also removed.

[5] This was revised to be equivalent to 11 adult bats in a clarification letter from USFWS and DOFAW (2014-TA0260), dated May 20, 2014. The annual take limit was also removed.

Table 5.8. Total Hawaiian Hoary Bat Observed Fatalities by Month for KWP I (January 2006 through June 2018) and KWP II (July 2012 through June 2018). -*NEW*

	Fatalities		
Month	KWP I*	KWP II	Total
Jan	0	0	0
Feb	1	1	**2**
Mar	0	1	**1**
Apr	3*	0	**3**
May	1	0	**1**
Jun	0	0	0
Jul	0	0	0
Aug	~~1~~2	0	~~1~~2
Sep	2*	0	**2**
Oct	0	0	0
Nov	1*	1	**2**
Dec	1	0	**1**
Total	**~~10~~11**	**3**	**~~13~~14**
***Includes one incidental observed**			

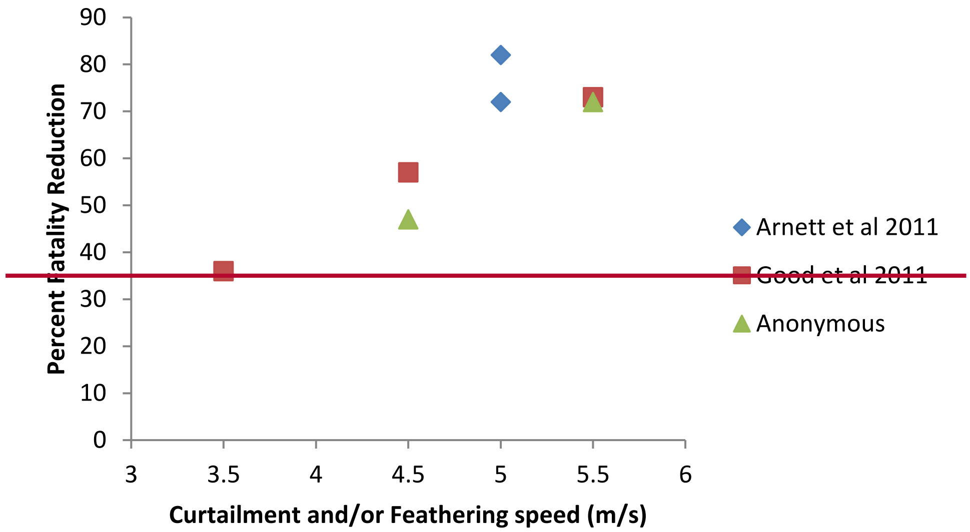
5.2.5.4 Estimating Total Adjusted Take for Hawaiian Hoary Bats Based on Post-Construction Fatality Monitoring Data -NEW

Estimating Total Direct Take

Research with different levels of LWSC as treatments show that fatality rates of bats may be reduced when turbine blades are feathered below any cut-in speed and also if LWSC is implemented (see section 4.2.2 and 4.2.3). Implementing LWSC at KWP I and KWP II is expected to reduce overall direct take ~~based on results from various studies on the mainland~~. LWSC began at KWP II in July 2012 (the beginning of operations) at 5.0 m/s and continued through December 1, 2012. In 2013 and 2014 LWSC to 5.0 m/s began on March 14 and February 15, respectively, and continued through December 4 and 16, respectively. In 2014 LWSC was increased from 5.0 m/s to 5.5 m/s on July 28, 2014 and will continue at 5.5 m/s for the duration of the 20-year permit unless determined to be ineffective or unnecessary at this level. LWSC implementation will ~~continue to~~ be ~~from February 15 through December 15~~ year-round beginning in December 2018. ~~unless an extension is triggered by the discovery of fatalities outside this period.~~

~~Arnett *et al.* (2013) conducted studies on the mainland quantifying the effects of LWSC on bat mortality. Their studies indicate that most bat collisions occur at relatively low wind speeds, and consequently the risk of fatalities may be significantly reduced by curtailing operation during nighttime periods when winds are light. Their research shows that bat fatalities were reduced by an average of 82% (95% CI: 52 – 93%) in 2008 and by 72% (95 % CI: 44 – 86%) in 2009 when cut-in speed was increased to 5 m/s and turbine blades were feathered at lower wind speeds. Subsequent studies have also shown significant reductions in fatalities. At Fowler Ridge, Indiana feathering alone below normal cut-in speed of 3.5 m/s reduced fatalities by 36%, below 4.5 m/s by 57% and below~~

~~5.5 m/s by 73% (16% decrease from 4.5 to 5.5 m/s) (Good *et al.* 2011). An anonymous study in USFWS Region 3 showed a fatality reduction from 47% to 72% for cut-in speeds of 4.5 and 5.5 m/s, respectively, (a 25% additional reduction from 4.5 to 5.5 m/s) (Figure 5.1).~~



~~**Figure 5.1. Percent Fatality Reduction in Various Studies on the Mainland.**~~

~~KWP II assumes that by increasing LWSC from 5.0 to 5.5 m/s the mortality rate was reduced by at least 15%, and that this reduction in the long-term average rate of take will continue.~~ As of June ~~2017~~2018, after ~~five~~ six years of operations, three fatalities had been recorded at KWP II: one each on March 13, 2013, November 5, 2013, and February 26, 2014. All three fatalities occurred prior to raising LWSC from 5.0 m/s to 5/5 m/s~~, which was implemented~~ in ~~July~~ August 2014.

Based on the three observed fatalities, the estimated direct take at the 80% credibility level as of June ~~2017~~ 2018 was ~~13~~ 12 bats. ~~Extrapolation using~~ Using these data in the Evidence of Absence Model (Huso *et al.* 2015, Dalthorp *et al.* 2017) ~~and assuming a continued 15% reduction in the mortality rate relative to year one and two,~~ the estimated 20-year (Tier 4) total direct take is no more than ~~45~~ 35.2 bats with 80% credibility (see Appendix 27 for calculations). SEEF and CARE trials used in this calculation include all trials through June ~~2017~~2018. Unobserved direct take not yet accrued for years ~~six~~ seven through twenty is estimated to be ~~32~~ 23.2 bats (~~45~~ 35.2 – ~~13~~ 12 = ~~32~~23.2).

Estimating Indirect Take

All three fatalities, two males and one of unknown sex, were documented at KWP II during the non-breeding season (April 1 through September 15) in February, March, and November, therefore, no indirect take (i.e., consideration of potential lost offspring) was assessed for the documented fatalities.

While the other bats taken under these scenarios ~~would be~~are assumed and, therefore, of unknown age or gender, for the purposes of this HCP it ~~will be~~is assumed that every Hawaiian hoary bat taken through "unobserved direct take" ~~will be~~is adult and ~~will have~~has a 50% chance of ~~having been~~being female (assuming the sex ratio of males to females is 1:1). Bats fly through the project area throughout the year and the probability of an individual female bat having dependent young during a 12-month period is assumed to be 25% (three out of 12 months). The average period of dependence is based on the information that Hawaiian hoary bats have one brood a year, and that hoary bats in North America have an average 56-day gestation period followed by parental care to weaning averaging 34 days or approximately three months in total (Hayssen *et al.* 1993, Hayes and Wiles 2013, and NatureServe 2015 for *Lasiuris cinereus*, the North American hoary bat). There is not enough information for hoary bats from Hawaii to determine the gestation and pre-weaning dependent period for the subspecies. Consequently, indirect take will be assessed to bats lost through "unobserved direct take" at the rate of 0.225 juveniles/bat (0.5 x 0.25 x 1.8 = 0.225).

For the purposes of estimating indirect take for the 20-year permit term the ~~42~~ 32.2 of the ~~45~~ 35.2 projected estimated direct take for the 20-year permit are considered unobserved direct take (~~45~~ 35.2 total estimated – 3 observed to date = ~~42~~ 32.2 unobserved take). Calculation of indirect take for unobserved direct take is described in Section 5.2.5.3. Indirect take is assessed to bats lost through unobserved direct take at the rate of 0.225 juvenile/bat. Based on these calculations, an indirect take totaling ~~10~~ 7.25 juveniles (~~42~~ 32.2 x 0.225 = ~~9.45~~7.25), is estimated.

The estimated indirect take from unobserved direct take for the 20-year period is therefore ~~10~~ 7.25 juveniles.

Estimating Total Adjusted Take (Direct Plus Indirect Take)

For purposes of indirect take, juvenile bats are converted to adults based on a 30% survival rate of juvenile to adult. Hawaiian hoary bats are considered mature one year after their birth. This converts the total indirect take of ~~10~~ 7.25 juveniles to ~~3.0~~2.17 adults. Adding these ~~three~~ 2,17 adults to the estimated total direct take of ~~45~~ 35.2 bats, results in an estimated total adjusted take of ~~48~~ 37.4 adult bats for the 20-year permit period or 38 adult bats rounded up.

The proposed projected take limit is ~~37~~ 27 adult bats greater than the currently authorized take limit of 11 adult bats (see Section 5.2.5.3 footnote no. 2). The Project proposes adding two additional tiers (Tier 3 and Tier 4) to be able ~~to incrementally add mitigation obligations~~ account for uncertainty in projecting take 14 years in advance. ~~Tier 4 take is three more bats than the~~ Mitigation for Tier 3 take of ~~34~~ 19 bats (~~45~~30-11=~~34~~19) has already been contracted ~~level to allow for uncertainty between the 20-year estimated take projected now and the actual take estimated near the end of the 20-year permit term~~.

The Tier 3 and 4 take levels were created considering hypothetical outcomes based on take observed during the first six years. As mentioned previously the EoA calculation for total projected take assuming no more take is observed during annual downed wildlife monitoring (as has been true for the last four years) would be 14 adult bats and if one bat were found every other year or seven more take observed (as has occurred on average in the first six years) the total take estimated would be about 39 adult bats or a difference of 25 bats. Tier 3 (19 more bats) represents about 75% of the difference between the extremes of no more take observed and take observed at a rate similar to the average for the first six years (which is a higher rate than has occurred in the last three years).

Requested Additional ITL/ITP Take Authorization

Tier 3	**~~45~~ 30 bats**
Tier 4 (20-year take)	**~~48~~ 38 bats**

Population Assessment

Individual bats are very difficult to count and so population estimation is limited to relative activity, distribution, and seasonality. The Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998) states "since no accurate population estimates exist for this subspecies and because historical information regarding its past distribution is scant, the decline of the bat has been largely inferred." The US Department of Agriculture Natural Resource Conservation Service (USDA NRCS) Biology Technical Note No. 20 speculates that "It is a Federal and State endangered species, but many have questioned whether the subspecies is truly endangered with so little known about its status." (USDA NRCS 2009). The initial ESA and state listing of the HHB were based on insufficient information and not any quantified critical threats known to be jeopardizing the species existence. As well, no studies have clearly determined that the species is in decline or that available habitat has been reduced.

There has been no clear indication from specific research that the species is actually endangered and at risk of extinction and therefore the need for "recovery" of the species has not been established. Once a species is listed as endangered the need for "recovery" is assumed because the species is considered "endangered". Previous population estimates for this species have been based on no actual organized assessments and should be considered merely guesses. Nonetheless, understanding population status and specific habitat requirements of the HHB have been identified as primary data needs for species recovery (USFWS 1998, Gorresen *et al.* 2013). Occupancy models and genetic studies have been, and continue to be, conducted to attempt to come up with population indices and effective population sizes, although effective population does not necessarily equate to actual population size (Gorresen 2008, Gorresen *et al.* 2013). Although population estimates are not currently available, studies indicate that the bat population on Hawai´i Island is stable and potentially increasing (Gorresen *et al.* 2013).

Although overall numbers of Hawaiian hoary bats are assumed ~~believed~~ (but not determined) to be low, they are thought to occur in the greatest numbers on the islands of Hawai'i and Kaua'i (Menard 2001). However, since 2001 Hawaiian hoary bats have been found in greater numbers than previously known on Maui and O`ahu (see KWP and Auwahi Wind Power annual HCP reports for Maui, and Kawailoa and Kahuku Wind Power annual HCP reports for O`ahu). We know now that bats occur on all the main Hawaiian islands, and breeding populations have been confirmed on all of the main Hawaiian islands except for Ni'ihau and Kaho'olawe (DOFAW 2015). Acoustic monitoring of bat activity throughout the main Hawaiian Islands almost always picks up bat detections; however, there is no way to convert acoustic detections into a viable population estimate. Nonetheless, as bat ~~activity~~detection research expands so does the known distribution, suggesting the Hawaiian hoary bat population is larger than previously guessed (Gorresen *et al*. 2013, Kawailoa Wind Power 2016).

Hawaiian hoary bats have been observed year-round in a wide variety of habitats and elevations below 7,500 feet (ft) (2,286 meters [m]) and a few sightings from limited surveys have been reported as high as 13,199 ft (4,023 m). Hawaiian hoary bats have been detected in both wet and dry areas of Hawaii but seem to be more abundant on the drier leeward side (Jacobs 1994) and generally less abundant in wet areas (Kepler and Scott 1990). Several researchers have examined spatial and temporal variation in occurrence patterns of bats in Hawaii, with conflicting conclusions about possible altitudinal or regional migration (Tomich 1986; Jacobs 1994; Menard 2001; Gorresen *et al.* 2013; Bonaccorso *et al.* 2015). Bats on the island of Hawai`i are habitat generalists and occur from sea level to the highest peaks on the island (Gorresen *et al.* 2013).

It is difficult to gauge what impact take of Hawaiian hoary bats resulting from the project may have on the subspecies. ~~Nonetheless, as bat activity research expands so does the known distribution, suggesting the Hawaiian hoary bat population is larger than previously guessed (Gorresen *et al.* 2013, Kawailoa Wind Power 2016).~~ Original incidental take estimates for permitted wind facilities in Hawai'i have been under estimated due to a lack of baseline data on the Hawaiian hoary bat and other factors beyond our knowledge at the time of permitting. Each of the permitted wind facilities operating in Hawai'i have required an amendment to their HCP to increase the amount of authorized take of the Hawaiian hoary bat. Assessing risk to the Hawaiian hoary bat with respect to wind facilities in combination with substantial gaps in baseline population and life history information for the bat has increased concern with respect to the potential cumulative impacts on the Hawaiian hoary bat. Sources of these potential impacts include existing and future wind energy development, as well as other sources of anthropogenic take. However, post-construction fatality monitoring results and preliminary research efforts suggest the population of Hawaiian hoary bats throughout the Hawaiian Islands is larger and more widespread than had previously been known (Kawailoa Wind Power 2015; F. Bonaccorso, USGS-BRD, pers. comm., 2014).

Four factors suggest this project, along with similar wind energy facilities, will not contribute significantly to cumulative impacts for the Hawaiian hoary bat: 1) Hawaiian hoary bats and are more widespread than previously assumed 2) mitigation commitments in this HCP are designed to provide a net benefit to the species, including contributions to improving the understanding of how to effectively mitigate for impacts to the Hawaiian hoary bat; and, 3) other wind facilities in Hawaii will similarly provide compensatory mitigation for the anticipated take of Hawaiian hoary bats.

Tree trimming and harvesting activities are not necessarily incompatible with bat habitat needs (Patriquin and Barclay 2003, Johnson and Strickland 2003), although they have the potential to impact juvenile bats which may be unable to fly away from an occupied tree when it is cut or disturbed. The USFWS recommends that harvesting or trimming of woody plants more than 15 feet tall should not occur between June 1 and September 15. No one knows exactly how much bat take occurs statewide as a result of tree trimming and harvesting.

Mortality has been documented from limited assessments of bats snagging on barbed wire. Annual mortality estimates range from 0 to 0.8 Hawaiian hoary bats per 100 kilometers of barbed wire (Zimpfer and Bonaccorso 2010). Although observed fatalities are uncommon, the extent of the impact of barbed wire fences is largely unknown because most fences are not checked regularly and any bats that may be caught on these fences may be quickly taken by predators or scavengers. Based on the low estimates of mortality related to bat impalement on barbed-wire fences, this impact is not expected to contribute significantly to the cumulative impacts to the species.

Authorized take levels of other listed species covered by permitted Hawaii wind farm HCPs are typically higher than actual fatality rates based on current monitoring data. The potential for take of these species associated with individual projects appears to be fairly well understood, conservatively estimated, and mitigated to achieve a net benefit for the species. Based on this information, the Service does not believe there are significant population-level cumulative impacts to these species. ~~A five-year occupancy trend study on the Island of Hawaiʻi from 2007 to 2011 indicates, based on acoustic data, that the population there is either stable or increasing (Gorresen *et al.* 2013). However, no population estimates were provided.~~ ~~Bats on the island of Hawai`i are habitat generalists and occur from sea level to the highest peaks on the island (Gorresen *et al.* 2013).~~

The projected yearly rate of take is ~~2.2~~1.95 adult bats (adults and juveniles surviving to adult) per year (~~48~~ 38 estimated/~~20~~ 19.5 years). The annual rate of take of ~~2.6~~ 1.95 adults/year means that approximately ~~eight~~ 6.5 juveniles need to be produced each year to replace the lost adults (using a ratio of 0.3 juveniles to one adult) (see Section 5.2.5.3). Because the Hawaiian hoary bat is reproductively mature in one year and a female Hawaiian hoary bat produces on average 1.8 pups a year surviving to weaning, it will take the weaned offspring of approximately ~~four~~ 3.4 reproductively active females each year to replace the lost adults (~~4~~3.6*1.8*0.3 = ~~2.2~~1.95 adults).

If the Maui bat population is similarly stable or slightly increasing as has been suggested for the population of Hawaiian hoary bats on the island of Hawaiʻi, and similarly widespread across habitats, significant impacts to the Maui population from this estimated yearly rate of take at KWP II appear unlikely. The proposed mitigation would include research that will further elucidate the bats distribution and foraging habits and protect or restore roosting and foraging habitat~~, and the proposed mitigation for the additional tier of the amendment~~ (see Section 6.5)~~, will contribute to preventing the degradation of, and improving the quality of, sufficient native bat foraging and roosting habitat to allow for enhancement of the survival of the species~~.

5.3 CUMULATIVE IMPACTS *-UPDATED*

Updated cumulative effects analyses for nēnē and the Hawaiian hoary bat are found in Sections 5.3.3.1 and 5.3.4.1 below.

The only other wind project on Maui other than KWP I and KWP II is the 21 MW Auwahi Wind Farm at ʻUlupalakua Ranch located on the leeward slope of Haleakalā on the southern coast of East Maui. ~~A Draft EIS was released for this project in February 2011~~ and the FEIS approved August 2011 (Tetra Tech EC, Inc. 2011a), the HCP was approved January 2012 and the ITP and ITL were approved February 2012. Four State and Federally listed wildlife species have been identified as having the potential to be adversely impacted by construction and operation of the Auwahi project: the Hawaiian hoary bat, Hawaiian petrel, nēnē, and Blackburn's sphinx moth. Mitigation measures to compensate for the take of these Covered Species at the Auwahi Wind Farm have been developed in cooperation with USFWS, DOFAW, and the ESRC. There is a potential for cumulative impacts to these species from this project.

The ~~proposed~~ construction and operation of the Advanced Technology Solar Telescope at the Haleakalā High Altitude Observatory Site has the potential to impact the endangered Hawaiian petrel. The National Science Foundation prepared a final HCP in October 2010 pursuant to the requirements of the ESA and HRS 195D that estimates incidental take of 35 Hawaiian petrel individuals (30 fledglings and 5 adults) over a six-year period (NSF 2010). An EA to address impacts of the ITL and associated conservation measures was also prepared (NSF 2011).

At a broader scale, KWP II represents one of many projects of various types that can be expected to occur on the Island of Maui. Some of the causes of decline of the Covered Species (such as mammal predation, bright light disorientation, and loss of nesting or roosting habitats) may be on the increase due to continued real estate development on Maui, and will likely continue increasing in the future. Even when conducted in compliance with all applicable local, State and Federal environmental regulations, there is the potential for cumulative impacts to occur from these projects because many do not trigger review under endangered species provisions and thus are not required to meet the "net environmental benefit" standard. By implementing the HCP and amendment, KWP II ensures that the net effects of this project will contribute to the recovery of the covered Species, and thus not contribute to cumulative impacts that may occur as a result of these other developments.

Take for the Hawaiian hoary bat and/or nēnē has been authorized or likely will be authorized on O`ahu, Maui, Kaua`i, and Hawai`i through several HCPs (Table 5.9).

Table 5.9. Take authorizations for Hawaiian hoary bat and goose on Maui, O`ahu, Kaua`i, and Hawai`i (as of June ~~2017~~2018). -*UPDATED*

Permittee	Permit Duration	Location	Species Covered	No. of Permitted Adult Take Over Permit Duration	Projected Permit Term Estimated Take (80% credibility[1])
Habitat Conservation Plan Permits					
KWP I	2006-2026	Mā`alaea, Maui	Hawaiian hoary bat	50	~~43[2]~~44[2]
			Hawaiian goose	60	~~68[2]~~64[2]
KWP II	2012-2032	Mā`alaea, Maui	Hawaiian hoary bat	11	~~48~~38
			Hawaiian goose	30	~~41~~44
Kahuku Wind Power	2010-2030	Kahuku, O`ahu	Hawaiian hoary bat	23	~~33[2]~~29[2]
Kawailoa Wind Power	2012-2032	Haleiwa, O`ahu	Hawaiian hoary bat	60	~~N/A~~222[3]
Auwahi Wind Farm	2012-2037	`Ulupalakua Ranch, Maui	Hawaiian hoary bat	23	~~N/A[3]~~140
			Hawaiian goose	5	5
Kauai Lagoons	2012-2042	Lihu`e, Kaua`i	Hawaiian goose	17	17
Na Pua Makani	pending HCP approval and permit issuance ~~(~~2016-2037~~)~~	Kahuku, O`ahu	Hawaiian hoary bat	51	51
			Hawaiian goose	6	6
Lālāmilo	pending HCP approval and permit issuance 2016-2036	Lālāmilo, Hawai`i	Hawaiian hoary bat	6	6
Pakini Nui	pending HCP approval and permit issuance 2016-2036	South Point, Hawai`i	Hawaiian hoary bat	26	26
			Hawaiian goose	3	3

[1]The take estimate is based on the *Evidence of Absence Software v.1.0 and 2.0* (Huso *et al*. 2015, Dalthorp *et al.* 2017), existing literature, and site-specific data.

[2]Unpublished report to USFWS and DOFAW.

~~[3]Not Available~~

5.3.1 Hawaiian Petrel *–NO CHANGE*

The only other authorized take of Hawaiian petrel on Maui is at the KWP I facility. Since 2006, KWP I LLC has documented three observed direct takes of adult Hawaiian petrels (Kaheawa Wind Power LLC

2008b; First Wind and KWP I LLC 2011). Take authorization for this species is being requested for the ATST and the Auwahi Wind Farm due to the potential for colliding with project components. In order to mitigate impacts to Newell's Shearwaters, ATST has proposed to fence and manage a 328-ac area adjacent to the western perimeter of Haleakalā National Park (NSF 2010). Auwahi Wind Farm has proposed to conduct predator control and monitoring at the Kahikinui Forest Project (Tetra Tech EC, Inc. 2011b). These mitigation efforts are expected to offset the requested take and provide a net benefit to the species. Other developments on Maui with the potential to have cumulative impacts to the Hawaiian petrel include tall structures (communication towers, turbines, etc.), developments with excessive lighting, and developments that decrease nesting habitat.

The proposed mitigation measures described for the Hawaiian petrel are expected to more than offset the anticipated take and contribute to recovery of the species by providing a net conservation benefit, as required by State law. Similar offsets are expected for the ATST and Auwahi Wind Farm, if it is constructed. With the low expected rate of take at KWP II, the proposed mitigation measures are expected to produce a measurable net benefit in the form of a marginal increase in the population of Hawaiian petrels. For this reason, the cumulative impact of take authorized for KWP II combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.

5.3.2 Newell's Shearwater *–NO CHANGE*

The only other authorized take of Newell's shearwater on Maui is at the KWP I facility. To date, no take of Newell's shearwater has been observed at KWP I. Other developments on Maui with the potential to have cumulative impacts to the Newell's shearwater include tall structures (communication towers, turbines, etc.), developments with excessive lighting, and developments that decrease nesting habitat.

Take for Newell's shearwater has also been authorized on O'ahu and Kaua'i (Table 5.9). Mitigation for Kahuku Wind Power on O'ahu consists of colony-based management (fencing and trapping) on Maui or Kaua'i. Social attraction and artificial burrows could also be used to enhance the colony numbers by attracting seabirds to a managed site, safe from predation. The mitigation is expected to offset the requested take and provide a net benefit to the species by contributing knowledge to new management techniques for the species such as social attraction.

Mitigation by KIUC for their Short-term Seabird HCP is comprehensive. It consists of rehabilitating downed seabirds, colony-based management and research and additional take monitoring. The Save our Shearwaters (SOS) Program rescues and rehabilitates downed seabirds that would otherwise have died due to powerline collisions and light attraction. It provides a significant conservation benefit to these seabirds, which supplements KIUC's main mitigation effort which is implementing colony based management. Seabird colony management will occur at Limahuli Valley and Hono o Na Pali Natural Area Reserve. The measures that will be implemented at Limahuli Valley include ungulate proof fencing, ungulate removal, feral cat removal, rodent control, alien plant control, and monitoring the breeding success of the seabirds. Measures to be implemented at Hono o Na Pali Natural Area Reserve include cat-trapping, rodent control, owl removal and monitoring of breeding success of the seabirds. Research initiatives include a two- year auditory survey to locate additional breeding colonies and updating at-sea seabird population estimates. Funds will also be provided to implement an appropriate underline monitoring program.

The proposed mitigation measures described for Newell's shearwater from the various HCPs are expected to more than offset the anticipated take and contribute to the species' recovery by providing a net conservation benefit, as required by State law. The proposed mitigation measures are expected to produce a measurable net benefit in the form of an increase in the species' population by increasing productivity and survival rates of birds through predator control and other management measures such as fencing and ungulate control and supplementary programs such as SOS. The research and development of new management techniques proposed by the different projects will also improve effectiveness of the management of the seabird colonies. The research and development will also have far reaching effects beyond the mitigation measures implemented by any of the Applicants. All the improved management measures will be available to be utilized by most parties involved in the management of Newell's shearwater colonies once developed. This is expected to result in better protection and greater reproductive success and adult survival for many colonies, including those that are currently unmanaged. For this reason, the cumulative impact of take authorized for KWP II combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.

5.3.3 Nēnē *-UPDATED*

~~Authorized take of nēnē is documented at several locations on Maui (Table 5.10). Since 2006, KWP I LLC has documented observed direct take of nine full-grown nēnē (Kaheawa Wind Power 2008b, 2009; First Wind and KWP I LLC 2011). Since 2005, two nēnē fatalities have been documented at Pi'iholo Ranch, while 48 nēnē have been released at this site (DOFAW 2008). Take authorization for this species is being requested for the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components. Other developments on Maui with the potential to have cumulative impacts to nēnē include developments that decrease nesting and foraging habitat, as well as golf courses which may attract nēnē to the area, increasing their vulnerability to vehicular collisions or golf ball strikes (Mitchell *et al.* 2005).~~

~~Proposed mitigation measures for nēnē at KWP II are expected to more than offset the anticipated take and will contribute to the species' recovery by providing a net conservation benefit, as required by State law. Similar offsets can be expected for the Auwahi Wind Farm, if constructed, based on the requirement under State law to provide an overall net environmental benefit for the species. Similar measures are expected for other developments on Maui with the potential to impact nēnē. Given the low expected rate of take at KWP II and the expectation that impacts of any future projects will include mitigation to provide a measurable net benefit for nēnē, the cumulative impact of take authorized for KWP II combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.~~

Incidental take of nēnē has been authorized or requested at several locations on Maui (Table 5.9). Over ~~11~~ 12.5 years, from January~~June~~ 2006 to June ~~2017~~2018, KWP I LLC estimated take of ~~37~~ 64 full-grown nēnē (Kaheawa Wind Power I 2008b, 2009, 2010, 2011, 2013, 2014, 2015, 2016, 2017 and ~~2017~~2018). In the ~~five~~ six years from July 2012 through June ~~2017~~2018, KWP II LLC estimated take of ~~11~~ 14 nēnē (KWP II 2013, 2014, 2015, 2016, 2017 and ~~2017~~2018). From 2005 to 2011, two nēnē fatalities have been documented at Pi'iholo Ranch, while 48 nēnē have been released at this site (DOFAW 2008). From 2011 through ~~2016~~2017, ~~32~~ 46 fledglings have been produced at the Haleakala Ranch pen as part of nēnē mitigation for KWP I (KWP I 2012, 2013, 2014, 2015, 2016 and ~~2016~~2017). Take has also been authorized for this species at the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components but as of FY 2017 no nēnē have been observed injured or killed (Auwahi 2017). Other developments on Maui with the potential to have cumulative impacts to nēnē include developments that decrease nesting and foraging habitat, as well as golf courses, which may attract nēnē to the area, increasing their vulnerability to vehicular collisions or golf ball strikes (Mitchell *et al.* 2005). Since 2008 the estimate of the total nēnē population increased from 1,900 to 2,855 in 2016, a 50 % increase in seven years (NRAG 2017, unpub.).

The projected permit term estimated take for KWP I and KWP II plus the total permitted take for all other projects with available data equal 140 nēnē (Table 5.9).

Proposed and implemented mitigation measures for nēnē at KWP I, KWP II, and Auwahi Wind sites are each expected to more than offset the estimated incidental take either approved or requested, and ~~will~~ contribute to the species' recovery by providing a net conservation benefit, as required by State law. Similar measures are expected for other developments on Maui with the potential to impact nēnē. Given the relatively large increase in the Maui nēnē population in the past seven years and the expectation that impacts of any future projects will include mitigation to provide a measurable net benefit for nēnē, the cumulative impact of take authorized for KWP II combined with previously and future authorized take is not expected to result in a significant cumulative impact to the species.

5.3.4 Hawaiian Hoary Bat -*UPDATED*

The only other authorized incidental take of Hawaiian hoary bats on Maui are at the KWP I facility and Auwahi Wind Farm. As of June ~~2017~~2018, a total of ~~nine~~ eight Hawaiian hoary bat fatalities have been documented within the search area at KWP I; three have been documented at KWP II and ~~13~~ 16 at Auwahi Wind Power (Auwahi Wind Energy LLC, 2014, 2015, 2016 and 2017) (Table 5.10.). The current estimated total bat take from wind energy generation sites on Maui over the last ~~11~~ 12.5 years is ~~81~~ 83 adult bats and for Hawai'i State is ~~169~~ 164 adult bats.

Table 5.10. Documented Fatalities and Total Estimated Take of Hawaiian Hoary Bats Found within the Designated Search Area at Wind Farms in Hawai`i through FY ~~2017~~2018. -*NEW*

Location	Operations Began	Observed Direct Take[2]	Estimated Take (80% credibility[3])
Auwahi Wind Farm (Maui)	December 2012	~~13~~16	**~~36~~42**
Kaheawa I Wind Power (Maui)	June 2006	~~9[4]~~8[4]	**~~31~~28**
Kaheawa II Wind Power (Maui)	July 2012	3	**~~14~~13**
Kahuku Wind Power (Oah`u)	March 2011	4	**~~13~~12**
Kawailoa Wind Power (Oah`u)	November 2012	~~28[4]~~32[4]	**~~59~~69**
Pakini Nui Wind Farm (Hawai`i)	April 2007[1]	3	**N/A**
Total		**~~59~~66**	**~~169~~164**

[1] Observed Direct Take is take found within designated search areas during intensive downed wildlife monitoring.

[2] Data from Kahuku Wind Power, KWP I, and KWP II (2017); Kawailoa Wind Power (2017); Auwahi Wind (2017) and Pakini Nui Wind Power Draft HCP (2016) and USFWS unpublished data.

[3] The take estimate is based on the *Evidence of Absence Software v.1.0 and 2.0* (Huso *et al*. 2015, Dalthorp *et al.* 2017), existing literature, and site-specific data, including indirect take calculated as adults.

[4] One additional bat was found outside of the search area.

Other developments on Maui with the potential to have cumulative impacts to the Hawaiian hoary bat include resort or recreational developments, farming, road construction, pesticide use, and other developments that decrease roosting and possibly prey generating habitat. It is however not known now to what extent these activities will result in any direct or indirect take of the Hawaiian hoary bat.

On O`ahu, take of Hawaiian hoary bats has been authorized for Kahuku Wind Power and Kawailoa Wind Power (Table 5.9). The estimated total take (direct plus indirect take) for these two O`ahu projects as of FY ~~2017~~ 2018 has been ~~72~~ 81 bats over approximately ~~11~~ 12 years (cumulative operations) (Table 5.10). The Na Pua Makani Wind Farm draft HCP has ~~recently~~ been ~~recommended for approval~~ approved by the ~~ESRC~~ Hawai'i state Board of Land and Natural Resources and requests incidental take authorization for 51 Hawaiian hoary bats on O`ahu over a 21-year period (Na Pua Makani 2016). Mitigation for these projects consists of funding for research and for appropriate management measures. Lālāmilo and Pakini Nui Wind Farms on Hawai`i Island also have draft HCP's in review and both include Hawaiian hoary bat take authorization requests of six and 26 bats, respectively (Lālāmilo 2016, Pakini Nui 2016). These requests cover take that would occur over a 20-year period.

Research was the main component of KWP I mitigation due to the need for research to help determine basic life history parameters and identify effective management measures, which in turn helped guide future management and recovery efforts. Kahuku Wind Power, Auwahi Wind Project and KWP II so far have mitigated for bats for originally permitted take by restoring forest habitat on Maui to increase or improve bat foraging and roosting habitat (see Appendix 29). Future mitigation Mitigation by KWP II and Auwahi Wind Farm will funds further bat population and ecology research on Maui and eventually may include additional habitat restoration or land conservation. Planned bat Bat population and ecology research will provides direct insight to inform future mitigation measures for wind sites on Maui that may include habitat restoration or land acquisition. The forest restoration efforts currently underway for originally permitted take are expected to increase survival and reproductive success to fully offset take and provide a net benefit to the species.

Kawailoa Wind Power's current mitigation for the anticipated take of Hawaiian hoary bat on O`ahu also contributes to restoration of native bat habitat at U'koa Wetland, includes a research component and is anticipated to have similar benefits (Kawailoa Wind Power HCP 2011). Similar mitigation measures are expected for Na Pua Makani Wind Farm on O`ahu and Lālāmilo and Pakini Nui Wind Farms on Hawai`i.

The Hawaiian hoary bat is considered in the USFWS Recovery Plan (1998) to be a species managed statewide and not currently managed by unique island recovery zones. However, Hawai`i state law 195D does consider impacts on an island basis. Cumulative impacts are considered for the species on a statewide basis and for Maui alone. Considering the current available take estimates from wind energy generation sites, potential amendments to currently approved federal and state take permits and wind generation sites that are likely to apply for take permits, the total projected take of bats at a conservative 80% credibility level in Hawai`i may be at least up to 264 556 adult bats over 20- to 21-year permit periods and 91 222 adult bats for Maui alone (Table 5.9). New projected take estimates for the total permit term for Kawailoa and Auwahi Wind Farms have not been made publicly available.

Most basic demographic parameters typically used to model population viability are not known for most bat species (Frick *et al.* 2017) including the Hawaiian hoary bat. These parameters include population size, ratio of males to females, annual birth rate, survival to weaning, survival to first reproduction, survival rate of adults by age, longevity, and sources of mortality. Consideration of the impact on Hawaiian hoary bats from wind energy operations and the species' viability is only possible using demographic parameters assumed from other bat species. Nonetheless, If if annual growth rate of the species is assumed as 1% of the total population of adults (Frick *et al.* 2017) and a 20–year period is considered, the starting population before any take had has occurred would have to be at least 1,3002,700 adults statewide or 1,100 adults in Maui alone to end up with a net gain of more than 264 and 91 adult bats, respectively to offset the proposed take after 20 years. Although the population size is unknown and will likely never be known, 1,3002,700 adults statewide is a relatively small population size necessary to sustain the impact of the take from all of the wind farms operating or planned to be operating in Hawai'i.

6.0 MITIGATION FOR POTENTIAL IMPACTS AND SELECTION OF MITIGATION MEASURES - *UPDATED*

The proposed mitigation program for KWP II was influenced greatly by the approved mitigation program for KWP I and the data that has been collected by KWP I biologists since operations commenced. In coordination with biologists from DLNR and USFWS, the Applicant will build upon the existing KWP I mitigation program, or perform other appropriate mitigation measures, to achieve the biological goals and objectives identified in Chapter 4.

The following principles were followed in selecting the proposed mitigation measures:

- The level of mitigation in general should be commensurate with the level of requested take for required tier and provide a net benefit to the species and increase the likelihood of recovery of the endangered or threatened species that are the focus of the HCP.
- Mitigation should be species-specific and, to the extent practicable, location or island-specific.
- Mitigation measures should be practicable and capable of being done given currently available technology and information.
- Mitigation measures should have measurable goals and objectives that allow success to be assessed.
- Mitigation measures should be consistent with or otherwise advance the strategies of the respective species' draft or approved recovery plans.
- Mitigation measures that serve to directly "replace" individuals that may be taken (e.g., by improving breeding success or adult and juvenile survival) are preferred, though efforts to improve the knowledge base for poorly documented species also have merit, particularly when the information to be gained can benefit future efforts to improve survival and productivity.
- Off-site mitigation measures to protect breeding or nesting areas for birds, and roosting areas for bats, located on otherwise unprotected private land are preferred over those on public land, and sites on State land are preferred over those on Federal land.
- Measures to decrease the level of take resulting from a private activity unrelated to the project (e.g., rescue/rehabilitation of downed seabirds outside the project area as a result of disorientation by outdoor lights not related to the proposed project) may be considered if agreed upon by the agencies.
- Alternate or supplemental mitigation measures should be identified for future implementation if monitoring shows the level of take is found to be higher (or lower) than anticipated. See Appendix 26 for further information on triggers and timelines for contingencies and Tier 2 mitigation.

The following sections provide details of the measures proposed, and these are summarized in Table 1.2 and 1.3 (these replace Table 6.1 and 6.2 found in the original KWP II HCP). The estimated cost for each measure is presented in Appendix 6. Should alternate mitigation measures or locations be identified or otherwise become available that would present the Applicant with a greater chance of meeting the biological goals and objectives of this HCP, the Applicant reserves the right to propose such alternate mitigation instead of the measures identified below if such mitigation receives approval from the USFWS and DLNR. All mitigation measures chosen for the project ~~will be~~ are subject to review by DLNR and USFWS over the lifetime of the project and may be modified or continued without modification, depending on measured levels of take and the success of mitigation measures, and as agreed upon by the Applicant, USFWS and DLNR. As discussed, the Covered Species considered to have potential for additional incidental take beyond what was authorized in the original HCP ITP/ITL during operation of the KWP II project include the nēnē, and Hawaiian hoary bat. The mitigation proposed to compensate for impacts to these species is based on anticipated levels of incidental take and includes additional mitigation for loss of productivity for nēnē that may be required because of delayed mitigation as determined through on-site surveys, modeling, and the results of post-construction monitoring. Lost productivity is defined as future offspring that would have been produced if adult nēnē would have survived in subsequent years.

KWP II intends to mitigate fully and in a timely manner for all lost productivity for nēnē, with the understanding that delay in mitigation will result in continued compounding of required mitigation. The USFWS, DLNR and KWP II agree that timely mitigation for all lost productivity is required but that any additional mitigation required because of delay will not accrue against permitted authorized incidental take. The USFWS and DLNR have recommended that mitigation begin to replace lost productivity concurrently with the mitigation for direct take.

Once total estimated adjusted take has reached 75% of its current Tier, planned and agreed-upon mitigation for the next Tier will be initiated and funding assurances, if insufficient, for the next Tier will be established.

Tier 1 and Tier 2 Mitigation for Covered Species

Possible rates of incidental take for all species discussed in this document have been identified as "Tier 1," and "Tier 2." These take levels were previously defined in Section 5.2. Initial yearly mitigation efforts are designed to compensate for requested take at the 20-year Tier 1 level. Total adjusted take as estimated through post-construction monitoring is used to determine which tier take is occurring at and the necessary levels of mitigation required to achieve mitigation success.

The proposed seabird and nēnē mitigation includes funding measures intended to increase populations of these species. Measures intended to increase seabird population sizes will generally be aimed at eliminating predation through exclusion and/or eradication of predators from a breeding area. Reducing or eradicating predators can dramatically increase adult and juvenile survival, leading to increased productivity, (e.g., Ebbert and Byrd 2002; Pascal *et al.* 2008; Hu *et al.* 2001; Hodges and Nagata 2001), thus compensating for any individuals that may be incidentally taken by the project.

The Applicant proposes to provide Nēnē mitigation primarily by improving survival and productivity of the existing nēnē populations ~~at a release pen or at Hanaʻula and the KWP I project areas~~ through predator control on Maui at the Pi`iholo Ranch release pen, Maui (Appendix 31). This will enhance efforts to establish separate breeding populations on Maui as recommended by the Draft Revised Recovery Plan for the species (USFWS 2004a).

Mitigation for the Hawaiian hoary bat consists of funding studies intended to provide a better understanding of the status and distribution of the species on Maui in order to facilitate future State, Federal, or private conservation and management efforts (Appendix 29). Funding also has been provided to restore native plant habitat to increase foraging or roosting sites for the Hawaiian hoary bat. The estimated cost for each measure for the Covered Species is presented in Appendix 6. As mitigation efforts may occur on State land for any of the Covered Species, all required permits will have been obtained before any mitigation measures commence.

Because authorized take of some of the Covered Species has the potential to occur early in the project, but the benefits expected from mitigation efforts would not be fully realized until some later point in time, it is possible that take could occur before mitigation measures have allowed for increases in productivity. This would result in a lag between the time of incidental take and intended replacement, possibly resulting in a slight loss of productivity by the species over that time. Therefore, the proposed levels of mitigation are also intended to compensate for possible loss of productivity by incidentally taken sexually mature adult birds for the anticipated lag-period.

Results of post-construction monitoring is used to determine annually whether take is occurring at Tier 1, Tier 2 or higher rates. In general, mitigation efforts are adjusted to compensate for the requested take at the required tier.

The Applicant has coordinated with USFWS and DLNR when Tier 2 rates of take occurred in order to adjust mitigation efforts accordingly and to implement adaptive management measures. Sections

5.2.2.4, 5.2.3.4, 5.2.4.4, and 5.2.5.3 identify the rates of take that are considered "Tier 2" for each species, as well as the amounts of time considered necessary to determine those rates. ~~If Tier 2 mitigation is initiated, these mitigation measures will be completed, even if monitoring indicates that take has fallen back into Tier 1 levels.~~

Proposed Tier 3 and Tier 4 Mitigation for the Hawaiian Hoary Bat and Nēnē -*NEW*

Proposed Tier 3 and Tier 4 mitigation measures are identified in Sections 6.4.4 and 6.5.3 to compensate for the additional requested take for the Hawaiian hoary bat and nēnē. Mitigation measures for both species build upon the mitigation measures identified above.

6.1 Wildlife Education and Observation Program *-NO CHANGE*

A wildlife education and observation program (WEOP) will be implemented for all regular on-site staff to minimize project-related impacts to listed species and other wildlife. The program will be long-term, on-going, and updated as necessary. Staff will be trained to identify listed and non- listed species of birds and other wildlife that may be found on-site, to record observations of native species protected by the ESA and/or MBTA, and to take appropriate steps when and if dead or downed wildlife is found. A plan for the WEOP is attached in Appendix 4. As part of their safety training, temporary employees, contractors, and any others that may drive project roads will be educated on speed limits, the possibility of downed wildlife being present on roads, and the possibility of nēnē presence on the ground or flying low across roads. Personnel will be instructed to contact the Site Environmental Compliance Officer immediately if they detect any downed wildlife on-site.

6.2 Downed Wildlife Protocol *-NO CHANGE*

The protocol for the recovery, handling, and reporting of downed wildlife will follow that developed for Kaheawa Pastures Wind Energy Generation Facility (Kaheawa Wind Power LLC 2006) or other protocols approved by USFWS and DLNR. This protocol was developed in cooperation with DLNR and USFWS. All regular on-site staff will be trained in the protocol which will include documenting all observed mortality or injury to wildlife (including MBTA-protected birds not otherwise covered by this HCP).

Any State or Federally listed species found dead or injured in the project area will be handled in accordance with the approved protocol. Injured State or Federally listed species will be photographed from a discrete distance and monitored until collection by an authorized individual. The Maui Wildlife Program manager at DLNR and the Fish and Wildlife Biologist at USFWS will be notified within 24 hours by phone and written notification will be provided within three calendar days upon discovery of any injured or dead Covered Species. All (covered and non-covered) species will be documented in accordance with approved protocols; collections will be made only by staff personnel permitted by USFWS and DLNR to handle and salvage wildlife. Injured individuals or carcasses will be handled according to guidelines in Appendix 2 and 14 of the HCP.

6.3 Petrels and Shearwaters *-NO CHANGE*

The major threats identified for Hawaiian petrels and Newell's shearwaters are: 1) introduced predators, which can prey on adults, eggs and fledglings; 2) feral ungulates, 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). Predation has been shown to have significant negative effects on fledging success for the Hawaiian petrel (Hodges 1994; Hodges and Nagata 2001; Hu *et al.* 2001; Telfer 1986) and predation on adults of both species has also been documented (Simons 1983; Ainley *et al.* 2001). In Haleakalā National Park, Hodges and Nagata (2001) identified predation as accounting for 41% of total terrestrial mortality (adults, fledglings, and eggs) in cases in which a cause of death could be determined. Predation mortality was attributed to cats and mongooses (38%), rats (41%), dogs (14%) and owls (6%) (Hodges and Nagata 2001). Human-related causes (road-kills, collapsed burrows, collision with structures) accounted for 49% of all mortalities, with natural causes accounting for the remaining 10%. It is expected that the causes of Newell's shearwater mortality in connection with the on land portion of their lives, are similar to those of the Hawaiian petrel due to their similar reproductive strategies and the pervasiveness of these threats, and as documented on Kaua'i (Telfer 1986, Ainley *et al.* 2001).

Nesting success rates can vary greatly from year to year and are probably dependent upon many environmental factors. Data from Hodges (1994), Hu *et al.* (2001), and Hodges and Nagata (2001) show that predator control (trapping and fencing) generally results in a significant increase in Hawaiian petrel nesting success as shown in Table 6.2.

Table 6.3. Comparison of Hawaiian Petrel Nesting Success (Percent Nests that Successfully Fledge a Chick) With and Without Predator Control. *-NO CHANGE*

Location	Year(s)	Nesting success (%)		Reference
		W/o predator control	W/ predator control	
Haleakalā, Maui		42.0	57.0	Hodges 1994
Mauna Loa, Hawai'i	1995-96	41.7	61.5	Hu *et al.* 2001
Haleakalā, Maui	1982	0.0	32.7	Hodges and Nagata 2001
Haleakalā, Maui	1990	10.0	49.2	Hodges and Nagata 2001
Haleakalā, Maui	1991	25.6	48.6	Hodges and Nagata 2001
Haleakalā, Maui	1992	15.2	17.0	Hodges and Nagata 2001
Haleakalā, Maui	1993	32.8	38.2	Hodges and Nagata 2001
Haleakalā, Maui	1994	44.0	23.0	Hodges and Nagata 2001
Haleakalā, Maui	1995	31.8	50.0	Hodges and Nagata 2001
Haleakalā, Maui	1996	28.1	46.7	Hodges and Nagata 2001
Unweighted Average		27.1	42.4	

In addition to the identified threats, a major factor limiting the ability to manage Hawaiian petrel and Newell shearwater colonies are the remote areas to which their populations have contracted since the advent of introduced predators and human development. This makes ungulate and predator management difficult (Mitchell *et al.* 2005). One method for increasing protection is by attracting first-time breeders to new colonies in accessible areas that are well situated for management. Seabird attraction to specific areas can be achieved by broadcasting audio play- backs of vocalizations of conspecifics. This technique has been shown to increase site prospecting, occupancy, and has led to successful breeding in a wide range of species of seabirds (Gummer 2003), including the Galapagos petrel (*Pterodroma phaeopygia*), Podolsky and Kress 1992), which is very closely related to the Hawaiian petrel, the Laysan albatross (*Phoebastria immutabilis,* Podolsky 1990), which also breeds in Hawaii, and the Bermuda petrel (*Pterodroma cahow*, Dobson and Madeiros 2009), and a large number of additional seabird species in New Zealand (Steve Sawyer pers. comm.).

6.3.1 Tier 1 Mitigation *-NO CHANGE*

The proposed Tier 1 mitigation for seabirds is designed to meet Tier 1 mitigation requirements for KWP II as well as KWP I per amendment submitted to DOFAW and USFWS in October 2011. The seabird mitigation plan follows a similar approach for both species, and for each species consists of establishing a new colony by enclosing an area with a predator (dog, cat, mongoose, rat)-proof fence, installing 50 artificial burrows, and broadcasting audio playbacks of conspecific calls (i.e., social attraction) to draw birds to the fenced area. This social attraction project will be implemented at Makamakaʽole, West Maui (Figure 3.1, Appendices 11 and 22).

6.3.1.1 Hawaiian petrel

Makamakaʽole was identified as a possible Hawaiian petrel nesting site in 2007 by First Wind biologists based on observations of Hawaiian petrel activity in the area. This finding was corroborated by seabird biologists from DOFAW (Fern Duvall), USGS (Josh Adams), and H.T Harvey and Associates (David Ainley). In 2010, after consultation with DOFAW and USFWS, First Wind carried out an assessment of the site to determine the extent of petrel activity. The assessment consisted of audio-visual point counts (June-August), radar surveys (June-August), Burrow searches (May-October), and a feasibility assessment for the construction of a pest-proof fence at the site (July 2011). Significant Hawaiian petrel passage rates and calling activity, including circling and paired flights were documented, but only a single, unoccupied burrow was found at the site. In July 2011 a canine team from Ecoworks, based in New Zealand, was brought in with two specially trained dogs, to help find Hawaiian petrel burrows at Makamakaʽole. After a very comprehensive search effort the team identified three old, disused burrows and one Hawaiian petrel carcass that was estimated to be several months old (Steve Sawyer pers. comm.).

The Ecoworks team concluded that:

- Makamakaʽole is a historic nesting site. No birds appear to maintain active nest sites.. Several razorback ridge areas contain evidence that resembles typical petrel nesting sites in New Zealand as well as on Kauaʽi (David Ainley pers. comm.). Peat type, soil mounds, old burrow remnants, fern habitat, ridges with optional landing and takeoff aspects all are very similar.
- Based on four nights of visual observations in 2011, Hawaiian petrels continue to congregate in the airspace above Makamakaʽole Valley even though no active burrows were found.
- Hawaiian petrels travel up the Makamakaʽole Stream from the sea a historic staging area where aerial courtship is facilitated by updrafts created as winds collide with a 350 ft. vertical rock face. Petrels do a considerable amount of aerial courting (pers.com Dr Nicholas Carlile), i.e., Grey-faced petrels at Nicks Head, Collared petrels at Waitambua, and Taiko at Awatotara Valley/Lower Tuku, New Zealand; it is also comparable to behavior observed at Haleakala and Lanaʽi adjacent to petrel breeding sites (David Ainley, pers.obs.).
- There is likely to be a remnant Hawaiian petrel colony somewhere in the Makamakaʽole – Kahakuloa watershed, highly likely to be several thousand ft. above sea level and very difficult to access, manage or protect sufficiently.
- Some of these juvenile birds probably land at Makamakaʽole and begin to excavate burrows. However these birds are highly likely killed by mongoose or feral cat in a short time as their searching for cavities or suitable burrowing sites is quite noisy (David Ainley, pers. obs, Haleakala).
- A total of 11 mongoose were trapped in two traps during 12 trap nights using two traps in July 2011, and there was sign of pig and cat activity in the area. These catch rates for mongoose appear substantially higher than areas known to contain dense habitation by mustelids and other pest vertebrates in New Zealand. Coupled with evidence of the only active nest site in the area containing remains of Hawaiian petrel, it suggests that the chances of a bird surviving even a short period of time on the ground at Makamakaʽole is extremely low.
- Based on the density of mongoose at lower elevations in Hawaii it is unlikely that predator control alone is going to be enough at lower altitudes (0-2,500 ft asl) to protect any nesting Hawaiian petrel or Newell's shearwater (Steve Sawyer & Tim Day, Xcluder pers. comm).

In addition to the conditions at the sites where remnant nesting locations in the Makamakaʽole-Kahakuloa watershed may be located, making effective management exceedingly difficult, locating these specific areas is likely to be very difficult even with dogs on the ground as current work with the Fiji petrel shows (Nicholas Carlisle pers. comm.). Using methods to shift the colony from these remote, unmanageable areas to sites in which threats to nesting seabirds can be kept to a minimum is an important tool to protect the Hawaiian petrels nesting on West Maui.

6.3.1.2 Newell's shearwater

Based on radar information and documented flight calls at Makamakaʻole and vicinity (see also Cooper & Day 2003), it was determined that the area was within an important flight route for Newell's shearwater flying to nest sites higher in up in the watershed. Cooper & Day (2003) detected only 51 radar targets they interpreted as Newell's shearwater, a very low number compared to Hawaiian petrel on Maui or Newell's shearwater on Kauaʻi. Maui SOS data indicate that Newell's shearwater fallout is decreasing, similar to the historic pattern on Kauaʻi where the population has decreased 75% over the past few decades (Ainley *et al.* 2001, Holmes 2010).
Therefore, the species' numbers are very low on Maui and likely decreasing.

A survey in 2007 along the Eke trail revealed the presence of a potential nesting site within the upper Kahakuloa section of the West Maui Natural Area Reserve (NAR) with an estimated 20-30 birds calling and exhibiting attendance (Greg Spencer pers. comm.). Subsequent attempts to fine- tune the specific location of the suspected colony and locate the nesting burrows in 2011 proved to be challenging due to the Natural Area Reserve System's concerns about impacts to existing resources, and prevailing weather conditions that almost always inhibit access to the site. Thus far, First Wind has made five helicopter flights to the site, and was forced to cancel a number of additional scheduled flights, but have not yet been able to land. Consequently, should nesting occur at the site, it is possible management actions that would provide adequate protection for prospecting sub-adults and breeding adults may not be feasible due to inaccessibility. The upper Kahakuloa area is currently the only documented site that represents a possible nesting colony for Newell's shearwaters in West Maui. Based on the location of Makamakaʻole relative to the upper Kahakuloa site, its demonstrated location within the suspected flight paths of Newell's shearwater (section 2.4.2), Makamakaʻole is considered an ideal site for the proposed enclosure and social attraction project. Using methods to shift the colony from these remote, unmanageable areas to sites where threats to nesting seabirds can be kept to a minimum is an important tool to protect the few Newell's shearwaters left nesting on West Maui.

6.3.1.3 Hawaiian petrel and Newell's shearwater Passage Rates Over Makamakaʻole

Radar surveys were conducted at Makamakaʻole from May through September 2010. Given that Hawaiian petrel and Newell's shearwater targets cannot be reliably differentiated by radar, the radar targets are proportioned out as 90% Hawaiian petrel and 10% Newell's shearwater based on the most recent analysis of inland seabird passage rates over West Maui (Cooper *et al.* 2011, Appendix 23). Auditory point count surveys at Makamakaʻole were conducted mainly in July 2010. Auditory surveys were also conducted at Kahakuloa in May 2007 to detect Newell's shearwaters. Follow up auditory surveys were conducted in June 2011, at a slightly lower elevation site. These data are used to estimate the potential numbers of birds that may fly over the site and be potential immigrants to the new colony established by social attraction.

Hawaiian petrels

Auditory and visual surveys have documented Hawaiian petrels circling over Makamakaʻole during the breeding season. Call activity rates in July ranged from 0 – 50 calls/5 minutes, with peak activity occurring around 20:00 to 20:30. The average call rate over the site was 17 calls/5 min and Hawaiian petrels and activity remains high in the area for approximately 2 hours from 19:30 to 21:30. A similar pattern is apparent at Haleakala (David Ainley pers. comm.).

Radar data collected at Makamakaʻole, give an indication of the number of birds that may be in the area in one night. The identity of these birds was confirmed by infra-red imaging. Up to 42 individual Hawaiian petrel targets were documented flying inland to the site in a single night, with the site averaging approximately 26 Hawaiian petrel targets during the survey period. Based on long-term observations, up to 75 Hawaiian petrels are estimated to have been in that area at any one time (Greg Spencer pers. comm.,2010). The population of Hawaiian petrel in the existing colony in the vicinity of Makamaka'ole is assumed to be approximately 600 pairs. This is a crude estimate based on the fact the up to 75 Hawaiian petrels have been observed circling and calling, including pair formation, at times, in the valley next to the proposed site of the predator exclosures. It is assumed that these birds represent roughly 10% of the expected colony size (N. Holmes pers. comm.)

The radar and auditory data provide strong evidence that sufficient numbers of birds fly over Makamaka'ole to support the number of immigrants needed for successful social attraction at the site.

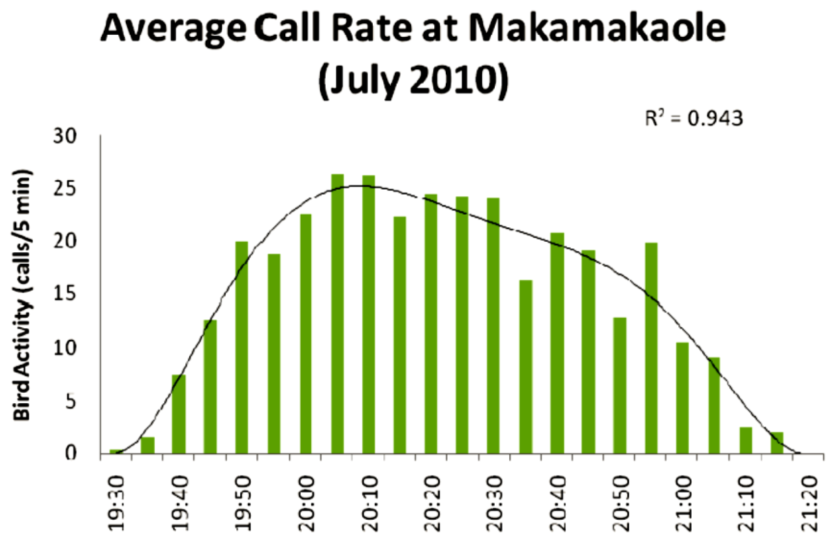


Figure 6.1. Average Hawaiian Petrel Call Rates at Makamaka'ole, July 2010. -*NO CHANGE*

Date	Total targets	Number of Hawaiian petrels (90% of total)	Number of Newell's shearwaters (10% of total)
5/28/2010	20	18	2
5/29/2010	45	40.5	4.5
5/30/2010	42	37.8	4.2
7/6/2010	14	12.6	1.4
7/7/2010	39	35.1	3.9
7/8/2010	35	31.5	3.5
7/9/2010	29	26.1	2.9
8/9/2010	37	33.3	3.7
8/10/2010	47	42.3	4.7
9/6/2010	10	9	1
9/7/2010	26	23.4	2.6
9/8/2010	18	16.2	1.8
9/9/2010	19	17.1	1.9
Average	29.3	26.4	2.9

Table 6.4. Radar data from Makamaka'ole. -*NO CHANGE*

Newell's shearwater

Presently, there are no direct data on what the population of Newell's Shearwater might be on west Maui owing to the extremely rugged terrain and unyielding bad weather, which has precluded surveys within the period during which the shearwaters are most vocally active. Therefore, a current best estimate of population size is based on indirect means.

In Cooper & Day (2003) the radar detection rates of Newell's shearwaters and Hawaiian petrels are given for surveys conducted in June 2001 (Fig. 2.2). For the 6 sites around west Maui, detection ranged from 0.4 to 21 birds/hr., or 1 to 62 birds per night (data collected during first 3 hours of each night). Cooper & Day (2003) concluded that shearwaters and petrels may use specific 'corridors' for accessing their breeding colonies. It's possible that the same colony could be accessed by more than one corridor on west Maui, where all valleys converge toward the summit. Certainly, this is true for sure for Hawaiian Petrels based on their data around east Maui/Haleakala. For the section of the coast containing Makamaka'ole, detection ranged 5.6 to 21/hr. Total for 3 sites in that area ('Iao, Waihe'e, Kahakuloa) was 48 birds/hr. (Newell's shearwaters in remainder of west Maui were negligible). Cooper & Day (2003) also concluded that any detections that occurred 60 min past sunset were likely Newell's shearwaters, although in their visual detections they only saw Hawaiian petrels. Their summary of the proportion of detections that they assigned to Newell's shearwaters and Hawaiian petrels is given in Figure 6.2. On the basis of their estimate, where 25 to 50% of detections were Newell's Shearwaters (average of 30% for the 3 sites), then, the detection rate for Newell's shearwaters in the north-east portion of west Maui, in 2001, ranged from 2 to 7birds/hr. or 6 to 21 Newell's shearwaters per night (bracketing Makamak'ole, between Kahakuloa and Waihe'e); or assuming that Newell's shearwaters detected at all 3 sites were all heading for the same colony, then 32 birds/hr. or 96 birds in a night.

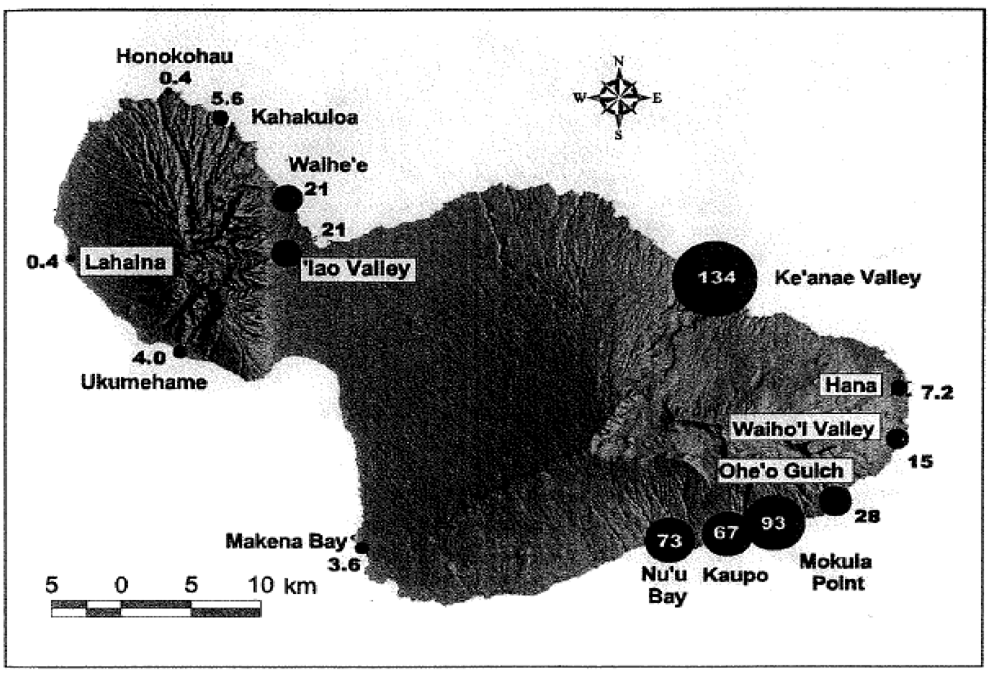


Figure 6.2. From Cooper & Day (2003). Radar detection rates, birds/hr, for the first three hours of night on surveys conducted 7-21 June 2001. -*NO CHANGE*

Based on work at Haleakala during 2008-11 (by Adams (2008), Ainley *et al.* David Ainley pers. comm.), it is known that Hawaiian petrels bring fresh food to their nestlings at all hours of the night, even up to 0430 (just before dawn). In other words, the petrels do not fly around the colony for hours before entering their burrows. Therefore, the assumption is made in the present analysis that

1/3 of what Cooper and Day (2003) thought were Newell's shearwaters actually were Hawaiian petrels (see their Figure 6.2). The detection of Newell's shearwaters in the north-east portion of west Maui in 2001 would therefore range 4-14 birds per night, bracketing Makamaka'ole, or 64 birds per night if Newell's shearwaters detected at the 3 NE west Maui sites were all headed for the same colony. Assuming that very few Newell's shearwaters arrived later than the first 3 hours of the night (probably a few arrived later but not many), the radar data indicate that these figures estimate the number of Newell's shearwaters flying to the colony(ies) of NE west Maui each night in June 2001.

During detection surveys at Makamaka'ole in 2010-11, 1-3 Newell's Shearwaters were heard flying up slope during the first 3 hours of each night in June-July (this is not birds/hr.); maximum was 13 vocal detections of Newell's Shearwaters in one night (FirstWind, unpubl. data). This is fewer by a third of what was detected by Cooper & Day (2003) 10 years earlier, either side of Makamaka'ole Valley. And a reduction in population size is consistent with the DOFAW Maui SOS data. According to Brenda Zaun (USFWS, pers. comm.), on the basis of electronically monitoring arrival and departures of Newell's shearwaters in burrows at Kilauea Pt NWR, at least one adult Newell's Shearwaters, and usually just one, visits its chick each night. Therefore, the number of detections at west Maui would be equivalent to the number of breeding Newell's shearwater pairs.

The overall conclusion is that at least 40, and no more than 100 pairs of Newell's shearwaters still nest in west Maui, and are confined to the NE portion that contains Makamaka'ole.

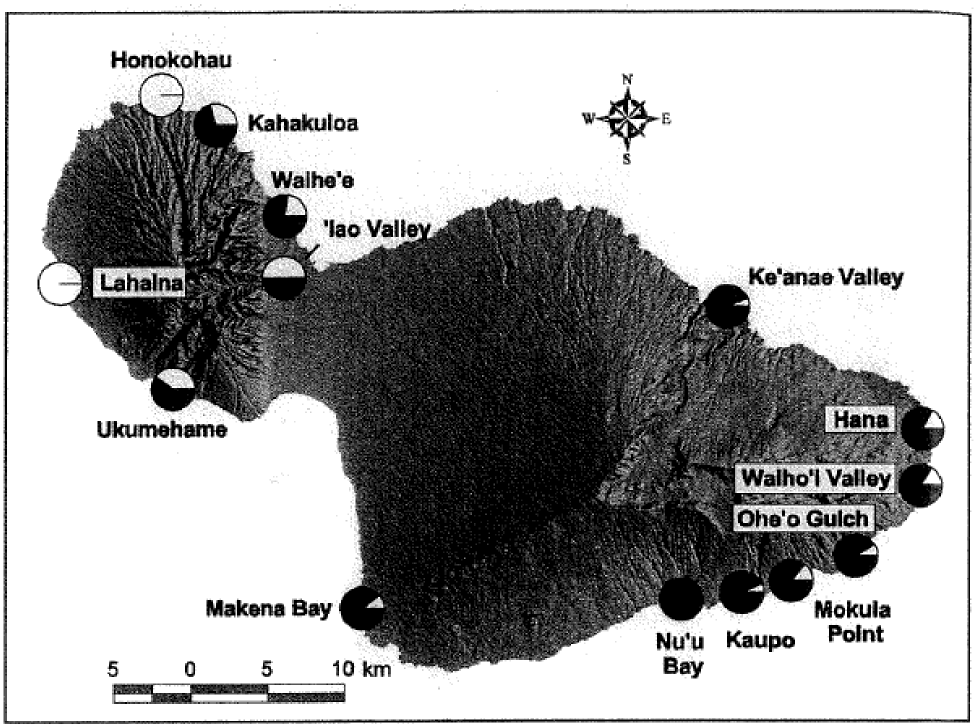


Figure 6.3. From Cooper & Day (2003). Radar targets by species. Pie charts showing the proportion of Newell's Shearwaters (white) and Hawaiian Petrels (dark) thought to compose the targets detected by radar, 7-21 June 2001. Distinguishing Newell's Shearwaters from Hawaiian Petrels was done only under the assumption that detections after 60 min after sunset were Newell's Shearwaters. -*NO CHANGE*

Table 6.5. Newell's Shearwater Auditory Data. -*NO CHANGE*

Date	Total calls	Total individuals detected	Comments
6/26/2010	1	1	
7/6/2010	2	2	1 observation from radar location
7/7/2010	7	7	1 observation from radar location
7/8/2010	16	13	at least 10 discrete observations from 1 point count station
7/9/2010	1	1	1 observation from radar location
7/15/2010	1	1	
7/27/2010	3	3	
8/3/2010	1	1	

A maximum of 13 individuals were recorded flying over Makamakaʽole during auditory point count observations in 2010. Newell's shearwaters were detected (based on auditory observations) eight days out of the 14 days that auditory point count surveys were made. Radar data at Makamakaʽole estimate that 1 to 5 individuals may fly over the site on any given night; this estimate is supported by the auditory detections.

These data strongly suggest that sufficient numbers of Newell's shearwaters fly over Makamakaʽole to be good candidates to be immigrants to the social attraction site.

6.3.1.4 Social attraction and artificial burrows

Ground-nesting and burrowing seabird species can be encouraged to nest at a prospective site by the placement of artificial burrows accompanied by vocalization play-backs. This increases the density of nesting pairs in the area which in turn attracts more individuals and ultimately allows for more effective management (Podolsky and Kress 1992). Artificial burrows may also be positioned in a manner that facilitates monitoring. So far, the use of artificial burrows has been attempted with some success for Newell's shearwaters at Kilauea Point National Wildlife Refuge on Kauaʽi (Joyce *et al.* 2008; U.S. Fish and Wildlife unpubl. data). These techniques have shown considerable success for an increasing number of ground-nesting seabird species at several locations in the Pacific and Atlantic Oceans. The Action Plan for Seabird Conservation in New Zealand states that colony establishment and enhancement is expected to contribute long-term conservation benefit to threatened seabird taxa (Taylor 2000a, 2000b). According to Hawaii's Comprehensive Wildlife Conservation Strategy, while protecting seabird populations and their breeding colonies remains an important management priority, re-establishing former (or even remnant) breeding colonies is also important to reduce the risk of eventual extinction (Mitchell *et al.* 2005).

For colonial seabird species, the presence of breeding birds in suitable habitat is attractive to additional nesters, presumably because it is a strong indicator that a site is safe and productive. Social attraction uses this behavior to lure seabirds to historic or safer breeding areas by using a combination of social cues that encourage colonization. Cues can be visual (decoys, mirrors) or acoustic (sound playback systems) depending on the nesting habits of the target species. Acoustic attraction is particularly important for nocturnal species. For example, in a project to attract Leach's storm-petrels using vocalizations, 70% of birds nested within 50 cm of a loud speaker compared with only 16% nesting three or more meters from speakers (Podolsky and Kress 1989b). Broadcasting calls from multiple birds (indicating a large colony) and using a complete set of typical colony sounds appears to attract the most birds (Podolsky and Kress 1989b; Podolsky and Kress 1992). This technique is well proven by over a dozen projects accomplished in New Zealand.

Artificial nest boxes are commonly used in conjunction with vocalizations to increase the availability and quality of nesting sites. They provide easy access to nests by prospecting birds, and subsequently are useful for monitoring; they can be modified to exclude larger, more aggressive seabird species and may decrease incidents of egg predation (e.g., from common mynas). Furthermore, some species have higher breeding success in artificial nest boxes than in natural nests (Priddle and Carlisle 1995; Bolton *et al.* 2004). Band-rumped storm-petrels, dark- rumped petrels, Newell's shearwaters, and wedge-tailed shearwaters have all nested successfully in artificial structures (Byrd *et al.* 1983; Podolsky and Kress 1989a; Bolton *et al.* 2004, Brenda Zaun USFWS pers. comm.), as have a multitude of seabird species elsewhere, including alcids, petrels, and shearwaters.

Social attraction has been used to successfully establish colonies of colonial waterbird species throughout the world (Kress and Nettleship 1988; Gummer 2003). The earliest successes were with terns (Laridae) (Kress 1983), but successes are also reported for albatross (Diomedidae), several species of shearwaters (see below), *Pterodroma* petrels ((Podolsky and Kress 1989a, Podloski and Kress 1992, Kress 1990, Sawyer and Fogle 2010, Miskelly *et al.* 2004), murres (Alcidae) (Kress and Borzik 2002), Cassin's auklets (Pyle 2001), rhinoceros auklets (www.Oikonos.org) and storm-petrels (Hydrobatidae) (Podolsky and Kress 1989b).

Podolsky and Kress (1992) were able to demonstrate the attraction of Galapagos petrel (*Pterodroma phaeopygya* - previously known as the dark-rumped petrel,) to playbacks of vocalizations demonstrating the potential of social attraction to establish new colonies. Evidence of breeding was discovered two years into the project (Kress 1990). At Nick's Head Peninsula, New Zealand calls of six pelagic seabird species were broadcast in 2005. After three years, grey-faced petrels (*Pterodroma macroptera*) successfully nested at the site (Sawyer and Fogle 2010) and fluttering shearwaters (*Puffinus gavial*) were observed in burrows. More recently social attraction of shearwaters and petrels in New Zealand has been successful at establishing breeding pairs (Sawyer pers. comm.). An attempt to establish colonies of common diving petrels (*Pelecanoides urinatrix*), fairy prions (*Pachyptila turtur*), fluttering shearwaters and white-faced storm-petrels (*Pelagodroma marina*) on Mana Island, New Zealand was successful in attracting three species to the target site (59 diving petrels, 2 fairy prions and 2 white-faced storm-petrels) (Miskelly *et al.* 2004). However, there were no breeding attempts after three years of attraction so a translocation program was initiated for common diving petrels and fairy prions. The combination of methods resulted in successful colony establishment (Miskelly and Gummer 2004; Miskelly and Taylor 2004). In Hawai'i, calling stations have been installed in order to re-establish breeding colonies of Bulwer's petrels, which were extirpated from Midway Atoll by rats. This is currently also planned for Ka'ena Point, Oahu, which is now protected by a predator proof fence (Lindsay Young pers. comm.). Additionally, a small scale project broadcasting calls of phoenix petrel (*Pterodroma alba*) was initiated in 2001 at Jarvis Island National Wildlife Refuge.

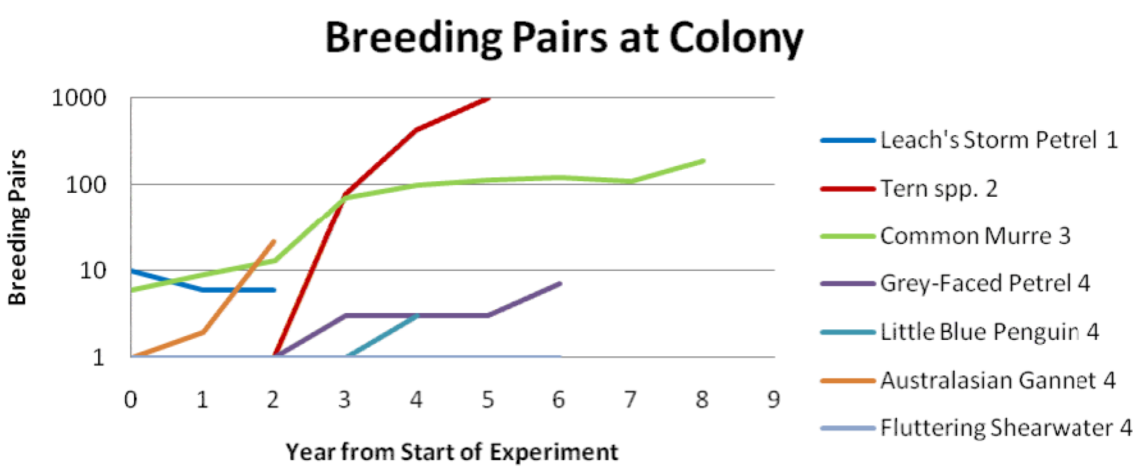
A fencing and social attraction approach at Makamaka'ole is expected to have a very high chance of success. The site is very accessible, being located within walking distance from the end of a road, and includes a range of topographical features and aspects, including slope, gullies, flat areas, ridges, banks, etc., as well as a range of soil types and options for birds to form natural burrows. The site which has received preliminary consideration for fencing primarily faces north into the prevailing wind, which aids the birds with takeoff. The proposed fence line will avoid waterways, which are more easily breached by vertebrate pests. The site is close to a community which may allow for community participation in the long-term conservation effort; those residents who so far are aware of the situation are supportive which will contribute to assuring long-term success (Steve Sawyer and Greg Spencer pers. comm.). In addition to providing protection to the target species of birds, the site can be used as a sanctuary for highly threatened and endangered plants and invertebrates if warranted.

Based on the presence of inactive, old and disused burrows and the significant amount of Hawaiian petrel activity over the site, the area is believed to be a historic nesting site where nesting attempts still occur, but fail due to high predator densities. It is interesting to note that historic maps show that one of the features at Makamaka'ole was identified as 'Ua'u Hill. The presence of a significant number of Hawaiian petrel transiting and even courting adjacent to the proposed attraction site indicate there is a significant source of birds that may be drawn in to the enclosure. In contrast, a recent acoustic attraction project at Young Nick's Head, New Zealand, was successful in attracting grey-faced petrels, a congeneric of the Hawaiian petrel, without any birds having been recorded at or near the site since they went locally extinct 81 years prior. Within 7 months of installation of the sound system birds landed at the site, and within 6 years, seven pairs are breeding at the site

(Sawyer and Fogle, 2010). Hawaiian petrel, like New Zealand *Pterodroma*, are expected to respond well to acoustic attraction, as demonstrated with the Galapagos petrel (Kress 1992). Historic records mention Indigenous Hawaiian people calling birds in to catch and eat (Steve Sawyer pers. comm.). War-whooping is very effective for calling in gadfly petrels (Gangloff *et al.* 2009).

6.3.1.5 Colony establishment and credit accrual

The rate of increase in colony size following re-establishment appears to be somewhat rapid, once breeding begins as judged from experience especially in New Zealand on other petrels. Assuming that the colony would initially be populated by prospectors (ages 2-5), breeding is expected to commence as early as year 2. For fluttering shearwater and common diving petrel, where chick translocation was used, the increase in the number of breeding pairs from year 6 to year 10 was rapid. By attracting, sub adult prospectors, there is no need to wait through the first few years of a petrel's life, which is spent entirely at sea. Acoustic attraction experiments on petrel species in New Zealand confirm that they can show signs of success earlier, as seen with studies conducted for fluttering shearwater (Bell *et al.* 2005) and common diving petrel (Miskelly and Taylor 2004). The rate of colony attraction appears to be such that there is a relatively rapid increase in breeding pairs with time after the initial breeding starts, kind of a 'snowballing' effect. Figure 6.4 illustrates rates of colony attraction based on published and unpublished data.



[1] Podolsky and Kress 1989
[2] Kress 1983
[3] Parker *et al.* 2007
[4] Steve Sawyer, unpub.

Figure 6.4. Colony attraction for social attraction projects. -*NO CHANGE*

Hawaiian petrel

Modeling by H.T. Harvey and associates (Appendix 24) based on published demographic parameters, data from social attraction projects referenced above, and a set of reasonable assumptions, projects the presence of 14 active breeding burrows within the enclosure in 20 years. Although Tier 1 mitigation requirements for KWP I and KWP II combined would not be reached during the 20 year license period (i.e., at least 1 individual above the Tier 1 take level of 42 individuals, at least 28 of which are adults), considerable progress would be made, especially for adults. Although the mitigation targets would not be exceeded within the license period, 67% and 65% of adult and fledgling Tier 1 take would be met, respectively. However, mitigation accelerates with time, and net recovery benefit would be reached by year 24 for adults and year 25 for fledglings (Appendix 24). Colonization and success of the enclosure starts fairly slowly, but colony growth accelerates rapidly each year. The assumed rate of social attraction for Makamaka'ole is based on Bell *et al.* (2005), which is a conservative value. Other studies (e.g. Miskelly and Taylor 2004) found much higher rates of social attraction within the first several years of establishment. In addition to birds transiting the area, up to 75 petrels are seen circling, calling, and performing paired flights in the valley immediately adjacent to the proposed site. Therefore the initial colonization rate at Makamaka'ole may well be higher than predicted by the model. If initial success is even slightly greater than predicted, it is likely that the proposed mitigation project will reach Tier 1 mitigation goals for both KWP I and KWP II within the 20-year license period.

Since the projection of colony growth is based on data available from other projects, the actual rate of colony growth is unknown. Therefore the success of the project will be evaluated at 5 years post implementation to make sure the project is on track, and will use data from the first five years to project when mitigation goals can be expected to be reached. Mitigation credit will be calculated as described by H.T. Harvey and associates (Appendix 24) where a Tier 1 scenario for birds breeding in an unprotected area (table 6.5) is subtracted from a reasonable, but conservative scenario within the enclosure. If monitoring results confirm that mitigation goals will not be reached within 20 years, adaptive management will be triggered as described in section 6.3.1.7 to ensure mitigation requirements are fulfilled within 20 years.

Any ground and burrow nesting birds in west Maui would be and have been subject to intense predation by cats, mongoose and rats. During work at Makamaka'ole in July-Aug 2011, 11 mongoose were trapped in 12 days using two traps; only predated carcasses of Hawaiian petrels and deserted burrows thus far have been found in the lower Makamaka'ole area over which the petrels circle at night (First Wind, unpubl. data). According to the NARS management plan (NARS 1989), mongoose tracks have been found on the Puu Kukui Trail well above Makamaka'ole (2980 ft and higher), and rat sign to as high as 4200 ft on west Maui (more or less the summit). Cats and rats occur at the summit of Haleakala (10,029 ft) and mongoose at high altitude as well; thus, there is reason to believe that these predators are likely widespread on west Maui, which is half that altitude. The annual adult survival rate of 0.80, which is the adult survival determined by Simons (1984) prior to initiation of predator control, is representative (average) of all of West Maui, including low-altitude areas such as Makamaka'ole, where adult survival is nil, and more remote and steeper areas at higher altitude where predation pressure may be lower and adult survival may be slightly higher.

Table 6.6. Parameter values used in the population model, existing colony (full predation) and mitigation colony (no predation), for Hawaiian petrel at Makamaka'ole. -*NO CHANGE*

Parameter	Value		Source
	Existing colony	Mitigation colony	
Survival			
Annual age 0 survival	0.66	Same	Calculated using ratio of age 0 to 2 survival rates, based on Ainley *et al.* 2001
Annual age 1 survival	0.79	Same	Calculated using ratio of age 1 to 2 survival rates, based on Ainley *et al.* 2001
Annual age 2 survival	0.90	Same	Back-calculated to result in a fledgling to age 6 survival rate of 0.2689 (from Simons 1984)
Annual age 3 survival	0.90	Same	Assumed to be same as age 2 year survival rate (see HTH and PRBO 2011b)
Annual adult (>=4) survival	0.80	0.93	Simons 1984, high level of predation; no predation could be as high as 0.94, see HTH and PRBO 2011a for explanation
Fecundity			
Breeding probability	0.51	0.89	Hodges and Nagata 2001, no predator control (high level of predation); Simons 1985, no predation
Reproductive success (4, 5)	0.27	0.50	Calculated based on ratio of estimate of 0.5 for ages 4, 5 from Bell *et al.* 2005 to the estimate of 0.72 based on the literature and the assumed reproductive rate of 0.39 for ages >=6; Bell *et al.* 2005
Reproductive success (>=6)	0.39	0.72	Simons 1985, for high predation; see HTH and PRBO 2011a for explanation regarding no predation scenario
Sex ratio	1:1	Same	Nur and Sydeman 1999; Simons 1985
Age at first breeding	6	Same	Simons 1984
Maximum breeding age	36	Same	Simons 1984

Newell's shearwater

Modeling by H.T. Harvey and associates (Appendix 25) based on published demographic parameters, data from social attraction projects referenced above, and a set of reasonable assumptions which are explained in Appendix 25, projects the presence of 6 active breeding burrows within the enclosure in 20 years. Tier 1 mitigation requirements for both KWP I and KWP II combined would be reached during the 20 year license period (i.e., at least 1 individual above the Tier 1 take level of 8 individuals, at least 4 of which are adults), by year 16. The proposed mitigation will also make significant progress toward the Tier 2 take level.

Since the projection of colony growth is based on data available from other projects, the actual rate of colony growth is unknown. Therefore the success of the project will be evaluated at 5 years post implementation to make sure the project is on track, and will use data from the first five years to project when mitigation goals can be expected to be reached. Mitigation credit will be calculated as described by H.T. Harvey and associates (Appendix 25) where a Tier 1 scenario for birds breeding in an unprotected area is subtracted from a reasonable, but conservative scenario within the enclosure (table 6.6).

Newell's shearwaters are assumed to be equally or more susceptible to predation than Hawaiian petrels, thus similar predation pressure as described for the Hawaiian petrel was used in selection of demographic parameters of the existing population of Newell's shearwaters on West Maui.

Table 6.7. Parameter values used in the population model, existing colony (full predation and mitigation scenarios) and mitigation colony (mitigation scenario only), for Newell's shearwater at Makamaka'ole. -*NO CHANGE*

Parameter	Value		Source
	Existing colony	Mitigation colony	
Survival			
Annual age 0 survival	0.654	Same	Griesemer and Holmes (2010)
Annual age 1 survival	0.780	Same	Griesemer and Holmes (2010)
Annual age 2 survival	0.815	0.890	Griesemer and Holmes (2010), high predation; Griesemer and Holmes (2010), no predation
Annual age 3 survival	0.830	0.905	Griesemer and Holmes (2010), high predation; Griesemer and Holmes (2010), no predation
Annual age 4 and 5 survival	0.770	0.920	Ainley *et al.* (2001), Griesemer and Holmes (2010); assumed same survival as for ages 6 and older under no predation
Annual adult (>=6) survival	0.877	0.930	Ainley *et al.* (1995), Griesemer and Holmes (2010), high predation; Schreiber and Burger (2001), Manx shearwater
Fecundity			
Breeding probability (3, 4, 5)	0.25	0.4	Assumed to be half of breeding probability for ages 6 years and older
Breeding probability (>=6)	0.5	0.8	Griesemer and Holmes (2010), high predation; Griesemer and Holmes (2010), no predation
Reproductive success (3, 4, 5)	0.21	0.29, 0.39, 0.50	Calculated based on ratio of estimate of 0.5 for ages 4, 5 from Bell *et al.* 2005 to the estimate of 0.7 based on Griesemer and Holmes (2010); Bell *et al.* (2005), gradual increase from year 2 to 8 (see HTH and PRBO 2011c)
Reproductive success (>=6)	0.30	0.4, 0.55, 0.70	Griesemer and Holmes (2010), high predation; Griesemer and Holmes (2010), low predation, gradual increase from year 2 to 8 (see HTH and PRBO 2011c)
Sex ratio	1:1	Same	Nur and Sydeman 1999
Average age at first breeding	6	Same	Ainley *et al.* 2001
Maximum breeding age	36	Same	Ainley *et al.* 2001

6.3.1.6 Project design

An area has been identified for the construction of two approximately 5 ac predator (dog, cat, mongoose, and rat) proof enclosures to protect breeding Hawaiian petrels and Newell's shearwaters. The enclosures will follow design specifications, materials, and installation criteria based upon proven New Zealand pest-proof fence technology (Steve Sawyer, Ecoworks; and Tim Day, Excluder). This enclosure size has proven to be optimal because it provides adequate space for 50 or more artificial and natural burrows while ensuring the effectiveness of the fence in excluding predators and pests (ungulates) and the practicability of eradicating the predator species from within the enclosure. The two enclosures will be separated from each other, in part to reduce the potential for competitive inter-specific interactions. The placement of the fence will conform to the natural contours of the immediate landscape, and will be situated below the crests of ridgelines to in order to stay below the flight path of the petrels and assure a minimal risk of collision. Similar projects for Gadfly petrels and shearwaters in New Zealand have not encountered any problems related to seabirds colliding with fences such as proposed for this project. Having the enclosure uphill of the fence effectively increases the height of the fence for mammalian predators outside the fence. The layout of the fenced enclosures will be designed to avoid any waterways, which are difficult to manage and are a likely pathway for pest incursions. An electric wire will be placed 4 m from the fence to discourage ungulates from approaching and potentially compromising the fence. The fence itself will be designed to keep out dogs, cats, mongoose, and rats, while allowing mice to come and go. Mice will be controlled down to an approximate 2% activity rate within the enclosure by maintaining a 25m grid of bait stations (Diphacinone), and a trapping program will be carried out within a 100m buffer zone around the enclosure using Conibear-type traps placed in ply boxes for cats and mongoose along ridges within a 1 km radius of the enclosure to depress predator densities in the surrounding buffer zone. All trapping and baiting activities will be in accordance with applicable regulations and labels. In addition, barn owl control will be implemented before petrels and shearwaters return to the area and may be continued during the breeding season if owls are observed re-occupying the area. The acoustic attraction setup will be based on methods proven to be effective in New Zealand, and will consist of remote solar powered digital acoustic attraction players and weather-resistant omni-directional speakers using local Makamakaʻole, Lanaʻihale, and/or Haleakala Hawaiian petrel vocal recordings and as-available Newell's shearwater recordings. Each enclosure will only broadcast calls of one species (i.e. only Newell's shearwater calls will be broadcast within the designated Newell's shearwater enclosure). Before social attraction begins, 50 artificial burrows specifically designed for each species will be installed within a 40m radius of the speakers, which may be followed in subsequent years by ongoing installation of up to 50 more burrows elsewhere within the enclosures and possibly additional speaker deployments. The use of artificial burrows has aided recolonization in social attraction projects for Procellariids in New Zealand and elsewhere (see section 2.3). A timeline of implementation and figures for the design and location of the enclosure can be found in Appendix 22.

The enclosures will be located within the Kahakuloa Natural Area Reserve (Appendix 22). The Newell's shearwater enclosure will be located entirely within the existing fenced area, but the Hawaiian petrel enclosure, as presently designed will intersect with the existing ungulate fence along its northeastern corner. To ensure that the enclosure is entirely included within the existing ungulate fence, and to minimize collision risk, the portion of the existing fence that will intersect the Hawaiian petrel enclosure will be rerouted to follow the lower edge of the Makamaka'ole Stream precipice at least four meters from the predator proof fence. This action, which will be executed in cooperation with the NARS, will not impact the effectiveness of the existing ungulate fence, and will be paid for by the Applicant.

6.3.1.7 Adaptive management plan for Tier 1 mitigation

As described above, the proposed mitigation project is expected to offset Tier 1 take within the 20-year life of the project. However, if the Makamakaole social attraction project does not produce the anticipated mitigation benefits, adaptive management at the Makamakaole site, or management at an additional site or sites would be conducted to ensure mitigation requirements are met within the life of the project.

The proposed mitigation project at Makamakaʻole may be delayed due to unanticipated circumstances, or additional landowner permit requirements. Discussions with NARS are ongoing, and the NARS permitting process is not expected to cause significant delays to the project. Additional landowner permit requirements for the Makamakaʻole social attraction project are not anticipated.

Throughout the first five years of social attraction at Makamakaʻole, management may be adapted to change methods, scale, or strategy at Makamakaʻole to incorporate updated techniques with the concurrence of USFWS and DLNR. Success of the mitigation project will be monitored annually, and after five years the performance of the project will be evaluated against predictions based on the presented models

Table 6.8. Minimal number of breeding pairs occupying the enclosures after 5 years of social attraction to confirm meeting mitigation requirements. -*NO CHANGE*

Species	Number Needed to Offset KWP II Tier 1	Total Needed to Offset KWPII Tier 1 + KWP II Tier 2	Total Needed to Offset KWP I Tier 1	Total Needed to Offset KWP I Tiers 1 and 2
Newell's shearwater	1	2	1	2
Hawaiian petrel	1	2	1	2

If based on results achieved during years one through five, the success of the Makamakaʻole social attraction project does not appear (based on Table 6.7, above) capable of offsetting the level of take anticipated during the 20-year permit term (at a minimum, Newell's shearwater mitigation will offset KWP II Tier 1 take, KWP I's anticipated 20-year take levels, and KWP II's Tier 2 requested take level, if triggered, based on observed take) the Applicant will, in year six, implement one or more adaptive management or additional mitigation measures to supplement the mitigation effort to the extent necessary to offset anticipated levels of take. For an explanation of how Tier 2 is triggered see Section 4. During years 1 – 5, the Applicant will develop management plans for the following alternative Tier 1 mitigation project sites. Alternatives will be evaluated in the order listed and implemented as needed to fulfill mitigation requirements. When mitigation commences at an alternative site, mitigation projects at the previous sites will continue for the duration of the permit term unless the Service and DOFAW agree the conservation action may be terminated.

Hawaiian petrel:

a) Implement predator control at Hawaiian petrel colony on the Haleakala Crater Rim.
b) Implement predator control at Hawaiian petrel colony at the ATST mitigation site on Haleakala.

Newell's shearwater:

a) Install predator fencing and manage predators around a Newell's shearwater colony or colonies in West Maui or, if USFWS and DOFAW agree management of a West Maui site is not feasible, control predators at a Newell's shearwater colony or colonies in East Maui.
b) If based on feasibility criteria such as presented in table 6.7 in situ management of Newell's shearwater colonies is not feasible in West Maui, implement a social attraction project at an alternative site on Maui.
c) If USFWS and DOFAW agree that neither in-situ management nor social attraction of Maui Newell's shearwaters are feasible, install predator fencing and manage predators around a Newell's shearwater colony or colonies on either Molokai or Lanai (see section 6.3.2.2).
d) If DOFAW and USFWS confirm management of Maui Newell's shearwater colonies is not feasible, or will fall short of mitigation goals, implement a social attraction project or projects on Molokai or Lanai to ensure that the collective mitigation efforts result in

successful achievement of mitigation goals for KWP II Tier 1 requested take in addition to KWP I's anticipated 20-year take levels and KWP II's Tier 2 requested take level, if triggered based on observed take.

Attracting breeding individuals of both Hawaiian petrel and Newell's shearwater to an area within which they can be protected from predation threats is believed to have the potential of saving the remaining colonies of both species on West Maui. Under current conditions both species are undergoing continuous population decline and, without intervention, are likely headed towards extinction on West Maui in the near future. Modeling (Appendix 24) shows that with an estimate of approximately 40 existing breeding pairs in West Maui, based on best available information, the West Maui Newell's shearwater population will reach extinction threshold of 10 pairs within 11 years. After that point stochastic events become a large factor in the extinction of the remaining population. The population is projected to have fewer than 2 breeding pairs within 29 year. The Hawaiian petrel population is projected (Appendix 24) to reach extinction threshold of 10 pairs within 27 years. Such has been the recent history of these species nesting at lower elevations (equivalent to West Maui) on Kaua'i. In contrast, once established in the predator free enclosures, the "rescued" colonies will have a positive population growth, and are projected to be self-sustaining (without immigration) at around 25 breeding pairs (David Ainley pers. comm.). Therefore, with the establishment of a viable self-sustaining or growing colony for each species, versus the currently unmanaged presumably declining colonies on West Maui, the net recovery benefit in the long term may far exceed the short-term benefits described above.

The actual measures implemented at Makamaka'ole or alternative sites will be subject to approval by the agencies. Input will be sought from the Seabird Recovery Group for the State of Hawai'i. However, if mitigation efforts at another seabird colony are identified as a greater need or having a greater potential benefit, priority will be given to other colonies on East Maui, West Maui or another island or in other areas as determined by DLNR and USFWS.

Newell's shearwater will not be a Covered Species in the HCP unless the USFWS and DLNR approve the requested reduction in Newell's shearwater take permitted at KWP I to a total take of 8 Newell's shearwaters. A decision regarding the requested permitted take reduction is anticipated before the start of the 2012 breeding season of this species; take is not anticipated before the start of the 2012 breeding season.

6.3.2 Alternatives for Tier 1 Mitigation *-NO CHANGE*

Makamaka'ole is considered by DOFAW, USFWS and others to be an important site for the recovery of the species. In addition, it is within a known flight path of Newell's shearwaters. However, if the preferred alternative is unsuccessful, or does not fulfill mitigation requirements, the following alternative mitigation actions are proposed. Figure 6.5 shows the locations of the sites described below. After discussing with the Applicant, DOFAW and USFWS will determine the most appropriate alternative for mitigating the impacts of this project.

6.3.2.1 Alternatives for Hawaiian Petrel

If necessary to offset KWP I and KWP II Tier 1 take of the Hawaiian petrel, KWP II would augment the Makamaka'ole social attraction efforts by implementing management measures at the south crater rim of Haleakalā Crater (South Rim site). The National Park Service has identified at least 100 burrows, and based on Hawaiian petrel monitoring and GIS modeling, they assert that at least 600 active burrows are present along the South Rim (C. Bailey pers. comm.). The nesting area is composed of large boulders, rocky outcrops, and cinder fields (Simons 1983). Vegetation in the area is very sparse (Hodges and Nagata 2001). The National Park Service has confirmed this area is protected from habitat damage by feral goats and pigs, but burrows within this area are not protected from mammalian predators, and are experiencing a much lower level of breeding attempts and breeding success (Hodges and Nagata 2001). If KWP II participates in the management effort with KWP I, the two entities will contract the labor and purchase equipment (e.g., traps and bait) required to conduct predator trapping in this area (or a section thereof, depending on mitigation requirements), and to conduct monitoring to document success. The National Science Foundation has proposed six years of monitoring at a control site on Haleakala pursuant to their Advanced

Technology Solar Telescope (ATST) project. Measured rates of reproductive effort, reproductive success, and adult and juvenile survival at the mitigation site would be compared to vital rates measured at the ATST or another control site. If appropriate control site monitoring data are not available, reproductive effort, reproductive success, and juvenile and adult survival rates agreed to by the Agencies shall be used in place of control site monitoring data. Trapping and monitoring protocols will closely follow the protocols that have already been established by the National Park Service for managing the rest of the colony (Hodges and Nagata 2001). This effort would run for an initial period of 13 years (permit years 6 through 18, assuming initiated as adaptive management after year 5); population modeling by H.T. Harvey and Associates (Appendix 21) indicates 13 years of management of approximately 100 burrows would offset all of the Tier 1 level of take requested in the KWP I and KWP II permit applications. If after the initial 13 years of predator trapping, mitigation is still not at least one fledgling above Tier 1 requested take for both projects, mitigation will continue until that is achieved. Additional details will be refined with concurrence of the National Park Service, DLNR, and USFWS.

The effort will, at minimum, include traps spaced 50 meters apart on the north side and south side of the burrow concentration. Traps will not be placed in the direct vicinity of active burrows to avoid attracting predators to burrow areas, and to avoid non-target capture. Traps will not be placed on slopes of more than 30% or in areas where a conflict may arise with public access, archeological sites, culturally sensitive areas, or in areas with sensitive natural resources. Configuration of the trapping grid will be dependent on the distribution of active burrows at the site, topographic and substrate characteristics, and other logistical considerations, including those regarding avoidance of adverse impacts on the colony or other sensitive species that may be present in the area. In the non-breeding season, trapping may be augmented with additional control methods. The limits of the area to be treated, the eventual area in which treatment will take place, need for additional years of treatment and other details of the mitigation efforts will be decided with concurrence of the National Park Service, DLNR and USFWS.

6.3.2.2 Alternatives for Newell's shearwater

As described above and discussed and agreed upon with the agencies, Makamakaʽole is the preferred site for mitigation. West Maui is largely dark and free from power lines that project above surrounding terrain. Based on feasibility and location within the Newell's shearwater flight path of the Makamakaʽole-Kahakuloa watershed, the proposed project has a very high likelihood of success. However, if the preferred alternative is unsuccessful, or does not fulfill mitigation requirements, the following alternative mitigation actions are proposed. Figure 6.5 shows the locations of the sites described below. After discussing with the Applicant, DOFAW and USFWS will determine the most appropriate alternative for mitigating the impacts of this project.

For Newell's shearwaters there are two possible sites on Maui where in-situ colony protection may be possible, but not enough information is available to confirm feasibility of management at these sites. Therefore, as part of the preferred mitigation plan, during the first breeding season after issuance of the ITL/ITP the Applicant will confirm a breeding site at the upper Kahakuloa area where Newell's shearwaters have been detected previously, including no fewer than 14 survey nights, but no more than 20 survey nights, not necessarily consecutive, between the months of May-August. Fewer nights will be acceptable if the Applicant and USFWS/DOFAW agree that data collected is sufficient to support decisions regarding delineation of a breeding site, determine the feasibility of management and determination of fencing or alternative actions. Surveys may be finished during the second year, at which time the Applicant will assure applicable landowner permitting processes in support of proposed management actions are completed. This approach will be carried out either concurrently or in consecutive years (within years 1-5) at a second site on East Maui to ensure the most informed decisions about feasibility of in situ colony protection at these sites can be made. There is no indication, or data available at this time, to suggest that other locations on Maui offer colony protection opportunities.

Both of the potential alternative in-situ colony protection sites are located within areas already fenced for the purposes of ungulate control. Measures to protect the Newell's shearwaters at these sites will consist of the construction of a pest-proof fence enclosure, similar to the fenced enclosure proposed for the preferred mitigation site. Further protection measures will be similar to those described for

Makamakaʻole, if feasible. The size and location of the fenced enclosure will depend on where the birds are found, and on the landscape features at those sites. Minor crossings of drainages would be minimized but may be possible using one-way valves in culverts, allowing unobstructed runoff flow, to ensure predators are kept out of the enclosure. The drawback is that debris may be lodged in the one-way valves in these drainage crossings during runoff events, preventing them from fully closing and enabling potential predator ingress. To be effective, multiple in-line valves may need to be installed. Additional feasibility considerations include the topography: excessively steep slopes and significant gulches are not possible to fence, accessibility: the site needs to be accessed fairly reliably for predator control and monitoring purposes, there have to be enough burrows (natural and/or artificially supplemented), and the enclosure has to be maintained and kept reliably predator free. Regardless of physical constraints to feasibility of this approach, approval of the landowner(s) will have to be obtained, and a contractor will have to be able and willing to construct the enclosure. Table 6.8 lists general, non- binding guidelines for determining feasibility, although feasibility of any site will be determined on a case-by-case basis. Feasibility will be made in consultation with the project contractor, landowner(s), DOFAW, USFWS, and other subject specialists when applicable.

Table 6.9. Factors that will affect the feasibility of installing and maintaining a predator proof fence. -*NO CHANGE*

Feasibility criteria	
Burrows:	Enclosure needs to contain at least 8 naturally-occurring burrows, documented shearwater activity, and allow protection for 20 years.
Access:	Site needs to be reliably accessible at least once a week for ongoing monitoring, and more frequently during fence installation. On-site basecamp consisting of a platform and Weatherport may be needed to accommodate overnight stays by field staff.
Topography:	Fenced enclosure cannot be built on or below steep slopes (in general, no greater than 50%, but varies depending on soil and rainfall)
Streams and drains:	Avoid significant waterway crossings as much as possible; high rainfall and low accessibility make these risky to effectively install and maintain.
	Surface water runoff needs to be effectively managed to prevent accelerated erosion.
Construction:	Fenced enclosure as specified for Makamaka'ole is the currently recommended design standard. A contractor must be willing and able to build the enclosure.
Soil type:	Soil needs to be sufficient for an underground skirt, and be stable enough to resist erosion.
Site clearance:	Need sufficient clearance for the fence alignment plus a 4 meter buffer.
	Significant excavation or fill should be avoided.
	Site access limitations may not allow large machinery, such as excavators, to be transported to the site.
Effectiveness:	Complete and permanent predator removal must be feasible.
Permit:	Landowner permission required for all activities including burrow ground searches, fence construction and maintenance, and any related management actions.

The site chosen by KWP II for colony-based mitigation would be selected with the concurrence of the DLNR and USFWS. It is likely that KWP II and KWP I will collaborate for this mitigation effort. KWP II would either support an existing conservation need at a known colony or direct mitigation at a newly discovered colony where no management presently exists. The success of the mitigation efforts of

KWP II will be measured using the method that is currently implemented at that site at the time. If the chosen mitigation site was previously unmanaged, the same measures of success used to estimate success at managed sites will be applied as appropriate.

If USFWS and DLNR determine that the mitigation measures at the Makamakaʻole social attraction site are insufficient, (see section 6.3.1.7) and based on feasibility criteria such as presented in table 6.7 it is determined that in-situ management opportunities are not feasible in West Maui, a second social attraction site will be implemented, as necessary, to offset project-related take of Newell's shearwater. During years 1-5, the Applicant will locate the area or areas in East Maui best suited for Newell's shearwater social attraction project(s) based on flight passage rates and access (landowner permission, terrain, and accessibility). Because the population of Newell's shearwater may be higher in East Maui than it is in West Maui, the benefits of a Newell's shearwater social attraction project or projects in East Maui are expected to be greater than those described for the Makamakaʻole social attraction project. The most likely sites may be on state land and TNC-managed land along the Koʻolau Gap, or Keʻanae Valley located north of Haleakala National Park, and on state land east of Haleakala National Park. To insure timely implementation of contingencies the applicant will collect data on calling rates and passage rates at these sites and information gained from the Makamakaʻole social attraction project to develop plans for a social attraction site or sites in east Maui sufficient to offset take addressed in the HCP. During years 1- 5 the Applicant will conduct surveys consisting of at least 14 survey nights, and no more than 20 nights, not necessarily consecutive, for each site where access is granted and evidence suggests birds are present in sufficient numbers between the months of May-August. Fewer nights will be acceptable if the Applicant and USFWS/DOFAW agree that data collected is sufficient to support decisions regarding feasibility of implementing subsequent social attraction projects. By the end of year 5, DLNR and USFWS, in consultation with the ESRC and/or Seabird Recovery Working Group, will select the area and the Applicant's plans will be finalized so that implementation of an east Maui social attraction project could begin as early as year 6 if needed.

If the USFWS and DOFAW, in coordination with KWP II, determine anticipated benefits of the Makamakaʻole social attraction project and any additional mitigation projects are not expected to offset KWP II's Tier 1 take, USFWS and DOFAW may direct KWP II to implement in-situ management at a Newell's shearwater breeding site or sites on Maui. Criteria for in-situ management feasibility and appropriate will be established by USFWS and DOFAW in coordination with KWP II, the landowner, and the contractor appointed to construct a possible fence. If DOFAW and USFWS determine that no additional social attraction or in-situ management actions are feasible and appropriate on Maui, mitigation options on other islands within Maui Nui will be considered.

The USFWS requires that if the previously identified in-situ management and social attraction projects on Maui are not feasible, or combined do not fulfill mitigation requirements, opportunities for predator exclusion or management be investigated on Moloka`i or Lana`i. During the first breeding season after the determination that mitigation requirements cannot be met through the proposed projects on Maui, KWP II will confirm a breeding site on south east Molokaʻi at Kainalu Gulch where Newell's shearwaters have been detected previously, including no fewer than 14 survey nights, but no more than 20 survey nights, not necessarily consecutive, between the months of May-August. Fewer nights will be acceptable if the Applicant and USFWS/DOFAW agree that data collected is sufficient to support decisions regarding delineation of a breeding site, determine the feasibility of management and determination of fencing or alternative actions. Surveys may be finished during the second year, at which time the Applicant will assure applicable landowner permitting processes in support of proposed management actions are completed. This approach will be carried out either concurrently or in consecutive year at a site on Lana`i where Newell's shearwaters have been detected previously, to ensure the most informed decisions about feasibility of in situ colony protection at these sites can be made. The surveys and determinations may be completed in series, if alternatives are still needed, but will be concluded within the first five years of the KWP II permit life. The surveys and feasibility determinations will be carried out in series according to the sequence outlined above, starting with upper Kahakuloa. Once a feasible alternative has been identified, no further surveys at that, or other sites, will be required.

Data collected during the breeding site searches on Molokaʻi or Lanaʻi will also inform feasibility, and expected outcome of a social attraction project in the vicinity of these sites and/or on Mokapu islet, off the North shore of Molokaʻi. If USFWS and DOFAW conclude that predator exclusion and management is not feasible at these sites on Molokaʻi and Lanaʻi, and a social attraction project similar to that described for Makamakaʻole is considered feasible and likely to meet the (remaining) mitigation obligations, a social attraction project will be implemented at or in the vicinity of these sites.

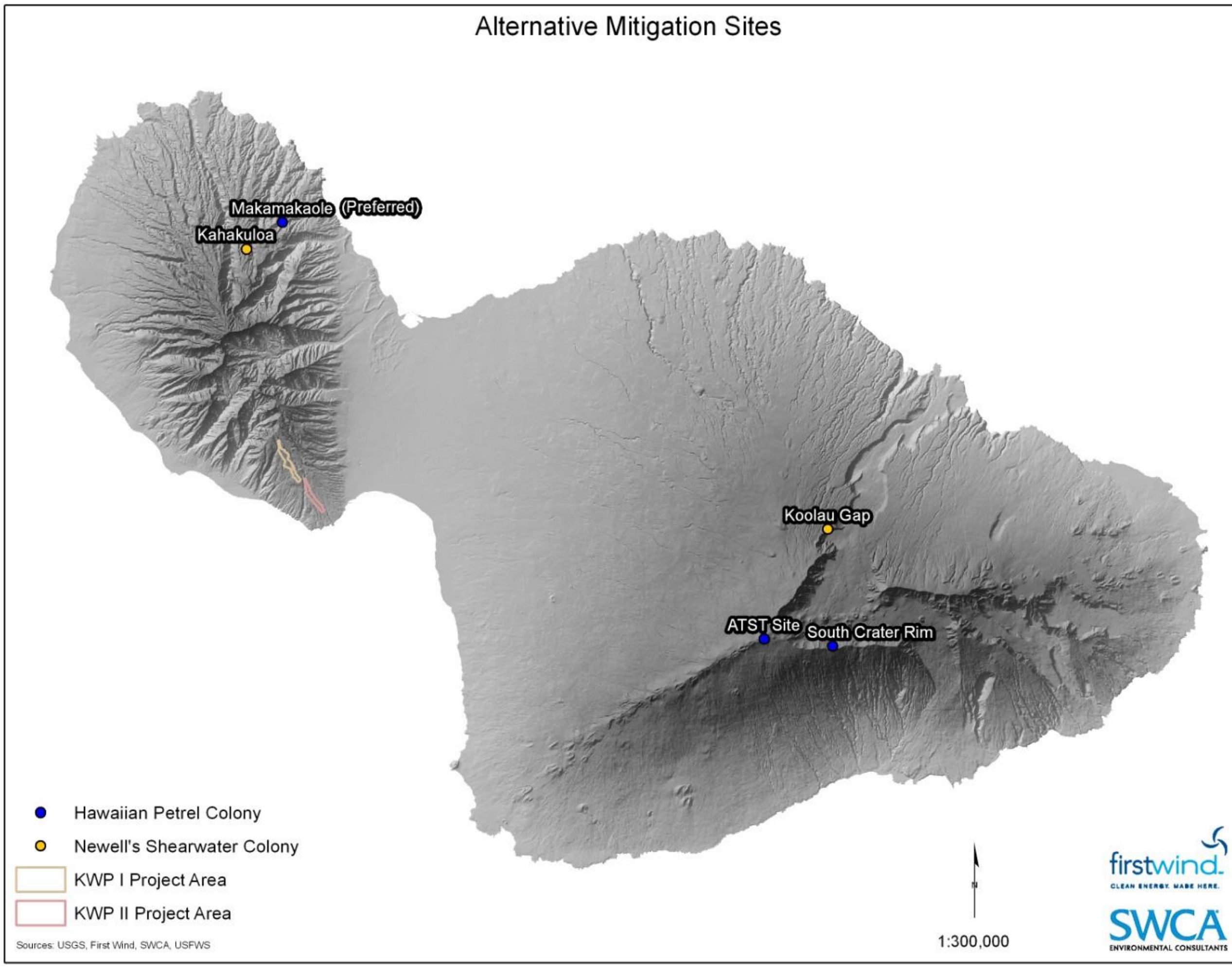


Figure 6.5. Locations of alternative mitigation sites for Hawaiian petrel and Newell's shearwater. -*NO CHANGE*

6.3.3 Mitigation for Tier 2 Rates of Take *-NO CHANGE*

The best available information indicates the mitigation projects described in the Tier 1 mitigation section, when combined, would produce mitigation benefits adequate to offset all Tier 1 and Tier 2 take addressed in the KWP I and KWP II permit applications. The proposed Makamakaʻole social attraction mitigation project is expected to mitigate for all of the Tier 1 take of KWP I and KWP II, and at least a portion of the requested take under the Tier 2 of take. For Newell's shearwater the proposed mitigation project at Makamakaʻole is projected to cover 76% of the total Tier 2 take in 20 years and a similar project in east Maui would produce benefits that are equal to the Makamakaʻole project. For Hawaiian petrels the proposed project is projected to cover 32% of Tier 2 tier take for adults and 40% of the Tier 2 for fledglings. Proposed mitigation at the Haleakala Crater Rim site, in conjunction with anticipated benefits at Makamakaʻole, is sufficient to fully offset all Tier 1 and Tier 2 take of Hawaiian petrel. Feasibility and anticipated benefits of in-situ predator control at Newell's shearwater nesting areas in West and East Maui will be assessed during project years 1-5.

Although the mitigation efforts for KWP I and KWP II are being implemented jointly, take will be monitored and assessed for each project separately. KWP II will be considered to be at the Tier 2 rate of Take for Hawaiian petrels or Newell's shearwater if the 5-year take limits for Tier 1 are exceeded within a five year period (i.e. in year 1-5, 6-10, 11-15, or 16-20), or if 20-year Tier 1 requested take is exceeded for the respective species; mitigation for KWP I occurs on a bird by bird basis, rather than full implementation for whole tiers of take. If take occurs at Tier 2, the Applicant, USFWS, and DLNR will first consider whether the mitigation efforts being provided under the existing programs in place are likely to be sufficient to offset requested take at Tier 2.

Should the Tier 2 take rate for Hawaiian petrel be triggered, and the mitigation measures described in the Tier 1 mitigation section are exhausted, additional mitigation will involve implementation of additional management measures at the south crater rim of Haleakalā Crater (South Rim site). The South Rim site area contains an estimated 5-15 Hawaiian petrel nesting burrows per hectare (Hodges and Nagata 2001), and is largely unprotected from predators and experiencing a much lower level of breeding attempts and breeding success.

6.3.3.1 Haleakala Crater

National Park Service data indicates at least 600 active burrows are present along the South Crater Rim (C. Bailey unpublished data). The nesting area is composed of large boulders, rocky outcrops, and cinder fields (Simons 1983). Vegetation in the area is very sparse (Hodges and Nagata 2001). The National Park Service has indicated that this area is protected from habitat damage by feral goats and pigs, but burrows within this area are only partially protected from mammalian predators. If KWP II participates in the management effort with KWP I, the two entities will contract the labor and purchase equipment (e.g., traps and bait) required to conduct predator trapping in this area (or a section thereof, depending on mitigation requirement), and to conduct monitoring to document success. Trapping and monitoring protocols will closely follow the protocols that have already been established by the National Park Service for managing the rest of the colony (Hodges and Nagata 2001). The effort will, at minimum, include traps spaced 50 meters apart on the north side and south side of the burrow concentration. Traps will not be placed in the direct vicinity of active burrows to avoid attracting predators to burrow areas, and to avoid non-target capture. Traps will not be placed on slopes of more than 30%, or in areas where a conflict may arise with public access, archeological sites, culturally sensitive areas, or in areas with sensitive natural resources. Configuration of the trapping grid will be dependent on the distribution of active burrows at the site, topographic and substrate characteristics, and other logistical considerations, including those regarding avoidance of adverse impacts on the colony or other sensitive species that may be present in the area. In the non-breeding season, trapping may be augmented with additional control methods. The limits of the area to be treated, the eventual area in which treatment will take place, need for additional years of treatment and other details of the mitigation efforts will be decided with concurrence of the National Park Service, DLNR and USFWS.

The National Science Foundation has proposed six years of monitoring at a control site on Haleakala pursuant to their Advanced Technology Solar Telescope (ATST) project. Measured rates of reproductive effort, reproductive success, and adult and juvenile survival at the mitigation site would be compared to these vital rates measures at a control site. If appropriate control site monitoring data are not available, reproductive effort, reproductive success, and juvenile and adult survival rates agreed to by the Agencies shall be used in combination with, or in place of, control site monitoring data.

The actual number of burrows that will be protected will depend on the number of years left on the permit at the time when Tier 2 is triggered and whether one or both projects are in Tier 2. The actual number of active burrows required to be managed will initially be determined by modeling and the mitigation measures will be monitored to document the results achieved. The South Rim site (given that 600 active burrows have been estimated in the area based on site specific observations) contains sufficient burrows to mitigate for Tier 2 of both projects combined, regardless of when Tier 2 mitigation is triggered. Mitigation measures will be extended beyond the ITL/ITP permit term if necessary to compensate for the requested take.

6.3.3.2 Advanced Technology Solar Telescope Site

A 328 acre (133 ha) mitigation area is proposed for mitigation for Advanced Technology Solar Telescope (NSF 2010) may be used instead of or in addition to the additional Haleakala Crater Rim Hawaiian petrel mitigation area to offset Tier 2 project-related take. The site is adjacent to the western perimeter of Haleakalā National Park, is unencumbered land owned by the State of Hawaii, and includes all observatories, broadcast facilities, communication towers, and other structures in the area. The site includes a number of cinder cones. The site includes 131 known Hawaiian petrel burrows, 61 of which have been identified as active (NSF 2010). The burrow density in the area adjacent to this mitigation area was found to have a significantly lower burrow density than areas inside the National Park (Hodges and Nagata 2001), and with an expanding population at the National Park and initial implementation of ungulate and predator control at the site by the National Science Foundation (NSF 2010) the number of burrows may well be higher. Mitigation measures are proposed to be implemented under the ATST HCP until 2016, after which the site may be available as an alternative site for this HCP, if the site has not been allocated as a management site for another project. Considering this area's similarity to the South Rim site described above, the number of burrows needed to offset the requested Tier 1 take will be the same as determined for the South Rim site.

6.3.4 Additional Research to Improve Avoidance and Minimization Measures for Tier 2 ***-NO CHANGE***

If Tier 2 rates of take are found to occur annually and persist for more than three consecutive years, KWP II will conduct on-site investigations in an effort to determine the cause(s) of the unexpectedly Tier 2 levels of take, and to identify and implement measures, where practicable, to reduce take levels. On-site investigations may include, but will not be necessarily limited to, additional surveys using radar, night-vision, thermal imaging, or newer state-of-the-art technologies, as appropriate, to document bird movements and behavior during periods when collisions are believed to be occurring, and particularly to determine whether certain turbines, seasonal or other site-specific conditions account for greater mortality. Investigations may also include experimental changes in project operations, and experimental measures to divert or otherwise repel birds from the area. Measures to reduce and minimize further take could include, but would not be limited to, implementing permanent changes in project operation, moving structures that cause a disproportionately high amount of take, and implementing methods to divert or repel birds from project facilities. Determining the appropriateness of any such measures would take into account costs and practicability, and will be done with concurrence from DOFAW and USFWS.

6.3.5 Measures of Success ***-NO CHANGE***

Mitigation efforts provided by KWP II will contribute to habitat and colony enhancement, and the control of predator populations and thus will provide a net benefit to, and aid in the recovery of, the two seabird species.

Strictly speaking, mitigation will be deemed to be successful if the mitigation efforts result in one more fledgling or adult than that required to compensate for the requested take of the required tier. In practice, however, mitigation measures are likely to provide much greater net benefits.
For the social attraction scenario for both species, mitigation credit will be calculated as described by H.T. Harvey and Associates (Appendix 24 and 25). A baseline scenario for birds breeding in an unprotected area is subtracted from a reasonable scenario within the enclosure (Table 6.5, 6.6). This is based on the assumption that at least some of the birds attracted to the colony may have landed and nested elsewhere where they would have been subjected to a baseline level of predation at an unmanaged site. The enclosures will be monitored for number of birds present and for burrow occupancy, and in 5-year intervals progress towards reaching mitigation goals will be modeled. This approach is considered to be conservative as the colony within the enclosure is expected to have a positive population growth, with the shift of an immigration supported colony to a self-sustaining colony expected with approximately 25 breeding pairs. The unprotected population, absent drastic management measures, will certainly continue to have a negative population growth and head for extinction.

For a colony-based management approach as described for the alternative mitigation measures for both species, mitigation will be deemed to be successful if the mitigation efforts result in one more fledgling or adult than that required to compensate for the requested take of the required tier. The realized credit will be based on the number of burrows protected, and the duration during which the protection was realized, using the models as presented in Appendix 21. The National Science Foundation has proposed six years of monitoring at a control site on Haleakala pursuant to their Advanced Technology Solar Telescope (ATST) project. Measured rates of reproductive effort, reproductive success, and adult and juvenile survival at the mitigation site would be compared to these vital rates measures at a control site. If appropriate control site monitoring data are not available, reproductive effort, reproductive success, and juvenile and adult survival rates agreed to by the Agencies shall be used in combination with, or in place of control site monitoring data.

The goal of the habitat conservation program (minimization, mitigation and monitoring) is to compensate for the incidental take of each species authorized at each tier (Take Scenario), plus provide a net conservation benefit, as measured in biological terms. Ultimately, it is designed to prevent the extinction of Hawaiian petrels and Newell's shearwaters in West Maui.

Although the overall expenditure at the Tier 1 is not expected to exceed a total of $3.16 million, the budgeted amounts are estimates and are not necessarily fixed. KWP II will provide the required conservation 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 re-allocated 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 Appendix 6. KWP II 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. For practical and commercial reasons, such reallocation of funds among years may require up to 18 months lead time to meet revenue and budgeting forecast requirements. However, if reallocation between species or budget years is not sufficient to provide the necessary conservation, KWP II will nonetheless be responsible for ensuring that the necessary conservation is provided.

6.4 Nēnē *-UPDATED*

KWP I biologists maintain an ongoing collaboration with biologists from DLNR and USFWS, as well as regional experts, to identify, select, and implement appropriate measures to mitigate for take of nēnē under the terms of the KWP I HCP. Several provisions in the KWP I HCP guide mitigation for nēnē. A similar approach is proposed for the KWP II project, with the intention of providing a net ecological benefit to the species in alignment with State and Federal species recovery goals. The Applicant will provide support for nēnē population protection and/or enhancement. The estimated cost for each proposed measure is presented in Appendix 6. All proposed measures are intended to promote the recovery of the species within portions of its historic range.

Mitigation efforts are targeted at addressing two of the seven recovery goals as identified in the *Draft Revised Recovery Plan for the Nēnē or Hawaiian Goose* (*Branta sandvicensis*) which is quoted below:

"2) Manage habitat and existing populations for sustainable productivity and survival complemented by monitoring changes in distribution and abundance;

3) Control alien predators which addresses control of introduced mammals to enhance nēnē populations"

6.4.1 Avoidance and Minimization Measures *-NO CHANGE*

The following measures will be employed to avoid and minimize the potential for construction and operation of the proposed project to adversely affect nēnē (see Appendix 12):

- Surveys will be performed in areas to be cleared for project construction to ensure that no active nēnē nests would be disturbed or destroyed by vegetation clearing activities.
- Areas temporarily disturbed during construction of the KWP II project will be re-vegetated in consultation with DOFAW biologists to ensure that nēnē will not be attracted to areas where they would be at increased risk of adverse impacts from project operation (however, planting vegetation favorable for nēnē in selected areas may be considered beneficial to the species), or create a fire hazard.
- Similarly, any ongoing management of vegetation in the project area, such as mowing, clearing or future planting, will be conducted in consultation with DOFAW biologists to ensure that nēnē will not be attracted to areas where they would be at increased risk of adverse impacts from project operation.

6.4.2 Tier 1 Mitigation *-UPDATED*

Predation has been identified as a main limiting factor in the recovery of nēnē (Banko *et al.* 1999). At Haleakalā National Park, adults were predated upon by cats, dogs, and mongoose (Banko *et al.* 1999). Adults were particularly vulnerable to predation while incubating, tending to goslings, and while molting. Cats, mongoose, and rats preyed upon goslings and nests were visited and eggs removed by mongoose and rats. Predator control of rats at Haleakalā National Park resulted in declines in egg predation, where at the Palika site 63% of nests (12 of 19) were predated prior to control from 1993 to 1994, while only 18% of nests (3 of 17) were predated following control from 1994 to 1995 (Baker and Baker 1996). The reduction in rat predation was attributed to the trapping and diphacinone poisoning conducted at the park. Exclusion of mammalian predators has similarly increased nesting success of nēnē at Volcanoes National Park, Hawai'i. Mongoose have also been documented causing significant nesting failures of wild nēnē on the Islands of Hawai'i and Maui (Hoshide *et al.* 1990; Banko 1992; Black and Banko 1994; Baker and Baker 1999).

Proposed predator removal measures may consist of deploying traps, leg holds, and/or snares or broadcasting rodenticide. These measures are expected to significantly improve adult and juvenile survival and increase productivity of nēnē pairs commensurate with the Tier 1 level of requested take and provide a net benefit to the species. The proposed mitigation measures are expected to result in the direct replacement of adults with adults and the replacement of fledglings with fledglings and no loss of productivity is expected. However, if adults are replaced by fledglings, the proposed mitigation will also need to account for possible loss of production during the lag years between take of adult birds and the sexual maturity of fledglings (Table 6.7).

Female nēnē mature at age three and males at age two (Banko *et al.* 1999). For the purposes of this HCP the take of a mature female will require accounting for two years of possible lost productivity (an adult lost in Year 1 would be replaced by fledglings in Year 1, with indirect take separately accounted for, no gosling production would occur in Year 2 and 3 because the birds released in Year 1 are still immature; in Year 4 the now adult female released as a gosling in Year 1 could begin reproducing). Only one year of loss of productivity will be attributed for the take of a mature male.

Average loss of productivity through mortality of one adult has been determined to be 0.09 goslings/individual/year (see Section 5.2.4.2). When adults are replaced by goslings loss of productivity will be assessed at an additional 0.09 fledglings for an adult male (one year loss of productivity) and 0.18 fledglings for an adult female (two years loss of productivity) assuming same year replacement (see Table 6.7). The mortality rate of captive-reared released goslings to Year 1 was reported to be 16.8% for females and 3% for males (Hu 1998; Banko *et al.* 1999). For the purposes of this HCP, an annual mortality rate of 17% is assumed to occur for both genders of geese through maturity (age two or three depending on gender). Male and female nēnē are assumed to be equally vulnerable to collision with the turbines and associated structures. Table 6.9 identifies the number of fledglings that will be required to offset the Tier 1 level of take anticipated for nēnē during operation of the KWP II project. It is anticipated that all take will be replaced with fledglings within the same year or earlier. If increased adult survival can be demonstrated, the estimate can be adjusted accordingly.

Table 6.10. Fledgling requirement for Tier 1 take assuming same year replacement. -*NO CHANGE*

	Direct Take		Indirect Take	
	Male	**Female**	**Fledglings**	**Total fledglings required**
Total requested Baseline take	9	9	2	
Fledglings required	13.1 (=9/0.83/0.83)	15.7 (=9/0.83/0.83/0.83)	2	30.8
Loss or productivity	0.81 (=0.09 x 9 x 1 year)	1.62 (=0.09 x 9 x 2 years)		2.4
			Grand total	33.2

Based on the numbers provided in Table 6.7, if take of nēnē at the KWP II facility occurs at Tier 1 level over the 20-year life of the project (take of 18 adults and two fledglings), this would require a net accrual of 34 fledglings total as compensation for the Tier 1 requested take.

6.4.2.1 Preferred Tier 1 Mitigation Measure -NO CHANGE

On April 14th, 2011 Governor Neil Abercrombie signed a proclamation approving the immediate translocation of nēnē, from their nesting grounds within the Kaua'i Lagoons Resort (located between two runways at the Lihue Airport on Kauai) to neighboring islands. This proclamation invoked provisions of Chapter 128, Hawaii Revised Statutes, and affirmed the State's responsibility to protect the health, safety, and welfare of the people and nēnē populations by mitigating potential bird-strikes with aircraft and enhancing the population of this federally listed Endangered Species on those designated neighboring islands.

The Department of Land and Natural Resources and Department of Transportation have been directed to develop and implement a five-year Nēnē Action Plan that will translocate and monitor the Kaua'i Lagoons nēnē population. According to the proclamation, "the five-year Nēnē Action Plan will be consistent with efforts to protect, maintain, restore, or enhance the endangered species to the greatest degree practicable". The emergency proclamation signed by Governor Abercrombie is to terminate on June 30, 2016. The nēnē are being translocated from Kaua'i to release pens on Maui and on the Island of Hawai'i and their monitoring and management subsequent to their release is funded by the proclamation for five years till June 2016. DOFAW anticipates that the translocated nēnē populations will increase and at the end of the proclamation, additional release pens will be needed to accommodate the increased bird population. Birds return to the release pen to nest and productivity of nesting pairs fall as a result of overcrowding. In 2010, at Pu'u O Hoku Ranch on Moloka'i, 42 goslings hatched but only two fledged into the wild, resulting in a 5% rate of fledging success for goslings. The high mortality was due to aggressive adults harassing and trampling young, which was attributed to overcrowding. Under normal managed conditions, all goslings bred within the release pen are expected to fledge (Medeiros pers. comm.).

Mitigation for KWP II will consist of providing funding to DOFAW to build an additional release pen and five years of funding for conducting predator control, vegetation management and monitoring at the additional pen beginning in 2016. The best location for release pen will be determined by DOFAW and USFWS in consultation with nēnē biologists. Monitoring will include an annual census, banding of adults and fledglings, identifying nests and quantifying reproductive success at the release pen area. Predator control measures to reduce populations of mammalian predators will be conducted in and around the release pen and are expected to increase the survival of fledglings and adults in and around the vicinity of the pen and also increase the productivity of breeding pairs.

The construction of a new pen will be used to accommodate family units from the other overcrowded release pens. When mitigation commences in 2016, monitoring will document the changes in the nēnē population and reproductive success at the pen. The actual number of fledglings or adults accrued at the new pen above the baseline productivity from an overcrowded pen will count toward the mitigation requirements of KWP II. The baseline will assume a 5% rate of fledging success for goslings in an overcrowded pen, using 2010 data from Puu O Hoku ranch.

It is expected that five breeding pairs with their goslings will be transferred to the pen from overcrowded pens *each year* (Medeiros pers. comm.). The five breeding pairs that are transferred are expected to be moved with at least 10 associated goslings (Medeiros pers. comm.). Table 6.9 shows that KWP II will be expected to accrue a minimum 42 fledglings after five years of management. This is calculated with the assumptions that 90% of the goslings fledge under managed conditions in the new pen, that a small amount of natural mortality occurs, and that these goslings would have had a 5% chance of survival in the overcrowded pen. This rate of accrual will exceed the Tier 1 requested take by eight fledglings (a total of 34 fledglings needed, see Table 6.8) in five years. Table 6.9 does not take into account the increasing number of breeding pairs that will be present each year, only the goslings from the five breeding pairs that are transferred each year. In reality, a total of 25 breeding pairs that could be nesting in the pen will have been added by the end of Year 5. This additional accrual is not accounted for in Table 6.9 as the previously released breeding pairs are not expected to return to the pen to breed every year. In addition, fledglings that have matured may also be expected to return to the pen to breed in subsequent years. Therefore, it is anticipated that there will be substantially more than five breeding pairs in the new release pen after five years of management. Thus, the accrual of 42 fledglings after five years of management is considered to be a very conservative estimate.

Table 6.11. Fledgling accrual for KWP II Tier 1 mitigation. -*NO CHANGE*

Number of goslings						Total Accrual
No. goslings reared in pen (from 5 breeding pairs)	10	10	10	10	10	
No. fledge (90% of all goslings)	9	9	9	9	9	
Accrual (minus baseline of 5% survival in a crowded pen)	8.6	8.6	8.6	8.6	8.6	42.8

When mitigation commences in 2016, monitoring will document the changes in the nēnē population and reproductive success at the pen. The actual number of fledglings or adults accrued at the new pen above the baseline productivity from an overcrowded pen will count toward the mitigation requirements of KWP II. Data from all years will also be used to document population trends and identify emerging and existing threats.

If monitoring after the first five years indicates that additional mitigation is required for mitigation efforts to be commensurate with the Tier 1 level of requested take or to provide a net benefit to the species, mitigation efforts will continue until mitigation requirement are fulfilled. Predator trapping will be continued if it is shown to be effective. Other measures that may be implemented include habitat improvement measures, such as providing additional water sources at appropriate locations, or mowing grasses in habitat beyond the vicinity of the pen to improve foraging habitat as described by Woog and Black (2001). The most appropriate measure to be undertaken will be determined based on data collected from the on-going monitoring and best available science and implemented with approval of DLNR and USFWS.

After the Tier 1 mitigation obligations are met by KWP II, DOFAW will continue the long-term management of the release pen.

However, should circumstances regarding nēnē population status or health change and indications are such that other conservation or management practices are deemed more important or pressing in aiding the recovery of the species, the Applicant in consultation with USFWS and DLNR will direct the funds toward whatever management or management activity is deemed most appropriate at the time.

6.4.2.2 Additional Tier 1 Mitigation Measures -NO CHANGE

In addition to the above, as part of mitigation for Tier 1 levels of take, a wildlife biologist will make systematic visual observations of nēnē activity from representative locations within the KWP II project area during the first year of project operation. The objective of these observations will be to document how nēnē use the project area following construction and to record observations of nēnē behavior and activity in the vicinity of the WTGs, including in-flight response to collision hazards (e.g., changing flight direction to avoid WTGs).

Observations will be made from at least three locations (upper, middle and lower points within the project area), and will occur on a weekly basis for at least three hours (one hour at each site). The time spent surveying from a particular location may exceed one hour if lengthening observation time provides more information useful in characterizing use patterns. The timing of observation periods will vary to cover daylight and crepuscular periods. Night-vision or thermal imaging equipment (as available) may be used during low-light periods.

Incidental observations of nēnē activity and response to the turbines will also be recorded under the WEOP (Appendix 4). Observations made as part of the WEOP will continue over the life of the project. These observations will contribute to a better understanding of how nēnē respond to wind facilities and will inform interpretations and management actions relevant to the population ecology of nēnē in West Maui. It is anticipated that avoidance and minimization measures will be refined and improved as a result of these studies, thereby reducing future nēnē fatalities at wind facilities.

6.4.2.3 Tier 1 Mitigation Plan -NEW

Tier 1 nēnē mitigation has been contracted to DOFAW and began in February 2017 (Appendix 31). The overall objective for Maui Nui Nēnē Monitoring and Predator Control Management Project is to assist in the recovery of the nēnē. This will be accomplished by maintaining predator traps, controlling cattle egrets and removal of invasive vegetation in and around the Pi'iholo Ranch pen. In fiscal year 2018 six fledglings were successfully produced at the Pi'iholo Ranch pen as a result of funding provided by KWP II (KWP II 2018). ~~establishing predator trap lines in known nesting areas, removal of invasive vegetation in and around an open-top release pen, and to monitor movements and nesting activities throughout Maui County~~.

The survival rate for fledgling to adult is assumed to be 64% (80% for each of two years to maturity). Therefore 1.56 fledglings must be produced for every adult nēnē take estimated. For Tier 1 at least 31 fledglings ((18*1.56) + 3 = 31) would be required to be produced.

Lost productivity occurring with delays in fledgling production would also require additional years to satisfy mitigation obligations. Total lost productivity accrued through FY 2018 is four fledglings.

If the Pi'iholo Ranch pen does not consistently produce fledglings, establishing predator trap lines in known nesting areas such as those historically occurring near Lahainaluna and Olowalu, Maui, for example, may be considered as an alternate source of fledgling production

6.4.3 Mitigation for Tier 2 Rates of Take ~~-NO CHANGE-~~*UPDATED*

Tier 2 mitigation for nēnē take will include continuing predator control, fence maintenance and vegetation management at the Pi'iholo Ranch pen. For Tier 2, an additional 14 fledglings (9*1.56 = 14) would be required to be produced to replace the estimated take of nine adult nēnē. If an average of five fledglings are produced at the Pi'iholo Ranch pen every year then Tier 1 and Tier 2 take mitigation would be satisfied in approximately nine years (45 fledglings required/5 produced annually = 8.5 years)

~~The Applicant will provide additional funding for three years as described in Section 6.4.2.1. Funding will be provided to DLNR to monitor the status of the nēnē population and conduct predator control at a chosen release pen. As Tier 1 mitigation is anticipated to be exceeded in five years, and as the Tier 2 is 1.5 times Tier 1 take (an additional request of nine adults), three years is anticipated be adequate to compensate for the additional take of nine adults.~~ Any extra fledglings already accrued in excess of that required for Tier 1 mitigation will also be applied to compensate for Tier 2 mitigation. Actual monitoring will document the changes in the nēnē population and reproductive success at the pen and the number of fledglings or adults accrued above the baseline productivity will count toward the mitigation requirements of KWP II. Monitoring will follow the same structure as outlined in 6.4.2.1.

However, should circumstances regarding nēnē population status or health change and indications are such that other conservation or management practices are deemed more important or pressing in aiding the recovery of the species, the Applicant with approval of USFWS and DLNR will direct the funds toward whatever management or management activity is deemed most appropriate at the time.

Additionally, if monitoring after the first three years indicates that additional mitigation is required for mitigation efforts to be commensurate with the Tier 2 level of requested take or to provide a net benefit to the species, mitigation efforts will continue till mitigation obligations are met. ~~Predator trapping will be continued if it is shown to be effective. Other measures that may be implemented include habitat improvement measures, such as providing additional water sources at appropriate locations, or mowing grasses in habitat beyond the vicinity of the pen to improve foraging habitat as described by Woog and Black (2001).~~ The most appropriate measures to be undertaken will be determined based on data collected from the on-going monitoring and best available science and implemented with the approval of DLNR and USFWS.

After the Tier 2 mitigation obligations are met by KWP II **and if no additional mitigation would be required**, DOFAW will continue the long-term management of the release pen.

6.4.4 Proposed Tier 3 Mitigation for Additional Take of Nēnē -*NEW*

Proposed mitigation for the Tier 3 nēnē take level is presented in Table 1.3 and ~~will~~ would be a continuation of Tier 1 mitigation underway (Appendix 31 specifically describes Tier 1 mitigation). As an adaptive management trigger, if annual review of the results of ongoing mitigation indicates take offset is not accruing in advance of take, then the wildlife agencies may require additional predator control measures at established sites or implement predator control measures at additional popular nesting and foraging sites on Maui~~or additional sites~~. A Memorandum of Understanding (MOU) and Scope of Work (SOW) for Tier 1 level take between ~~with~~ the Applicant and DLNR ~~will~~ details the specific mitigation plan, responsibilities, and expectations ~~if either agency agrees to implement~~ for mitigation that is funded by the applicant (Appendix 31). This MOU is updated and extended when necessary to include Tier 2 and Tier 3 funding and goals assuming the Tier 1 efforts are successful and the USFWS and DLNR agree that predator control and fence maintenance at the Pi`iholo Ranch pen is still appropriate and that the Tier 3 mitigation proposed is approved. Total mitigation for Tier 3 ~~will~~ would be commensurate with the take of ~~six~~ 14 additional nēnē. For Tier 3 an additional 22 fledglings (14*1.56 = 22) would be required to be produced. Mitigation planning for take exceeding the Tier 2 level of take of 30 nēnē would commence when estimated take is approximately ~~22~~ 27 nēnē (Tier 1 take level plus 75% of the difference between Tier 1 and Tier 2 (20 + (10*0.75) = 27.5~~30~~) and if take is projected to continue beyond 30 nēnē.

Funding ~~will~~ would be provided to employ personnel and/or provide equipment to implement predator control measures, monitor efforts, and provide status reports to the wildlife agencies. Proposed predator removal measures may consist of deploying traps, leg holds, and/or snares ~~or~~

broadcasting rodenticide or cattle egret control. These measures are expected to significantly improve adult and juvenile survival and increase productivity of nēnē pairs commensurate with to fully offset the requested take and provide a net benefit to the species and increase the likelihood of recovery of the nēnē.

Any extra mitigation credit (from previous mitigation measures) already accrued would be applied to mitigate for the additional take requested. Monitoring will would be conducted to document the changes in the nēnē population and reproductive success at the mitigation site. The number of fledglings or adults accrued above the baseline productivity at the mitigation site will would count toward the mitigation requirements of KWP II. Monitoring will would follow the same structure as outlined in 6.4.2.1.

Should circumstances change regarding the status or health of the nēnē population and other conservation or management practices are deemed more important or pressing to aid the recovery of the species, the Applicant will employ alternative mitigation in consultation with USFWS and DLNR.

6.4.5 Additional Measures for the Protection of Nēnē *–NO CHANGE*

If the nēnē population at Hanaʻula (associated with the release facility located above the KWP II project area), which is currently on the increase and believed to be self-sustaining, shows a decline over any five-year period for reasons directly attributable to take resulting from operation of the KWP II project, KWP II will shoulder the entire cost of construction and operation of the new release pen if the decline is attributable to KWP II only; however, if the decline is caused by the cumulative take at KWP I and KWP II, the cost of construction and operation of the additional release pen will be shared between KWP II and KWP I. The birds present at Hanaʻula will be translocated to the replacement site as needed.

6.4.6 Measures of Success *-UPDATED*

Strictly speaking, mitigation will beis deemed to be successful if the mitigation efforts result in one more fledgling or adult than that required to compensate for the requested take of the required tier. In practice, however, mitigation measures are likely to provide much greater net benefits.

This success will beis measured by an increase in adult or juvenile survival or increased productivity (average number of fledglings per pair) at the mitigation site over the baseline productivity level. A taken adult may be replaced through increased survival rates of adults in the area or adults may be replaced by fledglings.

If mitigation efforts do not exceed the baseline productivity or adult survival rates for two years running (to take into account possible annual variations), then adaptive management measures will be implemented. The magnitude and scope of these measures will be determined in consultation with the wildlife agencies and will be based upon monitoring data recorded at the mitigation site and best available science at that point in time. Adaptive management measures must be approved by the wildlife agencies and may include increasing predator control efforts at the mitigation site, changing the mitigation site or adding new mitigation sites.

Success Metrics/Adaptive Management Proposed:

1) Results of each year's efforts will be reviewed by the USFWS, DLNR-DOFAW (Oahu) and by the ESRC at the annual HCP review.
2) Based on results and review the agencies will provide suggested changes to the scope of work (if warranted). These could include increasing trap effort, changing trap types, finding a new area to attempt to manage and protect or building an addition to the Pi'iholo Ranch pen (with a new scope of work approved).
3) If after two years of effort at the Pi'iholo Ranch pen less than an annual average of **three** fledglings are produced, this site may be abandoned or an additional pen created at Pi'ihol;o

Ranch or predator control planned at nesting sites such as those historically near Olowalu and Lahainaluna on Maui.

~~1)~~4) Funding will be provided for whatever scope of work is effective until all mitigation for nēnē fledglings required to be reproduced to replace adults, fledgling or gosling is completed for the approved Tiers 1 and 2 and Tier 3 when the HCP amendment is approved.

~~Net benefit will also have been provided to the species if~~ These mitigation measures ~~will~~ may also aid in establishing one or more self-sustaining populations on Maui, in accordance with the recovery plan for the nēnē (USFWS 2004a).

The goal of the habitat conservation program (minimization, mitigation, and monitoring) is to compensate for the incidental take of each species authorized at each tier (Take Scenario), plus provide a net conservation benefit as measured in biological terms and increase the likelihood of recovery of the endangered or threatened species that are the focus of the HCP. The budgeted amounts are estimates and are not necessarily fixed. KWP II will provide the required conservation 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 re-allocated 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 Appendix 6. KWP II 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 therefore may require funds from future years to be expended or likewise unspent funds from previous years to be carried forward for later use. For practical and commercial reasons, such reallocation of funds among years may require up to 18 months' lead-time to meet revenue and budgeting forecast requirements. However, if reallocation between species or budget years is not sufficient to provide the necessary conservation, KWP II will nonetheless be responsible for ensuring that the necessary conservation is provided.

6.5 Hawaiian Hoary Bat *-UPDATED*

Recommendations by USFWS and DOFAW for mitigation for the Hawaiian hoary bat have consisted of habitat restoration to improve or provide additional roosting, breeding and foraging habitat. Mitigation targets have been identified based on the levels of take identified as "Tier 1" or "Tier 2." On-site monitoring during operations will be used to determine the tier at which Hawaiian hoary bat take is occurring. Mitigation is intended to compensate for take at Tier 1 level as described in Section 6.5.1. If monitoring shows that take is actually occurring below or in excess of Tier 1 level, adjustment to mitigation efforts would be made as described below (Section 6.5.2). The estimated cost for each proposed measure is presented in Appendix 6.

6.5.1 Take Minimization and Tier 1 Mitigation Progress *-UPDATED*

Research to determine if bat take at KWP II can be further minimized and mitigation for take of the Hawaiian hoary bat by KWP II was developed through discussions with USFWS, DLNR, and bat experts at USGS, and involved identifying measures believed most likely to contribute to the recovery of the species. Based on the feedback received, KWP II implemented a combination of:

1. on-site surveys to add to the knowledge base of the species' status on West Maui
2. on-site research into bat interactions with the wind facility
3. implementation of bat habitat improvement measures to benefit bats as approved by DLNR, USFWS and ESRC in consultation with KWP II.

6.5.1.1 Bat Habitat Utilization at KWP II and Vicinity

The Applicant surveys for and monitors Hawaiian hoary bats within and in the vicinity of the KWP II site. Surveys have been conducted ~~during~~ throughout ~~the first four~~ every years when systematic fatality monitoring has been conducted, (i.e., during the first ~~three~~ six years as determined under the

Adaptive Management provisions), to allow observed activity levels to be correlated with any take that was observed (Section 3.8.4.3 and KWP II 2013, 2014, 2015, 2016, 2017, and 2018 (unpubl.)). A critical component identified as essential to Hawaiian hoary bat recovery is the need to develop a standardized survey protocol for the Hawaiian hoary bat monitoring program to enable results collected by different parties to be directly comparable. KWP II also joined the Hawai'i Bat Research Cooperative (HBRC) and as a contribution to the on-going research efforts in the State, conducts its own surveys and monitoring at KWP II and the vicinity. Survey protocols were developed prior to the start of project operations, in consultation with HBRC, with approval by USFWS and DLNR. More than 12 acoustic bat detectors were deployed at KWP II and the vicinity (including KWP I).

The goal of this research is to document bat occurrence, habitat use and habitat preferences on site, as well as identify any seasonal and temporal changes in Hawaiian hoary bat abundance. This research is an extension of a five-year survey already underway on the Island of Hawai'i and Kaua'i and another that commenced on Maui and is intended to increase basic knowledge about Hawaiian hoary bat ecology and distribution.

6.5.1.2 Research on Bat Interactions with the Wind Facility

In conjunction with the study to determine habitat utilization by bats at KWP II and its vicinity, KWP II has conducted additional on-site surveys that will contribute to identifying areas of potential interactions and vulnerabilities of Hawaiian hoary bats at wind facilities, as follows:

1. KWP II has surveyed for bat activity near turbine locations for the first four throughout every years of operation using acoustic bat detectors. Surveys are conducted during years when systematic fatality monitoring is conducted (see Appendix 2 and Section 7.2.1). USGS (HBRC) monitoring protocols are used and adjusted if necessary. Thermal imaging or night vision technology may be used to assist acoustic monitoring as trends are detected and would follow similar protocols developed during pre-construction monitoring. The use of additional techniques and technologies will also be considered. These data are analyzed in an effort to determine seasonal and daily peak bat activity periods onsite, and comparison of data with pre-construction activity levels may help determine if bats have been attracted to the wind facility.

2. Incidental bat observations are recorded under the WEOP (Section 6.1 and Appendix 4).

These on-site surveys are expected to advance avoidance and minimization strategies that wind facilities in Hawai'i and elsewhere can employ in the future to reduce bat fatalities. Minimizing bat fatalities at the wind facility is not considered mitigation for take that occurs there.

6.5.1.3 Implementation of Management Measures

The Tier 1 mitigation for bats has been based on the recommendations received from USFWS and DOFAW in May 2011. USFWS and DOFAW received the results of Home Range Tools for ArcGIS®, Version 1.1 (compiled September 19, 2007) calculations based on Hawaiian hoary bat tracking data collected by USGS-BRD Wildlife Ecologist, Dr. Frank Bonaccorso (Bonaccorso *et al.*, 2015). This dataset from a two-week tracking study indicates a mean, short term (3-13 calendar days) core use area of 63.0 acres (25.5 hectares) of rainforest habitat on the island of Hawai'i used by 25 bats (14 male and 11 female). Male bat core areas do not appear to overlap; female core areas may overlap with male core areas. A core area was defined as the area that incorporates 50% of tracked movements; therefore, the USFWS and DOFAW assume that the core area is a minimum habitat requirement for bats.

The Tier 1 requested take of 6 adult bats and 3 juveniles (see Section 5.2.5.3) equates to a total of 7 adults (with an estimated 30% survival rate of juveniles to adulthood; see Appendix 5 for life history information). Assuming a 1:1 adult sex ratio, the potential take of 7 adults would result in the take of up to 4 adult male bats. As female core areas can overlap with male core areas, and up to two female bat core areas may be found within a male core area, mitigation requirements are based on the number of adult male bats requested to be taken.

Fencing of the Kahikinui Forest Reserve to exclude ungulates is the mitigation activity implemented and the mitigation Scope of Work is detailed in (Appendix 29). This mitigation enables the koa-'Ōhi'a montane mesic forest to regenerate and is expected to create additional habitat for the Hawaiian hoary bat. Native plants have been outplanted to enhance the regeneration of the mesic forest to meet the criteria for successful restoration (Section 6.5.4). KWP II contributed funding to DOFAW for the fencing and management of the Forest Reserve (including the monitoring of bat activity on site) commensurate with the Tier 1 requested take.

Kahikinui is a State of Hawaii conservation area which is already afforded a certain level of conservation. Kahikinui currently is in a permanent conservation easement and is protected from development but otherwise unmanaged.

KWP II provided funding to DOFAW to fence and manage and monitor for bats at a distinct area within the Kahikinui project (Appendix 29). Partnerships have been secured to ensure management of the whole of Kahikinui, KWP II has contributed to a portion of the cost for overall management. The fencing, ungulate removal and habitat restoration of Kahikinui is expected to take six years with a subsequent yearly maintenance of the habitat and fence line throughout the remainder of the 20-year Permit period. The monitoring of bats at Kahikinui and the implementation of restoration actions has been the responsibility of DOFAW (based on criteria 3a-d in Section 6.5.4 and an approved Scope of WorkMOU). However, KWP II will remain responsible for ensuring that the mitigation actions are sufficient to offset the requested take and will result in a net benefit to the Hawaiian hoary bat. A Scope of WorkMOU between the Applicant and DOFAW details the specific mitigation plan, responsibilities, and expectations of the parties. If the plan is not being met the Applicant, DOFAW, and USFWS will review the implementation process and results and determine what, if any, corrective actions are warranted. KWP II will then implement the identified actions to meet mitigation success criteria.

The location of the mitigation area may be modified with the approval of DOFAW and USFWS.

It is anticipated that the measure outlined above or any others that are developed in the future will be conducted in partnership with other conservation groups or entities and that these activities will complement other restoration, reforestation or conservation goals occurring in that area at the time. Other sites may be considered if they are determined by USFWS and DOFAW to be more appropriate for the implementation of the mitigation measures. Funds will be directed toward whatever management or research activity is deemed most appropriate at the time.

6.5.2 Minimization and Mitigation Progress for Tier 2 Rates of Take *-UPDATED*

6.5.2.1 Additional Research

KWP II continues to review the fatality records in an effort to determine whether measures in addition to the low wind speed curtailment can be implemented that will reduce or minimize take. If causes cannot be readily identified, KWP II will continue to conduct supplemental investigations that may include:

1. additional analysis of fatality and operational data
2. deployment of acoustic bat detectors to identify areas of higher bat activity during periods when collisions are believed to be occurring
3. determining whether certain turbines are causing most of the fatalities or if fatality rates are related to specific conditions (e.g., wind speed, other weather conditions, season)

Additional measures KWP II has implemented include raising LWSC from 5.0 m/s to 5.5 m/s. Other measures to reduce bat fatalities will be implemented as identified and feasible , and supported by research and may include changes in project operations, such as modifying structures and lighting, and implementing measures to repel or divert bats from areas of high risk without causing harm if practicable. These data may also be used to refine low-wind speed curtailment options, such as determining the times of year when curtailment is mandatory, or if curtailment can be confined to a subset of "problem" turbines. These additional measures will be implemented by KWP II with the concurrence of USFWS and DLNR.

As described in Section 1.4.5.4 and 5.2.5.3 no bat fatalities have been observed at KWP II since LWSC was increased to 5.5 m/s. The success of any additional minimization that could be implemented (further reducing bat take) would be impossible to determine if no bats fatalities are found.

6.5.2.2 Implementing Bat Habitat Management Measures

The Tier 2 requested take of 9 adult bats and 5 juveniles (see Section 5.2.5.3) equates to a total of 11 adults (with an estimated 30% survival rate of juveniles to adulthood; see Appendix 5 for life history information). Tier 2 mitigation included additional funding for the Kahikinui Forest Restoration Project (Appendix 29).

6.5.3 Tier 3 and Tier 4 Mitigation for Additional Take of Hawaiian Hoary Bat -*NEW*

6.5.3.1 Background

As of November 2014, the mitigation for the authorized take of 11 adult bats (Tier 1 and 2) at KWP II has been funded and mitigation measures are being implemented. The following sections describe the potential mitigation options generally and the proposed mitigation specifically for Tier 3 and 4. Adaptive management (see section 7.3) could be used to redirect the proposed mitigation, with the approval of the wildlife agencies, to provide a greater benefit for the species.

The total estimated cost to mitigate for the remaining take of ~~37~~ 27 bats (Tier 3 and 4) would be approximately $950,000 for Tier 3 (19 bats)~~$1.85M~~ per ESRC federal and state mitigation guidance indicating the cost/bat of $50,000 for research specific mitigation (See Appendix 6). Tier 4 mitigation (for eight bats) costs estimates are not yet determined. The guidance provided in the *Endangered Species Recovery Committee Hawaiian Hoary Bat Guidance* (DOFAW 2015) communicates that it is appropriate to allocate a mitigation credit of one Hawaiian hoary bat for each $50,000 of funding that is included in a proposed or amended HCP and assured of implementation by the applicant or permittee through a letter of credit or other financial assurances acceptable to the USFWS and DOFAW. The ESRC based this calculation on the reasonable expected cost of on-going land-based mitigation projects, estimated at $50,000 per enhanced management area for one bat (or 40 acres, as defined in DOFAW 2015 and KWP II HCP). Therefore, the ESRC suggests that an appropriate estimated cost for mitigating take of one bat is $50,000, and recommended that this figure be applied to different types of mitigation, including funding research as well as habitat restoration (DOFAW 2015). KWP II will provide funding in full for the required conservation measures (monitoring, minimization, adaptive management, and mitigation). Nonetheless, the DOFAW (2015) guidance provides a limited-term per-bat mitigation suggested cost of $50,000 for research specific mitigation with the caveat that this cost estimate is likely to change in the future, and mitigation will be tied directly to specific actions known to benefit the species as opposed to specific dollar amounts.

Because of the paucity of information regarding Hawaiian hoary bat population size, habitat use, and limiting factors, USFWS and DOFAW have recommended that mitigation for this species consist of a research component and a habitat management component. As described in DOFAW (2015) and further in the Research section below, filling information gaps on the Hawaiian hoary bat is a high priority to inform better management and improve mitigation approaches that increase the likelihood of recovery of the species.

The research component of the mitigation program is intended to reduce uncertainty in mitigation effectiveness and inform more consistent, scientifically justifiable and quantifiable mitigation practices for Hawaiian hoary bats in the future – both during and after the term of this HCP. It is unknown whether the research portion of the proposed mitigation will be the preferred path for the life of the permit. Research results may suggest a completely new strategy for bat mitigation in the future, or other refinements and improvements to improve effectiveness of existing hoary bat habitat management strategies.

With approval of USFWS and DOFAW, mitigation activities may consist entirely of habitat restoration or protection, research, or a combination of both (as currently proposed). Any~~The~~ land-based restoration or~~and~~ protection mitigation proposed for Tier 4 is expected to ~~provide habitat that is of higher quality than the habitat that will be impacted by covered activities, and fully~~ offset the requested take of Tier 4 to the maximum extent practicable, if reached. Alternatively, mitigation for ~~Tier 3 and/or~~ Tier 4 ~~will~~ could be through an approved federal and state Hawaiian hoary bat in lieu fee program, if available and approved at the time of mitigation implementation.

6.5.3.2 Potential Mitigation Options

6.5.3.2.1 Research

Section 5.6.3.2 of the 2016 USFWS Mitigation Policy states that research, although important to the conservation of many resources, is not typically considered compensatory mitigation, because it does not directly offset adverse effects to species or their habitats. In rare circumstance, research that is directly linked to reducing threats, or that provides a quantifiable benefit to the species, may be included as part of a mitigation package. These circumstances may exist when: (a) The major threat to a resource is something other than habitat loss; (b) the Service can reasonably expect the outcome of research to more than offset the impacts; (c) the proponent commits to using the results/recommendations of the research to mitigate action impacts; or (d) no other reasonable options for mitigation are available. KWP II, working with the Service, evaluated the proposed research project with regard to these four circumstances:

The major threat to the resource is something other than habitat loss.

The greatest *overarching* challenge~~threat~~ to Hawaiian hoary bat conservation is the lack of basic biological understanding of how to improve bat productivity and survival and increase long term population viability. ~~This threat is statewide; all bats are affected by this threat.~~ In order to address this challenge~~threat~~ a Hawaiian hoary bat workshop was held on April 14-15, 2015 in Honolulu Hawaii to discuss issues ranging from take avoidance, to research priorities, to future mitigation strategies. Participants included Hawaiian hoary bat researchers from DOFAW, U.S. Geological Society, U.S. Forest Service, University of Hawaii, Pacific Cooperative Studies Unit, the Service, as well as government regulators, consultants, stakeholders, and the public. On September 8, 2015, DOFAW introduced to the Endangered Species Recovery Committee a white paper outlining new guidelines for incidental take license applicants regarding bat avoidance, minimization, and mitigation that were based on the outcomes of the 2015 bat workshop. The Service provided comments on the paper, and the document, *Endangered Species Recovery Committee Hawaiian Hoary Bat Guidance Document*, was finalized in December 2015 (DOFAW 2015). The white paper acknowledges challenges in designing mitigation plans due to the paucity of data pertaining to Hawaiian hoary bat conservation and directs proponents to include both habitat management and research in mitigation proposals. Furthermore, measurements of the metrics that are used to estimate the three R's (redundancy, resilience and representation) for ~~HHB~~ Hawaiian hoary bats are largely unknown for this species. The research proposed by KWP II is designed to inform those metrics.

The three greatest *physical* threats to Hawaiian hoary bat, based on observed fatalities are wind turbines, removal of trees during the bat pupping season, and barbed wire. All of these threats have the potential to cause localized reduction in bat numbers. These three threats are limited to specific sites, but may be located across the state.

- Threats by wind turbines represent the highest amount of observed take of Hawaiian hoary bats statewide. Fatalities are minimized through low wind-speed curtailment, but fatalities are not completely avoided. Complete dusk to dawn, year-round curtailment would reduce power output 50% and require modification of the existing wind farm's power purchase agreement (PPAs), and potentially negate the incentive for wind energy.
- Threats to pups in roosting trees is avoided or minimized by avoiding tree removal during the pupping season. KWP II avoids removal of trees above 15 feet at its facilities and mitigation sites during the pupping season.

- Barbed wire on federal projects is avoided or minimized depending on project need (military and security applications are the typical exceptions). The Service recommends smooth wire when replacing fencing to all parties. KWP II avoids use of barbed wire at its facility and mitigation projects.

The greatest *unquantified* threats to HHB are from habitat loss, fire, pesticides, reduction in prey, and predation. These threats may pose a risk to Hawaiian hoary bat numbers, reproduction, and distribution. These threats may occur statewide. KWP II implements a fire management plan at its facility, though the site does not provide roosting habitat for bats.

The Service can reasonably expect the outcome of research or education to more than offset impacts.

This depends on the temporal scale applied. The outcome of the proposed research will not provide an immediate increase in bat productivity or a physical replacement of a fatality. However, the research proposed does focus on the identified priorities such as diet, foraging and distribution will inform the management and protection of the correct type of habitat, prey, foraging, and roosting resources that the bat needs. As a result, productivity is expected to be improved in the future ~~as a result of~~ from implementation of the proposed research results, and thus is expected to improve the offset of impacts to the bats ~~to the maximum extent practicable~~.

The proponent commits to using the results and recommendations of the research to mitigate action impacts.

KWP II will implement recommendations based on outcome of the proposed research into its ongoing and future mitigation projects if deemed appropriate by the wildlife agencies under the adaptive management provisions. By adopting the "best scientific data available" standard in the ESA, Congress indicated it expected that the USFWS will make decisions on the basis of "available" information. The reinitiating of consultation provisions of section 7 of the ESA, and the adaptive management provisions of the HCP, provide a mechanism for the USFWS and KWP II to adjust the HCP's conservation strategy to reflect new scientific information.

No other reasonable options for mitigation are available.

This factor largely fails to prioritize the importance of what is needed to sustain and recover the bat. KWP II and the wildlife agencies recognize the need for restoration and protecting habitats for Hawaiian hoary bats. The bats do not roost in buildings or caves. They roost in native and non-native trees that have suitable physical characteristics. The bats may forage in a variety of landscapes that have suitable insect prey (Coleopterans and Lepidopterans of a certain size are an important component of their diet). Land-based habitat protection, either through restoration or acquisition needs to be a component of HHB mitigation. But the degree to which restoration and preservation can improve the bats representation, resilience and redundancy, needs to be informed by the priority research outcomes. To obtain full offset with land-based mitigation actions, we need to have an understanding of what may be limiting their population.

While research is not typically a preferred mitigation practice because it does not directly offset adverse effects to species or their habitats, it has been used in cases when information is needed to inform better management of the species and, therefore, indirectly contributes to offsetting the impacts of authorized take. In recognition of the need for better scientific information on the Hawaiian hoary bat to inform and develop more effective and scientifically justifiable mitigation options in support of recovering this species, the USFWS and DOFAW have approved wind energy-related HCPs that include a Hawaiian hoary bat research component as part of the mitigation program to offset the impacts of authorized take. The inclusion of a research-based mitigation measure for the Hawaiian hoary bat in HCPs is consistent with the findings presented in the *Endangered Species Recovery Committee Hawaiian Hoary Bat Guidance* (DOFAW 2015). This guidance suggests that it is appropriate to allocate a mitigation credit of one Hawaiian hoary bat for each $50,000 of funding originally allocated for specific Hawaiian hoary bat research projects intended to inform and improve mitigation approaches and the function of bat habitat managed under a HCP. A provision for such research funding can be included in a proposed or amended HCP, provided the applicant or permittee ensures through a letter of credit or other financial assurances acceptable to the USFWS and DOFAW.

The results of funding research are likely to contribute to reducing uncertainty in mitigation effectiveness and inform more consistent, scientifically justifiable and quantifiable mitigation practices for Hawaiian hoary bats in the future – both during and after the term of this HCP. The ESRC has identified priority research questions that may be eligible for mitigation funding including population dynamics, limiting ecological factors, and improved take monitoring (DOFAW 2015). The research component of this plan ~~will be~~ has been closely coordinated with the ESRC to ensure it is ~~addressing~~ addressed these priorities.

During the HCP development or amendment process, or implementation of adaptive management, the USFWS and DOFAW may provide the description of specific research projects for suggested inclusion in the HCP mitigation program. Once research projects are approved by the USFWS and DOFAW, such projects would receive mitigation credit as described above if the research project is implemented and performance targets (discussed below) are met even if the substantive outcome of the research is different than expected. The source of the research proposals is discussed below.

Specific Hawaiian hoary bat research proposals were solicited nationwide in 2016 through an ESRC request for proposals. A Hawaiian hoary bat subcommittee of the State's ESRC evaluated the 21 proposals received and identified several projects that may meet Hawaiian hoary bat mitigation needs for prospective HCP applicants or permittees to consider for inclusion in their HCP. These projects were identified based on the priority research needs identified in the *Endangered Species Recovery Committee Hawaiian Hoary Bat Guidance*. Research funded as part of implementation of this HCP ~~may~~ has incorporated one ~~or more~~ of these research proposals ~~or additional priority questions~~ as approved by the USFWS and DOFAW.

The contract for executing and funding the selected research project under the HCP ~~will be~~is the responsibility of KWP II. However, all modifications to the cost or plan for implementing a selected research project(s) contained in this HCP amendment would need to be approved by the USFWS and DOFAW since such changes, if approved, also become part of the HCP and the ITL/ITP terms and conditions.

In addition, KWP II ~~would be~~is responsible for ensuring that the research project included in the approved HCP as Hawaiian hoary bat mitigation or adaptive management occurs. The "No Surprises Assurances" associated with an ITL/ITP does not change that obligation. If the proposed mitigation does not meet required performance targets, the permittee ~~would be~~is responsible to complete the project performance targets. While the permittee ~~would be~~is responsible for ensuring the research occurs and performance targets are met, the permittee ~~would not be~~is not responsible for ensuring an outcome of the research.

The contractor for the research project ~~would be~~has been expected to define measurable performance targets and timelines for USFWS and DOFAW approval prior to onset of the research project. The research project contractor also ~~would be~~is expected to provide semi-annual and annual progress reports to the permittee, USFWS, and DOFAW. The report ~~would~~ needs to clearly describe the progress and any setbacks towards meeting the project performance targets and timelines, a summary of the findings to date, and any changes to study methods and approaches that may be needed. The USFWS and DOFAW ~~would~~ reviews the report to: (1) make sure the contractor is meeting the performance targets and timelines agreed to at the onset of the project; (2) request clarifications; (3) recommend changes to the report or project; and (4) approve or deny the continuation of the research project.

The research project chosen for funding ~~will~~ supports the research priority of identifying limiting factors of bat habitat by conducting a long-term experimental study to measure changes in bat activity and invertebrate abundance across the study and between various habitat types ~~because of forest restoration activities~~, as identified by the ESRC in their 2016 request for proposal. ~~If a study is not approved that addresses this research priority, KWP II will provide funding for an alternative~~

scientifically and statistically rigorous research proposal deemed appropriate by the wildlife management agencies.

Bat habitat restoration will also include a research component that could for example include an insect assessment near deployed bat detectors and additional bat detector deployment. Basic ecological research would commenced as the Tier 3 initiative and would beis expected to be completed within five years (see 6.5.4 and Appendix 30). Additional research at any restoration site would commence as a Tier 4 initiative, be separate from ecological research described above and would be expected to be completed within five years (habitat restoration may take longer).

6.5.3.2.2 Protect or Enhance Native Bat Habitat

For the Tier 4 mitigation obligation, KWP II, LLC would contribute to protecting and/or restoring habitat considered favorable for roosting, pupping and/or feeding and include, monitoring efforts and providing status reports to the wildlife agencies. Restoration or protection of habitat could include all or a combination of ungulate fencing, ungulate control, fire-fuel management, native tree out-planting, native plant seed dispersal, invasive species control, long-term maintenance and invasive species monitoring or purchase of appropriate land for conservation. Any restoration will also include pre- and post-restoration bat monitoring with ultra-sonic bat detectors with at least one detector for every 60 40 acres and implemented deployed from July through October. Any potential land purchase would also require bat detection assessment to determine that bats are present in order for the purchase to be approved.Protection only of existing habitat such as fire-fuel management may not include additional bat monitoring.

6.5.3.2.3 In-Lieu Fee Program

Mitigation for Tier 3 and/or Tier 4 could be implemented through an approved federal and state Hawaiian hoary bat in-lieu fee program, if available and approved at the time of mitigation implementation.

6.5.3.3 Proposed Mitigation

The proposed mitigation would occur through the end of the KWP II take permit (i.e., approximately 15 years) unless take is reduced by yet undetermined means or mitigation is planned for a fixed period. A management plan would be completed with the approval of ESRC, DLNR and USFWS prior to implementation of any management measures.

As of June 20172018, the total bat take estimate considering observed take is 14 12 adults (KWP II 2017) with 34 26 more estimated (out of 48 38 estimated) during the remaining 15 14 years of the permit. If the rate of take is reduced by yet undetermined means and total take is not projected to exceed 45 30 bats (Tier 3 limit), then the project would not plan for or fund Tier 4 mitigation.

Planning for Tier 4 mitigation for the take of an additional three eight bats would commence when total take estimate reaches approximately 34 25 bats (Tier 2 take level plus 75% of the difference between Tier 2 and Tier 3 (11 + (19*0.75) = 2545 bats) and if take is projected to continue above 45 30 bats.

The mitigation measures, or others developed in the future, would may be implemented in partnership with other conservation groups or entities and will complement other restoration, reforestation, or conservation goals occurring in that area and at the same time. The location and size of mitigation sites also may be changed with the approval of ESRC, DLNR and USFWS in order to provide optimal benefit. If at any time new scientific information indicates mitigation measures other than habitat restoration are more important or pressing for recovery of the Hawaiian hoary bat, KWP II may revise the mitigation plan with the approval of USFWS and DLNR, provided any revision will not require a significant increase in the cost of total mitigation as estimated in this HCP amendment.

The mitigation plan proposed here incorporates applied research (Tier 3) that is closely tied to the habitat management component and a land-based component for Tier 4 (both are detailed below). This approach is consistent with recommendations of the ESRC, which includes representatives from the USFWS, USGS, the State of Hawaii, and others (DOFAW 2015).

6.5.3.3.1 Tier 3 Mitigation

Although mitigation for Tier 3 level bat take can only be considered "approved" when this HCP amendment has been approved by the Hawaii BLNR and USFWS, a final mitigation plan for research, to better understand bat movements, roosting behavior and diet, has been agreed to be appropriate approved by DLNR, USFWS and ESRC on September 28, 2016. Appendix 30 is the scope of work detailing the approved plan for research to be being conducted by the USGS and Pacific Island Ecosystems Research Center (PIERC). Although this plan has not been formally approved by the USFWS and the BLNR, KWP II has contracted with and begun funding the USGS/PIERC research in FY 2018. As previously indicated basic research on Hawaiian hoary bat ecology is necessary to understand how to successfully mitigate for bat take through restoration, protection or enhancement of this bat's preferred habitat. KWP II has chosen to begin this timely research as mitigation rather than wait an undetermined length of time for the formal approval.

6.5.3.3.2 Tier 4 Mitigation

Commence and complete the following (based on a final mitigation plan to be approved by DLNR, USFWS and the ESRC):

Purchasing land on Maui that is not already in conservation, where bats are present, and where the land parcel is in danger of being developed or compromised. The approximate acreage per bat would be 60-80 acres or 480-640 acres total for eight bats. The specific parcel would be determined when funding and planning for Tier 4 take is required. Prior to any planned land purchase bat detectors would be deployed to ensure that bats are present on or near the parcel. At least 10 bat detectors would be deployed throughout the parcel for at least three months. Bat detection would have to occur on at least three detectors during the assessment period.

OR

Mitigation through an approved federal and state Hawaiian hoary bat in lieu fee program. Conduct regular fire fuel management along fire breaks in the West Maui Mountain Watershed to protect forests considered bat habitat and/or grassland near such forests. The extent and period of management will be determined based on funding required to meet the Tier 4 mitigation obligation ($150,000 for three bats).

6.5.4 Measures of Success *-UPDATED*

The success of the Tier 1 and Tier 2 mitigation efforts has been determined as follows:

1. Both components of on-site research into Hawaiian hoary bat habitat utilization and bat interaction with wind facilities were considered successful when KWP II joined the HBRC and the specified survey and monitoring were carried out, including proper deployment and operation of bat detectors, data reduction and analysis, and reporting of findings to DLNR, USFWS and ESRC.
2. KWP II exceeded the Tier 1 rate of take. Measures to reduce bat fatalities include increasing LWSC from 5.0 to 5.5 m/s and will be considered successful when corrective measures implemented result in an estimated 50 percent or greater reduction in bat fatalities over previous levels when averaged over a five-year period.
3. Implementation of management measures was considered successful when KWP II contributed funding sufficient to restore the acreage required to compensate for the Tier 1 requested take (for take at or below Tier 1) within 6-months of beginning project operations; and when Tier 2 rate of take was identified and additional

funding sufficient to restore the acreage required to compensate for the Tier 2 requested take (for Tier 2 take upon exceeding the 5-year or 20-year Tier 1 requested take) was provided within six months of the determination. Management measures will be considered successful if:

Prior to the start of management measures:

a. Ground and canopy cover at the mitigation site is measured,

And after 6 years:

b. The fencing is completed;
c. The ungulates have been removed within the fenced area and the area is kept free of ungulates for the 20-year permit term.

And after 20 years:

d. The cover of non-native species (excluding kikuyu grass) in the managed areas is less than 50%.
e. The mitigation area should have a canopy cover composed of dominant native tree species (particularly koa and 'Ōhi'a) that are representative of that habitat after 15 years of growth. According to Wagner *et al.* (1999), mature koa/'Ōhi'a montane mesic forests "consist of open-to-closed uneven canopy of 35 m tall koa emergent above 25 m tall 'Ōhi'a." Therefore, there should be at least a 25% increase in canopy cover over original conditions throughout the mitigation area, and closed canopy areas should attain at least 60% canopy cover.
f. Restoration trials are implemented.
g. Radio-transmitter monitoring (or other measures as appropriate) is conducted every three to five years to detect changes in bat density and home range core area size as the site is restored.

These criteria were refined by DOFAW before management commenced in the Kahikinui area. If these criteria are not met as proposed, the Applicant will consult with, ~~DOFAW~~DLNR, and USFWS and implement a revised strategy to meet success criteria as approved by USFWS and DLNR~~will review the implementation process and results and determine what, if any, corrective actions are warranted~~. The FY ~~2016~~ 2017 DOFAW progress report for the Kahikinui State Forest Reserve Project relative to funds provided by KWP II is Appendix 32.

The measures of success for Tier 3 mitigation as bat ecological research and Tier 4 mitigation as bat habitat protection and/or restoration efforts are:

6.5.4.1 Tier 3 Mitigation:

Tier 3 mitigation will be considered successful if the approved research project~~(s)~~ as described in Appendix 30 ~~have~~ has been funded at $50,000 per estimated bat take ($950,000 for 19 bats~~$1,700,000~~), and if:

- the tasks and activities toward accomplishing the research goals and objectives have been completed as proposed or as modified with the approval of DOFAW and USFWS (regardless of outcome or findings);
- a final report has been submitted and approved by DOFAW and USFWS; and
- the specified raw data has been provided to the agencies.

The total cost of the USGS/PIERC research project is $1,832,000. KWP I and Kahuku Wind Power will fund the remaining cost of the plan, $882,000.

KWP II will fund the following parts of the research plan ($950,000):

1) Capture and release of Hawaiian hoary bats
2) Radio-tagging bats caught
3) Banding bats caught
4) Radio-tracking tagged bats

5) Reporting

If the research project described in Appendix 30 is not proceeding as expected according to quarterly and annual reviews the principal investigator and the agencies would determine what steps would be required to accomplish the goals as expected. Additional cost could be required and would be expected to be paid by KWP II to fulfill the stated goals.~~If mitigation is through an approved federal and state Hawaiian hoary bat in lieu fee program, mitigation success will be determined by completed payment for the entire Tier to the in-lieu fee program.~~

6.5.4.2 Tier 4 Mitigation:

Tier 4 mitigation will be considered successful when the preferred land parcel of between 480 and 640 acres in size has been purchased and documented to be dedicated to conservation in perpetuity~~the proposed fire fuel management is funded and completed.~~ A preferred land parcel will have been proven to have bats occupying the land (through bat detector deployment), is not previously designated as "conservation zoned", and is at risk of deterioration by development or invasive species encroachment.

If mitigation is through an approved federal and state Hawaiian hoary bat in lieu fee program, mitigation success will be determined by completed payment for the entire Tier to the in-lieu fee program.

If these criteria for Tier 4 are not met as proposed the Applicant, DOFAW, and USFWS will review the implementation process and results and determine what, if any, corrective actions are warranted.

The goal of the habitat conservation program (minimization, mitigation and monitoring) is to compensate for the incidental take of each species authorized at each tier (Take Scenario), and provide a net conservation benefit, as measured in biological terms. KWP II will provide the required conservation 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 re-allocated 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 Appendix 6. KWP II 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. For practical and commercial reasons, such reallocation of funds among years may require up to 18 months' lead time to meet revenue and budgeting forecast requirements. However, if reallocation between species or budget years is not sufficient to provide the necessary conservation, KWP II will nonetheless be responsible for ensuring that the necessary conservation is provided.

6.5.4.3 Adaptive Management for Higher than Projected Take

The current projected take and amendment request is 38 bats. As explained in section 5.2.5.4, assuming search conditions are similar, approximately seven bats would be expected to be observed on the ground in the search area in the next 14 years to reach a total estimated take of 39 bats. If no more bats are observed on the ground in the remaining permit years the projected estimated total take would be 14 bats.

If searched area remains the same throughout the remaining permit period and search conditions continue to be similar (primarily canine-assisted searching, SEEF at least 85%, CARE averaging at least seven days), the following triggers would be used to Adaptively Manage a higher than projected rate of take:

1) During the next two permit years (permit years seven and eight or state fiscal years 2019 and

2020) if more than two bats have been observed on the ground in search areas (assuming the search area size has not changed) KWP II will implement additional minimization techniques to ensure the requested estimated take will not be exceeded.

2) Assuming the first trigger is not met, during the next five years or less (permit years seven through 11, state fiscal years 2019-2023) if more than three bats have been observed on the ground in search areas KWP II will implement additional minimization to ensure the requested estimated take will not be exceeded.
3) Assuming the second trigger is not met, during permit years 12 through 16 if more than five bats have been observed on the ground in search areas (for permit years seven through 16; state fiscal years 2019-2028) KWP II will implement additional minimization to ensure the requested estimated take will not be exceeded.
4) Assuming the third trigger is not met, during permit years 17 through 19 if more than six bats have been observed on the ground in search areas (for permit years seven through 19; state fiscal years 2019-31) KWP II will implement additional minimization to ensure the requested estimated take will not be exceeded.

Once the permittee and/or wildlife agencies have determined the observed take is exceeding the permit year trigger, the appropriate minimization technique determined in consultation with the wildlife agencies would be implemented immediately if minimization includes just a change in wind turbines operations and within six months if minimization includes deployment of equipment on the wind turbines.

Minimization could include any or any combination of the following:

1) a higher level of Low Wind Speed Curtailment if additional research demonstrates a higher likelihood of success than does current research,
2) periods of complete cessation of operations during the night (such as during the first 2 hours of the night or during annual periods of highest activity, for example),
3) implementing deterrents that have been proven to reduce fatality rates on at least 50% of the wind turbines (with the highest bat detection and/or fatality rates),
4) implementing "early-warning" systems on at least 50% of the wind turbines (with the highest bat detection and/or fatality rates) that detect the presence of bats and shutting down at least 50% of the wind turbines (with the highest bat detection and/or fatality rates) for at least 15 minutes (assuming no additional bat activity is detected),
5) or a not yet identified option.

6.6 Mitigation for Other Native Species – the Hawaiian Short-Eared Owl *–NO CHANGE*

Since the start of project operations at KWP I four years ago, one observed take of the Hawaiian short-eared owl attributable to collision with a turbine has been documented. One vehicular collision has also occurred. Hawaiian short-eared owls also occur at the KWP II area (see Section 3.7). Hence, it is reasonable to expect that a low level of take may also occur at KWP II over the life of the project. While this native species is common on Maui, KWP II intends to offer mitigation to compensate for the impacts that the wind facility may have on the species in the vicinity.

Mitigation for possible take of the Hawaiian short-eared owl by KWP II will consist of funding research and/or rehabilitation of injured owls. Therefore, within 60 days of the commercial operation date, KWP II will contributed a total of $25,000 to appropriate programs or facilities such as the Hawaii Wildlife Center to support owl research and rehabilitation. The Hawaii Wildlife Center, located on the Island of Hawai�much‘i, is currently under construction and is still fundraising to complete the facility. One need identified by Linda Elliot (founder, president and center director) was funding to complete the recovery yard at the Hawaii Wildlife Center which will houses the outdoor holding pens and aviaries for raptors. This recovery yard will have the capacity to rehabilitate native raptors from the entire Hawaiian Archipelago. The Hawaiian short-eared owl is one of two native raptors in the state, the other being the Hawaiian hawk, or i‘o (*Buteo solitarius*). The cost of completing the recovery yard, which will consist of grading, laying down of gravel substrate, irrigation and plumbing, improving drainage, predator-proof fencing, installing gates, and landscaping is estimated at $25,000.

The allocation of funds to research and/or rehabilitation will be determined by DLNR and USFWS. If funding is allocated to research, funding may be used for (but not limited to) the purchase of radio transmitters, receivers, or provide support for personnel to conduct research, such as a population census. However, these funds will be used for whatever management or research activity is deemed most appropriate at the time, with the concurrence of USFWS and DLNR.

The rehabilitation efforts of injured owls are anticipated to offset any impact that the wind facility may have on the local population in the area. An annual report will be obtained from the rehabilitation facility documenting the number of Hawaiian short-eared owls rehabilitated each year. If research is funded, it is anticipated that the research conducted will result in an increased understanding of the habitat requirements and life history characteristics of Hawaiian short-eared owl populations, leading to the development of practicable management strategies and possibly help with the recovery of the Hawaiian short-eared owl on O'ahu, where it is state-listed as endangered.

6.7 Restoration of Vegetation and Prevention of Soil Erosion *-NO CHANGE*

KWP II received approval of their CDUA (Appendix 1) from the Office of Conservation and Coastal Lands (OCCL) on August 2010. As part of that process, a plan for revegetating disturbed areas and reintroducing native plants is being proposed. The proposed revegetation strategy is included here for reference. KWP II plans to implement a revegetation strategy to restore vegetation in temporarily disturbed areas intended to meet the dual objectives of stabilizing disturbed areas immediately following construction, and a longer-term effort to re-introduce and establish several native plant species throughout the site. Most elements of this plan are derived from experiences and lessons learned at the adjacent KWP I project site, which underwent construction in early 2006, and which has a comparable plant ecological history. KWP II anticipates working alongside and in collaboration with DLNR Forestry and Wildlife specialists to ensure that revegetation initiatives consider and incorporate all wildlife, forestry, fire and rangeland concerns and are in alignment with the management provisions of the Conservation District. The goal is to immediately stabilize soil and prevent erosion following construction. Details of the revegetation plan are included in Appendix 8.

6.7.1 Immediate Revegetation to Control Soil Erosion *–NO CHANGE*

Due to the rocky nature of much of the KWP II area, revegetation is anticipated in only limited areas. Much of the area modified for the project will result in coarse rocky surfaces, and thus will remain unvegetated, including the turbine pads (kept open for increased searcher efficiency), cuts into native rock, and riprap slopes. Re-vegetation will be implemented for erosion control in areas where finished grading results in exposed soil, such as along the edges of some turbine pads and along certain road cuts and fill slopes. In such areas KWP II proposes to apply a hydro-seed mixture of annual rye (*Lolium multiflorum*) to establish an initial cover of vegetation. Annual rye grass is expected to provide rapid cover that will gradually dies back and allows natural recruitment of neighboring species. Supplemental irrigation for a 90-day period and monitoring will be necessary to ensure that immediate revegetation measures are successful. This phase of the project will be considered successful if it can be demonstrated that >75% of the bare areas, fill slopes, and road cut segments that receive treatment have established cover within one year following treatment. If initial applications appear to be only partially successful, subsequent hand and/or hydro-seeding applications or additional temporary measures (e.g., excelsior, jute or coir matting) may be installed to ensure adequate coverage and erosion control. Over time, areas re- vegetated with annual rye will be supplemented with suitable hardy native seedlings, or other appropriate non-invasive plants in accordance with the re-vegetation plan (Appendix 8).

6.8 Managing Invasive Species *-NO CHANGE*

KWP I is also working actively to minimize and reduce the ingress of certain undesirable invasive plant species. For example, fireweed (*Senecio madagascariensis*) is a pasture weed that is highly toxic to grazing livestock and is known to readily exploit disturbed areas. KWP II intends to continue measures to minimize and avoid the introduction of invasive species to the Kaheawa Pastures area during the proposed wind farm development using best management practices (Appendix 1). These measures include the cleaning and inspection of all equipment, materials, and vehicles brought onto the site during construction to prevent the introduction of invasive or harmful non-native species. KWP II will ensure that construction materials brought from off-site will be inspected and documented along with recommendations for managing materials prior to transport and use. An inspection station at the staging area near the main highway will be established to reduce the possibility of introducing alien plant species to the site prior to project work. Each vehicle will be inspected and cleaned of debris or plant materials prior to authorizing traveling up to the site. KWP II LLC will support and collaborate with the Fireweed Group on existing efforts to control and manage fireweed. KWP II LLC will consult with the Hawaiʽi Department of Agriculture and Maui Invasive Species Commission to establish protocols and training orientation methods for preventing invasive species introductions. Post-construction protocols will also be developed to minimize the spread of existing invasive species and monitor the potential establishment of new introduced species. However, non-native vegetation will be removed from search plots if such vegetation creates unsearchable conditions within the required search areas.

6.9 Enhancement of Mid-Elevation Native Plant Habitat *-NO CHANGE*

The USFWS has suggested that the area affected by the development of the Kaheawa Wind Power Phase 2 wind energy generation facility (KWP II) presently under construction above Māʽalaea in the southwestern portion of the Island of Maui, could represent future habitat for the recruitment of certain rare and native plant species. The approximately 143 acres (58 ha) project site is situated southeast of the existing 30-MW Kaheawa Wind Power (KWP I) project area and both projects reside on Conservation District Land administered by the Hawaii Department of Land and Natural Resources (DLNR). There are no Critical Habitat designations and no State or Federally- listed species known to occur in the project area.

The area to be disturbed during construction of the KWP II facility is former pasture that was converted from native plant communities well over 100 years ago, and is currently dominated by a mixture of native and non-native grasses and low shrubs with scattered small trees. The area is prone to periodic wildfires, which suppress native plants and favor the spread of non-native, fire-tolerant grasses. Several native plant species are spread throughout the project area, mixed among the grasses, but are less prevalent at the lower, drier parts of the project area where fires have occurred more recently (Hobdy 2009b, June 2010). At KWP II, native plants are more prevalent in the rocky habitat bordering Manawainui and Malalowaiaole Gulches (Hobdy 2009a, 2009b).

Construction of the proposed KWP II facility will disturb approximately 43 ac (17 ha) of land. Approximately one third of the disturbed area will be revegetated upon completion of earthwork to ensure adequate stabilization, such as cut and fill slopes and road cuts. Turbine pads, as well as some portion of the road cuts, will be stabilized with hard materials (e.g., rip-rap and compacted gravel) rather than vegetation in order to ensure stability or increase searchability of turbine plots for downed wildlife.

Benefits expected to result in favorable conditions for native species recruitment

KWP I biologists have had considerable success reintroducing nursery grown native plants at various locations throughout the existing wind farm site, including along cut and fill slopes and other open earth portions of the roadsides and turbine pads. These outplantings and their propagules have become the dominant botanical cover in the areas treated and after 5 years' time have enabled other recruits of native species to take hold in these areas. Between July 2007 and June 2008, approximately 7,500 young aʻaliʻi (*Dodonaea viscosa*) were propagated from seed collected at the KWP I site. These seedlings were outplanted with the help of volunteers and survival was excellent. A second intensive outplanting effort comprising roughly 16,000 individual plants of several key native species occurred during the winter and spring of 2009 at KWP I. These efforts have enabled many disturbed areas to become re-established with native species common in the area and would undoubtedly represent conditions necessary for the recruitment of certain rare or listed species, should natural conditions enable their establishment independent of nursery propagation and enhancement-oriented reintroduction.

KWP II biologists propose to re-introduce native plants at the project site in discrete locations over several years, with the intent of eventually re-establishing some key species of plants that existed historically and/or at the time of project construction. This may involve collecting native seeds and cuttings in the area, propagating these at local nurseries, and subsequently outplanting these species at the site. If native species are selected that did not occur before construction but are believed to be good candidates for reintroduction, these will be reviewed in advance to be sure they will thrive and not represent a nuisance by creating an attractive habitat feature that could increase the risk of take for HCP-covered species.

Native species that may potentially be used in the reintroductions at KWP II include species identified in the botanical assessments of the area such as ʽaʽaliʽi (*Dodonaea viscosa*), pili grass (*Heteropogon contortus*), ʽūlei (*Osteomeles anthyllidifolia*), and ʽilima (*Sida fallax*). These relatively fast-growing and easily propagated species provide excellent root structure for maintaining surface substrate retention, as well as provide a native seed source for the project area. Pili grass and ʽaʽaliʽi are particularly appropriate for the conditions at Kaheawa Pastures because these species are among the few native Hawaiian plants shown to be fire tolerant (Tunison *et al.* 1994, Loh *et al.* 2009), appear resilient enough to withstand extensive periods of time between rain events, and may function to retain recruits of rare native species, should they emerge.

The specific locations of native outplantings will be determined based on site-specific factors such as the size of the disturbed area, slope, erosion potential, and substrate. Due to physical constraints of the site (i.e. the presence of surface bedrock material), KWP II may propose to direct some native outplantings outside of the immediate project area (i.e. near the puʽu), if such locations are deemed to offer a greater ecosystem and/or landscape level benefit. The specific locations of any outplanting areas adjacent to the site will be determined in consultation with DLNR, USFWS, and native plant community specialists.

It may be important and prudent to control the influx of unwanted non-native weeds that were not present prior to construction, either manually or in conjunction with an approved herbicide. Any use of herbicides will be done only in consultation with DLNR, and only in accordance with applicable restrictions on handling and use.

KWP II biologists plan to approach this phase of the site revegetation plan in a manner that emulates the successful native plant reintroduction efforts at KWP I while incorporating the knowledge of past experience working in the region. KWP II will work in collaboration with KWP I to share resources and coordinate logistics. Knowledgeable experts will be consulted for their advice and guidance to ensure that appropriate site selection, species, and timing of outplanting will result in the highest probability of establishment.

The long term revegetation efforts at KWP II are expected to be very successful given the success at KWP I. A well-established seed collection and propagation program already exists in cooperation with local nurseries, other native plant specialists, contract landscape specialists, community conservation groups, and volunteers. The entire outplanting effort will be implemented, maintained, monitored, and documented using resources available at KWP II and KWP I and in collaboration with community and conservation groups. This effort will be considered to be successful if a minimum of 5,000 individual plants are installed during the first three years following construction, with an average survival rate of greater than 75% (i.e., a minimum of 3,750 surviving plants), for all plants one year after installation, as determined by representative sampling of planted areas. If mortality exceeds 25%, replacement plantings will be installed as needed to achieve the 75% minimum.

Besides grazing, frequent wildfires have significantly altered the vegetation at the site and its immediate surroundings. The fires have benefitted fire-adapted weeds, and altered microsites making the area unsuitable for recruitments of most native plant and invertebrate species. KWP I has already significantly reduced both the potential frequency and the impacts of wildfires in the area. Roads and turbine pads function as fire breaks, and onsite personnel are equipped and trained to suppress incipient fires. The KWP I wildfire contingency plan (Appendix 18) ensures adequate response and suppression of potential wild fires. In addition, KWP II staff is participating in and advocating for the development of a Community Wildfire Protection Plan, which once implemented, will provide for minimization of wildfires at the regional level. Minimization of wildfires, along with implementation of measures described above, increase the suitability of the area for the recruitment of both rare and common native species.

Measures to protect existing native species and their habitats

The KWP II project site is not known to contain any listed or candidate species and no Critical Habitat designations at this time. A somewhat rare native grass species, *Eragrostis deflexa*, was identified during a recent botanical assessment of the project area. This species is distributed in small, discrete patches mostly among rocky enclaves along the edges of the deep gulches bordering the site where it is able to withstand the impacts of wildfires. The areas where this grass is known to occur are physically outside of the operational foot-print of the project area and have been delineated as sensitive areas to be avoided. Long-term protection from wildfires may enable *E. deflexa* to further recover and proliferate, which would enhance the native ecological diversity of the area. Combined with the native plant re-establishment efforts planned at KWP II, protecting the integrity of existing native-dominated sections of the project area will promote the health and long-term stability of these unique resources.

7.0 IMPLEMENTATION

7.1 HCP Administration ***-NO CHANGE***

The Applicant will administer this HCP under the direction of the USFWS and DLNR. The schedules for implementation of HCP requirements and reporting requirements are outlined in Appendix 19. In addition, outside experts may be periodically consulted, including biologists from other agencies (e.g., National Park Service, USGS), private conservation organizations, conservation partnerships (e.g., Nēnē Recovery Action Group), consultants and academia. When appropriate, and as requested by USFWS and DLNR, HCP-related issues may be brought before the ESRC for formal consideration.

The Applicant will meet at least semi-annually with USFWS and DLNR. Additional meetings/conferences may be called by any of the parties at any time to address immediate concerns. The purpose of the regular meetings will be to evaluate the efficacy of monitoring methods, compare the results of monitoring to the estimated take, evaluate the success of mitigation, and develop recommendations for future monitoring and mitigation. Regular meetings will also provide opportunities to consider the need for adaptive management measures, or changes to the monitoring protocol or mitigation measures. In addition, the Applicant will meet annually with the ESRC to provide updates of monitoring, mitigation, and adaptive management, and to solicit input and recommendations for future efforts. Additional meetings may be requested by the ESRC at any time to address immediate questions or concerns.

The USFWS or DLNR may suspend or revoke their respective permits if Kaheawa Wind Power fails to implement the HCP in accordance with the terms and conditions of the permits or if suspension or revocation is otherwise authorized or required by law. Suspension or revocation of the permits shall be done in accordance with applicable Federal or State law.

7.2 Monitoring and Reporting ***-UPDATED***

Monitoring and reporting by the Applicant ~~will~~ addresses both compliance and effectiveness. Compliance monitoring ~~will verify~~ verifies the Applicant's implementation of the HCP terms and conditions. Annual reports and other deliverables as described below ~~will be~~are provided to USFWS and DLNR to allow them to independently verify that the Applicant has performed all of the required activities and tasks on schedule. Monitoring ~~will~~ investigates the impacts of the authorized take and the success of the HCP's mitigation program. The monitoring ~~will~~ involves surveys to make sure the authorized level of take is not exceeded, and that the effects of take are minimized and mitigated to the greatest extent practicable (i.e., minimization and mitigation measures are sufficient and successful).

7.2.1 Monitoring ***-UPDATED***

The Applicant ~~proposes to~~ documents 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 Hawai'i and the continental United States. Another alternative is for KWP II to contribute to a cooperative monitoring program led by DOFAW (total costs estimated to be approximately $225,000 to $250,000 per year). In this program, DOFAW ~~will~~ would establish the monitoring protocol and provide personnel to conduct the monitoring. If the program is established, KWP II will contribute to DOFAW an amount up to its budget allocation for self- performing the monitoring. Additional funding for the program may be provided by DOFAW or obtained by DOFAW through grants or other sources.

Details of the proposed monitoring protocol are provided in Appendix 2. The actual monitoring protocol ~~will be~~ has been finalized with the approval from the agencies prior to the start of project operations. Key components include:

- Use of KWP II technical staff and/or third-party contractors who have been trained by experienced biologists having specialized expertise in conducting wind turbine/bird interaction studies. Criteria for selecting third-party contractors approved by USFWS and DLNR will be developed with approval of DLNR and USFWS. Additional funds are provided in the event a third-party contractor is required for monitoring and will only be used for this purpose.

- Upon With agency concurrence, carcass removal (i.e., scavenging) and SEEF trials will beare conducted each season using carcasses of different size classes within different vegetation types. Two seasons will be addressed: the winter/spring season (December–May) and summer/fall (June–November). Three size classes have been chosen to represent the size classes of the Covered Species: bat-sized, medium birds and large birds. The vegetation will beis classified according to structure (bare ground and mowed grass) and the vegetation types and their boundaries will beare mapped at KWP II after construction. Carcass removal and SEEF trials will be conducted with sufficient replication to produce statistically reliable results. These results will provide a basis for estimating unobserved take (see Appendix 2 on the potential study design); the Applicant will covers all costs and responsibilities for acquiring carcasses for trials.
- Intensive searches will bewere conducted for the first three years under the direction of a qualified biologist, after which the approach may bewas reduced in total area searched to a sampling method based on the results obtained up to that point, subject to the approval of DOFAW and USFWS. For example, systematic searches of 50% reduced effort could subsequently be conducted at five-year intervals and a further reduced but regular sampling method conducted during the interim years. Any The reduction in searcher effort will was first be evaluated using data collected up to that point, and final decisions on searcher effort reduction will required the approval of DOFAW and USFWS, and ESRC, when applicable.
- The frequency of searches during the intensive search years will ensured that a variety of conditions are were included. For example, days after moonless, cloudy, or stormy nights are of particular interest, because the wind turbines would be least visible and the risk of collision would presumably be greater, especially during peak fledging periods.
- Incidental observations by on-site staff of bird use, injury and mortality will beare documented in accordance with the WEOP and Downed Wildlife Protocol described in Section 6.1 and 6.2.
- Third party quality control of data analysis and the proctoring of SEEF trials will cost $30,000/yr during intensive monitoring years.
- Annually, on the anniversary of the start of operations, the USFWS and DOFAW will determines, in coordination with the applicant and based on the best available information, the project's take tier, anticipated adequacy of ongoing mitigation, and the necessity for additional mitigation implementation. KWP II will ensure projected 20-year benefits of mitigation remain at or above the anticipated 20-year mitigation requirements during years six through 20. Projected 20-year mitigation benefits may fall short of projected mitigation requirements for one period, not to exceed 356 365 days in length, during years six through 20.

7.2.1.1 Long Term Monitoring -NEW

The long-term monitoring protocol for KWP II from Years 4 through 20 of the permit term includes a reduced search effort relative to the intensive monitoring protocol. It will consists of searching roads and graded pads that occur within 70m radius from each turbine (Appendix 27). SEEF and CARE trials will beare conducted at least quarterly. The long-term monitoring protocol is detailed in Appendix 28.

7.2.2 Reporting *–NO CHANGE*

During construction, weekly reports of nēnē activity in and around construction areas will be provided to the agencies.

If the minimal monitoring search interval at the project site is exceeded, the Applicant will report the event to USFWS and DLNR within a week. If the minimal search interval is exceeded more than once per season (for reasons other than weather, health or safety), the Applicant, DLNR and USFWS will discuss possible adaptive management measures to address and correct the problem. Semi-annual meetings with DLNR and USFWS will be held in March and September to provide brief progress reports and summarize the findings of scavenging, SEEF trials and results of mitigation efforts. Electronic copies of HCP-related data will also be submitted with the progress reports. 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 a take of a Covered Species occur, DLNR and USFWS will be notified within 24 hours by phone and an incident report will be filed within three (3) business days (Appendix 14).

Annual reports summarizing the results of each of the two years of intensive monitoring 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 carcass removal trials with recommended statistical analyses, if any; 3) directly observed and adjusted levels of take for each species; 4) whether there is a need to modify the mitigation for subsequent years; 5) efficacy of monitoring protocols and whether monitoring protocols need to be revised; 6) results of mitigation efforts conducted as part of the HCP; 7) recommended changes to mitigation efforts if any; 8) budget and implementation schedule for the upcoming year; and, 9) continued evidence of the Applicant's ability to fulfill funding obligations. 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 June to July of the previous year. Agencies will have 15 calendar days to respond to the report, after which a final report incorporating responses to the agencies will be submitted by September 1. The report may also be presented to ESRC as required.

In subsequent years, monitoring may consist of a reduced level of effort, consisting of smaller search plots at a subset of turbines, with plots relocated periodically to sample a variety of locations. The ongoing effort will be supplemented by the WEOP Program, as implemented by on- site staff. Depending upon the findings, the location and focus of the ongoing effort can be modified, with the concurrence of the USFWS and DLNR, to target areas or times of particular interest. A table summarizing the results of incidental observations will be submitted to DLNR and USFWS twice each year. The first would be submitted in January (post-fledging for seabirds in the previous year) and the second in July (post-fledging for nēnē). In addition, in accordance with the Downed Wildlife Protocol, biologists at DLNR and USFWS will be notified whenever an MBTA or Covered Species is found dead or injured. The Applicant will confer formally with the USFWS and DLNR at least once a year following submittal of the annual report to review each year's results, review the rates of take (directly observed and as adjusted), and plan appropriate future mitigation and monitoring measures. Any changes to future mitigation and monitoring would only be made with the concurrence of USFWS and DLNR.

7.3 Summary of Adaptive Management Program *-UPDATED*

According to USFWS policy (see 65 Fed. Reg. 35242 [June 1, 2000]), adaptive management is defined as a formal, structured approach to dealing with uncertainty in natural resources management, using the experience of management and the results of research as an on-going feedback loop for continuous improvement. Adaptive approaches to management recognize that the answers to all management questions are not known and that the information necessary to formulate answers is often unavailable. Adaptive management also includes, by definition, a commitment to change management practices when determined appropriate. KWP II shall implement specific adaptive management measures in addition to those it may propose, if such measures are determined to be necessary and appropriate by the USFWS and DLNR to achieve the conservation benefits of the plan.

In the case of KWP II, some uncertainty exists related to estimated rates of take and the success of the proposed mitigation measures. However, there is reasonable basis for expecting the proposed mitigation measures to be successful, including a long history of nēnē releases on Maui and other islands. Nonetheless, uncertainties regarding take of Covered Species remain and, as a result, adaptive management provisions have been incorporated into this HCP. The Applicant may also consider whether changes in operational practices are needed to reduce levels of take. The following adaptive management measures have been/can be implemented to attempt to reduce take of Hawaiian hoary bats:

- As an avoidance and minimization measure, from July 2012 to July 2014, low wind speed curtailment was in effect from at least sunset to sunrise 1900-0600 from April through November (see Section 4.3.1). As of July 29, 2014, the low-wind speed curtailment regime was modified to extend from February 15 to Dec 15 (due to known fatalities occurring on February 24 and 26, 2014 at KWP I and II respectively and a fatality on December 14, 2013 at KWP I). The cut-in and cut-out speed was raised from 5.0 m/s to 5.5 m/s.

- If bat deterrent devices become commercially available, are effective and feasible, cost similar to or less than existing planned mitigation, and mitigation obligations have not yet been met, they will may be implemented during the permit term, with the agreement of USFWS and DLNR. In that situation, bat take may not exceed Tier 3 take levels therefore additional mitigation for Tier 4 may not be required. LWSC may also no longer be necessary and if this is determined, will be reduced or dis-continued. Reduction or dis-continued LWSC will require prior approval of DLNR and USFWS.

The proposed tiered approach to mitigation was designed with adaptive management in mind as it is acknowledged that actual rates of take may not match those projected through the seabird modeling and results of mortality monitoring performed to date at the KWP facilities. When estimated take at the 80% credibility level for a current tier reaches 75% of the current tier limit, mitigation, funding and funding assurances for the next higher tier will be planned for and implemented. Take will not be authorized for the pending tier until funding assurances for the pending tier are in place. Mitigation efforts will increase if monitoring demonstrates that incidental take is, or may be, occurring above Tier 1 levels. Any changes in the mitigation effort would be made only with the approval of USFWS and DLNR. Regardless of recorded take levels, the avoidance and minimization measures described in Section 4.3 would be employed for the duration of the KWP II project.

Monitoring of bats and nēnē mitigation efforts is intended to inform the Applicant, USFWS, and DLNR as to whether these efforts are adequately compensating for the total direct take and indirect take assessed to the KWP II facility. If monitoring reveals that a particular mitigation effort is not achieving the necessary level of success as dictated by the amount of take assessed to the KWP II facility, the Applicant will, as adaptive management and as approved by USFWS and DLNR, develop and implement a revised mitigation strategy intended to meet the project mitigation requirements. Tier 1 and Tier 2 bat mitigation and Tier 1 nēnē mitigation results are reported annually with the HCP annual report and reviewed by the ESRC during the annual report review to determine if the projects are proceeding as expected and to address any changes that might be necessary to assure success. As of FY 2018 the Tier 1 and Tier 2 bat mitigation project is proceeding as expected and has successfully met the six-year benchmarks. Tier 3 bat mitigation as research includes a quarterly agency review of progress to confirm the project is proceeding as expected and meeting the benchmarks that also have been approved by the agencies. Tier 1 nēnē mitigation, funded to begin in 2017, involves the Pi`iholo Ranch pen maintenance and predator control. Nonetheless, as with bat mitigation, the annual results are reviewed by the agencies and ESRC and any changes to mitigation planned or underway is determined.

While research is not typically a preferred mitigation practice because it does not directly offset adverse effects to species or their habitats, it has been used in cases when information is needed to inform better management of the species and, therefore, indirectly contributes to offsetting the impacts of authorized take. Bat research can be justified as mitigation when there is an adaptive management approach wherein the results/recommendations of the research will then be applied to improve future mitigation efforts (DOFAW 2015).

If the take of any of the Covered Species exceeds that authorized by the ITP and ITL at any Tier level, but remains within the range identified in Section 5.0 as the Tier 2 rate for that species, the Applicant will implement the additional increase the mitigation effort for that species as prescribed described in Section 6.0. As an adaptive management process trigger, the Applicant will promptly discuss take projections that may indicate exceeding a current Tier with USFWS and DLNR to review the total take of that species recorded to date at the KWP II facility and the mitigation performed to date on behalf of that species, and to identify whether mitigation performed to date has compensated for the next higher Tier (or any higher) rate of take, or whether changes in mitigation are needed to compensate for the next higher (or any higher) rate of take. Any changes to the mitigation efforts would be made only with the concurrence of the Applicant, USFWS and DLNR.

7.4 Funding *-UPDATED*

The HCP includes a habitat conservation program with measures that KWP II 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 proposed conservation program is presented in Appendix 6 of the HCP. KWP II will provide the required conservation (monitoring, minimization, and mitigation) measures in full, even if the actual costs are greater than anticipated. The budgeted amounts are estimates and are not necessarily fixed. One way of accomplishing this is that past, current or future funds allocated to a specific Covered Species may be re-allocated 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 Appendix 6. KWP II 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. For practical and commercial reasons, such reallocation of funds among years may require up to 18 months' lead time to meet revenue and budgeting forecast requirements. However, if reallocation between species or budget years is not sufficient to provide the necessary conservation, KWP II will nonetheless be responsible for ensuring that the necessary conservation is provided. Funding re-allocation for one species to another will not impede the implementation of mitigation measures for either species.

Funding for the implementation of the HCP ~~will be~~ is provided by KWP II LLC as an annual operating expense paid *pari passu* with other operating expenditures (operation and maintenance costs, insurance, payroll, lease payments to the State of Hawai'i, audit costs, and agency fee costs) and, most importantly, ahead of both debt service to lenders and dividends to equity investors. A variety of measures assure that the project ~~will~~ operates as a viable commercial entity, fully capable of meeting all HCP obligations for the life of the permit term. These include:

1. A 20-year Power Purchase Agreement (PPA) with MECO, with a set price structure. As a result the project will not be subject to unforeseen swings in energy markets. As long as the project is operating it is assured to generate revenue within a predictable range.

2. Performance of the turbines (i.e., to generate revenue) is warranted by the manufacturer. Turbines must maintain a high level of availability (upwards of 97%) to comply with the warranty. The project's owners are thus protected from losses due to equipment non-performance, failure, etc.

3. The project's financing ~~will~~ requires that it meet all obligations, including HCP-related monitoring and mitigation. These costs are built into the project's financial pro forma. Failure to fulfill permit obligations would constitute a material breach of financing terms, and would trigger remedial steps. Failure to remedy could lead to default and loss of ownership.

4. Revenue would be generated and the HCP activities would be funded regardless of who the owner/operator is. In the unlikely event that Kaheawa Wind Power II defaulted, the lender would assume ownership and presumably seek to sell the project to a new owner. In order to operate the project, the lender or any new owner would be required to continue to fulfill the obligations under the HCP in order to be in compliance with the project's Conservation District Use Permit (CDUP) from the Hawaii Department of Land and Natural Resources. Any new owner would not be able to operate the project unless they were in compliance with the CDUP, which in turns requires compliance with the HCP.

5. The CDUP for KWP II, issued by the Hawaii DLNR, requires an approved HCP for the project to operate. Failure to comply with the permit would lead to a shut-down, and if the project

is not brought into compliance, could in the worst instance lead to decommissioning.

6. If for any reason the project is no longer operational (or is shut down) then an agreement with the DLNR (the landowner) requires decommissioning, including removal of all structures and remediating/re-vegetating the site within 12 months. The decommissioning obligation for KWP II is secured with a LC of $1.4 million.

Additional assurance that adequate funding ~~will be~~ is available to support the proposed monitoring, mitigation measures and adaptive management necessary to achieve the results specified in this amendment, regardless of their actual costs, ~~will be~~are provided by Kaheawa Wind Power II in the form of a bond, letter of credit (LOC) with a banking institution subject to regulation by the United States, or similar instrument naming the DLNR as beneficiary. The LOC ~~will be~~is in an amount sufficient to cover the costs of the current Tier mitigation for all Covered Species (if not funded), annual compliance monitoring, adaptive management, and genetic bat sexing and will be secured prior to ITP/ITL issuance. 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 Tier is reached to include the following: the amount of the LOC for the existing Tier; mitigation already funded; and mitigation cost estimated for the new Tier.

The LOC ~~will be~~is 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. The LOC ~~will be~~is automatically renewed prior to expiration, unless it is determined to no longer be necessary by the USFWS and DLNR. As beneficiary, DLNR ~~will have~~has the ability to draw upon the LOC to fund any outstanding mitigation and compliance obligations of the project.

The LOC presented for approval must contain the following provisions: it must be payable to DLNR; the initial expiration date must not be less than one year from the effective date of the LOC and contain a provision for automatic renewal for periods of not less than one year unless the bank provides written notice of its election not to renew to USFWS and DLNR at least 90 days prior to the originally stated or extended expiration date of the LOC; it must contain provisions allowing collection by DLNR for failure of the permittee to replace the letter of credit when 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 USFWS and DLNR at least 30 days before its expiration date; and the LOC shall be payable to DLNR upon demand, in part or in full, upon notice stating the basis therefore, e.g., default in compliance with the permit or HCP or the failure to have a replacement for an expiring LOC.

As of June ~~2017~~2018, Tier 1 and 2 bat mitigation has been funded ($375,000) and Tier 3 bat mitigation is in the process of being funded and implemented. Tier 3 bat mitigation cost is estimated to be $~~1,700,000~~ 950,000. Nēnē mitigation funded as of June ~~2017~~2018, is $162,750. An additional estimated $~~235,540~~ 237,250 for Tier 1 take limits is yet to be funded. Seabird mitigation is ongoing and is estimated to cost KWP II $20,000 per year, or $~~300,000~~ 280,000 for ~~15~~ 14 more years. The total funding obligation for mitigation measures for the current Tiers and not completely funded therefore is $1,467,250 ~~2,235,540~~ (Table 7.1).

Contingency for third party compliance monitoring (in case KWP II is unable to fund compliance monitoring while still operating) is like the cost for ongoing compliance monitoring. Funding assurance is provided for one or the other but not both. DOFAW has indicated that to meet the requirement of HRS 195D-4 "to ensure monitoring of the species by the State", five per cent of the current mitigation funding obligation for all species must be provided in the assurances in case the Project ceases operations before current mitigation obligations have been met. Five percent of the current mitigation obligation total of $1,467,250 ~~2,235,540~~ is $146,725 ~~111,777~~.

Contingency funding to account for inflation and possible adaptive management changes is also requested by the USFWS and is at least 10% of mitigation costs not yet funded. Current Tier mitigation not yet funded equals $1,467,250 ~~2,235,540~~ and 10% of this total is $146,725 ~~223,554~~.

Therefore, the total funding assurance required at the time of this amendment is for the remaining

Tier 1 nēnē mitigation, Tier 3 bat mitigation, Tier 1 seabird mitigation costs, the HRS 195D-4 monitoring assurance requirement and USFWS contingency for inflation and potential adaptive management changes amounts to $1,687,338 2,570,871 ($1,467,250 2,235,540 + $73,363111,777 + $146,725223,554).

KWP II funding assurance (LOC) of $1,000,000 was secured in a form approved by the USFWS and DLNR within 30 days of KWP II Permit issuance and is renewed annually. An additional LOC was secured in March 2014 for $554,590. In March 2018 these two LOCs were combined into one LOC for $1,554,590. Funding assurances already implemented amount to $1,554,590 for the HCP program. Unless negotiated otherwise, $132,7481,016,281 more funding assurances will be implemented before amended ITP/ITL issuance. As the projected mitigation funding indicated above is paid, funding assurances will be reduced in equal amount, at least annually.

Table 7.1. Monitoring and Mitigation Funding Assurances -*NEW*

Species	Mitigation Tier	Mitigation Obligation	Funded	Funding Assurance Required
Hawaiian hoary bat	1 and 2	$375,000	$375,000	$0
	3	$1,700,000950,000	$0	$950,0001,700,000
	4	$150,000400,000[1]	$0	$0
Nene	1	$398,290400,000	$162,750	$237,250235,540
	2	$150,000[1]	$0	$0
	3	$300,000	$0	$0
Seabirds	1	No limit established	$348,000	$300,000280,000
Expected Mitigation Funding Total				$1,467,2502,235,540
Federal Contingency (10% Expected Total)				$146,725111,777
State Monitoring Assurance (5% Expected Total)				$73,363223,554
Total Funding Assurance Required (As of FY 2017)				**$1,687,3382,570,871**
Funding Assurance Established				**$1,554,590**
Remaining Funding Assurance to Establish prior to Amended Permit (unless sufficient mitigation has been paid for to reduce the funding assurance)				**$132,7481,016,281**

[1] Estimated cost. Actual cost will be determined and could be more or less than the estimates.

When KWP II LLC reaches 75% of the take within a tier, funding assurances for additional tiers would be required for all covered species before the next tier of take is authorized. The effective date for the next tier of take authorization will be dependent on submission of proof of that tier's funding assurance in a form acceptable to the Service. Absent that proof, the Service may consider KWP II LLC to be out of compliance and the permit subject to suspension or other enforcement action.

KWP II funding assurance (LOC) of $1,000,000 was secured in 2010 in a form approved by the USFWS and DLNR within 30 days of KWP II Permit issuance and is renewed annually. An additional LOC secured in March 2014 for $554,590 continues to be renewed annually. KWP II Newell's shearwater take requested will be limited to the Tier 1 take level until KWP II LLC secures, in a form approved by the USFWS and DLNR, a total of $1,554,590, or less with approval of USFWS and DLNR, in funding assurance for the KWP II project, in addition to the seabird mitigation funding already in place pursuant to the KWP I HCP.

According to HRS §195D-23 (c)(4)(d), DOFAW "may establish a habitat conservation technical assistance program to assist landowners in developing, reviewing, or monitoring habitat conservation plans by providing technical assistance. The department may collect fees and payment for costs incurred for use of the technical assistance program in the development, review, or monitoring of a specific habitat conservation plan. Fees shall be charged at an hourly rate of $50. The fees and payment for costs collected pursuant to this subsection shall be deposited into the endangered species trust fund established under section 195D-31." DOFAW billing for the State HCP program and supporting staff per HRS §195D-23 (c)(4)(d) with hours listed for each individual will be paid by KWP II upon receipt of billing up to the amount budgeted per annum, or higher in connection with development of an amendment for the HCP, when substantial adaptive management is required, or there are major compliance or legal issues. The estimated annual cost to KWP II is $8,000.

7.5 Changed Circumstances *-UPDATED*

The HCP process allows for acknowledgement of, and planning for, reasonably anticipated changes in circumstances affecting the subject species, other species occurring in the project area, or in efforts expended toward mitigation. Changed circumstances are *changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that can reasonably be anticipated by plan or agreement developers and the Service and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events)* (50 CFR 17.3). Changed circumstances that can be anticipated are not unforeseen circumstances, as described below.

Changed circumstances that may affect the implementation of the HCP include, but are not limited to:

1. ***Listing of New Species or Delisting of a Covered Species***

   If a new species that occurs on the island of Maui is added to the federal or state endangered species list, KWP II will evaluate the likelihood of incidental take of the species due to Project operation. If incidental take appears possible, KWP II 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. KWP II 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 the Service or DOFAW. Should any of the Covered Species become delisted over the permit term, KWP II will consult with USFWS and DOFAW to determine if mitigation measures should be discontinued.

   In the event that one or more species that occur on-site are listed pursuant to the ESA, the Applicant will evaluate the degree to which the species is (or are) at risk of being incidentally taken by project operations. If take of the species appears possible, the Applicant will then assess whether the mitigation measures already being implemented provide conservation benefits to the newly listed species and if any additional measures are needed to provide a net conservation benefit to the species. The Applicant would then seek coverage for the newly listed species under an amendment to the HCP if it is determined that the coverage would benefit both Kaheawa Wind Power II and the species.

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 will be considered a changed circumstance provided for in the plan. KWP II, in consultation with USFWS, will implement adjustments in covered activities in 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, KWP II will adjust activities until

KWP II has an approved amendment. Such adjustments may also require amendment of the ITP, in accordance with then applicable statutory and regulatory requirements, or until the USFWS notifies KWP II that the adjustments are no longer necessary.

3. ***Catastrophic Events*** ***Natural disasters, such as hurricanes, storms or fire of sufficient magnitude to significantly affect the Project site or mitigation sites for any of the Covered Species.***

Hurricanes and severe storms periodically strike or affect the Hawaiian Islands, and the likelihood of a hurricane causing severe damage on Hawaii 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 KWP II 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 Hawaii 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 efforts will be modified to respond to impacts to the covered species from a hurricane should USFWS and DOFAW reasonably determine in consultation with KWP II that such a response is necessary.

4. ***Invasive Species*** ***Deleterious change in relative abundance of non-native plant species or ungulates occurring at the mitigation sites for Covered 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 efforts will be modified should USFWS and DOFAW reasonably determine after consultation with KWP II that such a response is necessary.

Should the proportion or coverage of non-native plant species or ungulates increase at any mitigation site to a point where it is believed that this change is causing significant habitat degradation or loss of habitat for any of the Covered Species, thereby resulting in a measurable decline of the species at the site, the Applicant will consult with DLNR and USFWS to determine if measures to prevent the further spread of non-native plants or incursion of ungulates are available, practical and necessary. If no such measures are available, mitigation measures for the affected Covered Species may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP which includes funding available for the tier of mitigation required and the Surety Letter of Credit if mitigation actions have not been fully achieved or unmitigated take remains.

5. ***Disease Outbreaks Affecting Covered Species*** ***The outbreak of disease affecting the Covered Species.***

Should prevalence of disease increase substantially and become identified by DLNR 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 the HCP, the HCP mitigation efforts will be modified should USFWS and DLNR reasonably determine after consultation with KWP II that such a response is necessary.

~~Disease is considered one of the lesser threats to the persistence of the seabirds, nēnē and bats covered in the HCP. Newell's shearwater and Hawaiian petrel have not been documented to have disease outbreaks, although Newell's shearwater fledglings have been found with mild symptoms of avian pox (Ainley et al. 1997; Mitchell et al. 2005; Simons and Hodges 1998). Nēnē are not considered to be limited by disease, although omphalitis, an infection of the umbilical stump, has been found to cause mortality in both wild and captive nēnē goslings (USFWS 2004a). These geese have also been documented to have been infected with avian pox and avian malaria but no deaths have been attributed to either disease (USFWS 2004a). It is considered possible that the introduction of West Nile virus may affect the survival of nēnē (USFWS 2004a). It is currently not known if the Hawaiian hoary bat is susceptible to any diseases. Should the prevalence of disease increase dramatically and become identified as a major threat to the survival of any of the Covered Species by DLNR and USFWS, the Applicant will consult with DLNR and USFWS to determine if changes in monitoring, reporting or mitigation are necessary to provide assistance in documenting or reducing the impact of the disease. If USFWS and DLNR determine that no such measures are available, mitigation measures for the affected Covered Species may be implemented at another site as determined with DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP, which includes funding available for the tier of mitigation required and the Surety Letter of Credit if mitigation actions have not been fully achieved or unmitigated take remains.~~

~~***6. Changes in the price of raw materials and labor.***~~

~~Annual reviews will be performed to analyze the costs in the previous year's budget for mitigation expenses and cumulative costs. Annual expenses for subsequent years will be adjusted to meet projected costs based on previous years' expenditures and cumulative spent to date.~~

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, because 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, KWP II would seek coverage under an amendment to the existing HCP and avoid non-authorized take until the permit is amended. As part of that process, KWP II 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.

7. ***Development of an Effective, Economical, and Commercially-viable Bat Deterrent***

Preliminary research indicates that technologies may be developed during the Project permit term that could deter the Hawaiian hoary bat from flying into the airspace near the WTG rotors (Szewczak and Arnett 2007, Arnett *et al.* 2013). Such a development could be used independently or in coordination with low wind speed curtailment to further reduce the risk of Hawaiian hoary bat fatalities. If an effective, economical, and commercially-viable bat deterrent technology becomes available during the Project's permit term, KWP II will consult with USFWS and DOFAW to determine if implementation of the technology is appropriate and, if implemented, how to measure the effectiveness of the measure.

8. Global Climate Change ~~Significantly and Negatively~~ 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; US Climate Change Science Program 2009), which may increase the risk of damage to established mitigation sites. Sea level is predicted to rise approximately 1 m in Hawai'i 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 1 m (3 feet).

Precipitation may decline by 5%–10 % in the wet season and increase 5% 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 DLNR reasonably determine after consultation with KWP II 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 DLNR reasonably determine after consultation with KWP II that such a response is necessary.

~~Global climate change within the life of the project (20 years) has some limited potential to alter the current distribution of vegetation communities utilized by the Covered Species through region-wide changes in weather patterns, sea level, average temperature and levels of precipitation (IPCC 2007). In some instances, climate change may also cause populations of Covered Species to decline. Covered seabird species are likely to be affected through changes in the distribution of their food resources at sea and possible changes in the vegetation at their preferred nesting habitats. The distribution of nēnē native food resources, particularly at high elevations, may change if climate change alters the range of native plants that they utilize. Nēnē, however, are also able to use a wide variety of non-native food resources. Hawaiian hoary bats are not expected to be affected by any changes in climate over the life of the project due to their ability to utilize nonnative habitats which are unlikely to decrease in availability during that time frame.~~

~~With climate change, hurricanes or storms may occur with greater intensity (Webster et al. 2005; U.S. Climate Change Science Program 2009), which would increase the risk of damage to established mitigation sites. This is discussed in Scenario 8 below. Sea level is predicted to rise approximately 1 m in Hawai'i by the end of the 21st century (Fletcher 2009). Given this, any rise in sea level experienced during the life of the project would likely be less than 1 m. As all the mitigation sites for the Covered Species are at or more than 1 m above sea level, these sites are unlikely to be impacted by sea level rise while the project is operational.~~

~~Precipitation may decline by 5-10% in the wet season and increase 5% in the dry season, due to climate change (Giambelluca et al. 2009). Vegetation at the seabird or nēnē mitigation sites may change with decreased precipitation or increased temperatures; however, changes are expected to be small over the lifetime of the project. Should significant changes in vegetation be deemed to be occurring and demonstrated to affect the productivity of the Covered seabird species or nēnē, other mitigation sites will be considered for continued mitigation if deemed necessary and will be chosen with approval of USFWS and DLNR. In all cases, mitigation efforts will mitigate impacts of the requested take to the covered species to the maximum extent practicable and avoid jeopardy (unless agreed by all parties otherwise) with a net benefit provided to each Covered Species as required by State law.~~

~~Any changes in the mitigation measures implemented for any of the Covered Species due to climate change will be performed under the budget established for mitigation expenses in this HCP, which includes the Surety Letter of Credit if mitigation actions have not been fully achieved or unmitigated take remains.~~

9. Adaptive management

The U.S. Department of the Interior defines adaptive management as a structured approach to decision making in the face of uncertainty that makes use of the experience of management and the results of research in an embedded feedback loop of monitoring, evaluation, and adjustments in management strategies (Williams & Brown, 2009; Williams *et al.* 2009). Uncertainties may include a lack of biological information for the Covered Species, a lack of knowledge about the effectiveness of mitigation or management techniques, or doubt about the anticipated effects of the Project. Adaptive management is a required component of HCPs that allows for the incorporation of new information into conservation and mitigation measures during HCP implementation. Effective implementation of this approach requires explicit and measurable objectives, and identifies what actions are to be taken and when they are to occur. Adaptive management measures do not trigger the need for an amendment unless they would increase amount of incidental take or effects to the covered species through a reduction in mitigation.

~~occur at the seabird mitigation site, and then increase to the point where the dieback causes significant loss of habitat for seabirds, thereby resulting in a measurable decline of the species at the site, the Applicant will consult with DLNR and USFWS to determine if measures to prevent the further spread of the dieback are available, practical and necessary. If USFWs and DLNR determine that measures to prevent further spread of the dieback are not available, the Applicant will explore other measures available to re-create nesting habitat, such as the use of artificial burrows. The use of another seabird colony for the implementation of mitigation efforts may also be explored. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented under the budget established for mitigation expenses in the HCP, which includes funding available for the tier of mitigation required and the Surety Letter of Credit if mitigation actions have not been fully achieved or unmitigated take remains.~~

10. Increased abundance of predators at the seabird mitigation site.

If an increase in predator occurrence is observed or becomes unmanageable during the implementation of mitigation for seabirds at Makamakaʻole and/or any other seabird study areas supported by KWP II mitigation, or if such changes affect monitoring or the success of mitigation, then the Applicant will consult with DLNR and USFWS and the USFWS and DLNR will reasonably determine if measures to prevent further ingress of predators are necessary. KWP II will implement such measures to meet mitigation obligations. Such measures may include more aggressive removal of predators and/or modification of mitigation actions. If USFWS and DLNR determine that no such measures are available, mitigation measures for seabirds will be implemented at another site as determined by DLNR and USFWS. Any such measures and consequent changes in monitoring, reporting or mitigation as deemed appropriate by DLNR and USFWS will be implemented by KWP II.

The Applicant will report such changes as they occur and DLNR and USFWS would work with the Applicant as soon as possible to discuss any necessary changes in the implementation of the HCP. The Applicant will implement changes determined to be necessary by USFWS and DLNR as soon as possible and will assist DLNR and USFWS in any related response or remediation efforts. Such changes are, therefore, provided for in this HCP and do not constitute unforeseen circumstances or require the amending of the ITP or ITL.

The Applicant will implement additional conservation and mitigation measures deemed necessary to respond to changed circumstances as provided for and specified in the HCP's adaptive management strategy (50 CFR 17.22(b)(5) and 50 CFR 17.32(b)(5).

7.6 Unforeseen Circumstances and "No Surprises" Policy *-UPDATED*

Unforeseen circumstances are changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that could not reasonably have been anticipated by the plan or agreement between developers and the USFWS at the time of the conservation plan's or agreement's negotiation and development, and that result in a substantial and adverse change in the status of the covered species (50 CFR 17.2).

It is further acknowledged that circumstances may arise that are not fully contemplated by this HCP and that may result in substantial or adverse impacts to the biological status of any of the four subject species or their habitat. Such impacts may or may not be a result of the operation of the proposed facility. If and when the Applicant, USFWS or DLNR become aware of any circumstances that may affect any listed species and/or the ability of the Applicant to implement this HCP, all involved entities will be immediately notified and meet as soon as possible to discuss the circumstances and identify appropriate action.

In negotiating unforeseen circumstances, the USFWS will not require the commitment of additional land, water or financial compensation or additional restrictions on the use of land, water or other natural resources beyond the level otherwise agreed upon for the species covered by the HCP without the consent of the Applicant [50 CFR 17.22(b)(5)(iii) and 50 CFR 17.32(b)(5)(iii)]. If additional conservation and mitigation measures are deemed necessary to respond to unforeseen circumstances, and the HCP is being properly implemented, the USFWS may require additional measures of the Applicant only if such measures are limited to modifications within conserved habitat areas, if any, or to the HCP's operating conservation program for the affected species, and maintain the original terms of the HCP to the maximum extent possible.

A "No Surprises" policy provides that, in negotiating "unforeseen circumstances" provisions for HCPs, USFWS and DLNR shall not require the commitment of additional land or financial compensation beyond the level of mitigation that was otherwise adequately provided for the four listed species under the proper implementation of this HCP. Additionally, USFWS and DLNR will not seek, nor will the Applicant be required to provide, any other mitigation beyond that provided for in the mitigation and minimization program, adaptive management program, or changed circumstances section (Sec. 7.5) of this HCP. Any other changes will be limited to measures that can be accomplished within the parameters of the existing wind energy generation facility and its operation and as agreed upon by the Applicant. Additional conservation and mitigation measures will not involve the commitment of additional land, water or financial compensation or additional restrictions on the use of land, water or other natural resources otherwise available for development or use under the original terms of the HCP without the consent of the Applicant.

The "No Surprises" policy also provides that "if additional mitigation measures are subsequently deemed necessary to provide for the conservation of a species that was otherwise adequately covered under the terms of a properly functioning HCP, the obligation for such measures shall not rest with the HCP Permittee." Specific to this HCP, the Permittee will not have to mitigate for any increased take of nēnē (either assessed as direct take or indirect take) due to population or habitat enhancement measures (see Sections 6.4.2.2 and 6.4.3.2) that may be conducted in the vicinity of the project as part of their mitigation requirements.

The USFWS and DLNR will have the burden of demonstrating that unforeseen circumstances exist, using the best scientific and commercial data available. These findings must be clearly documented and based upon reliable technical information regarding the status and habitat requirements of the affected species. The USFWS and DLNR will notify the Applicant in writing should the USFWS or DLNR believe that any unforeseen circumstance has arisen.

7.7 Permit Duration and Amendments *-NO CHANGE*

The Applicant proposes to have a HCP in effect for the duration of the wind energy generation facility's operation, which is anticipated to be 20 years.

7.7.1 Minor Amendments

Informal, minor amendments are permissible without a formal amendment process provided that the change(s) necessitating such amendment(s) does not cause an adverse effect on any of the four Covered Species that is significantly different from the effects considered in the original HCP. Such informal amendments could include, but are not necessarily limited to, routine administrative revisions, changes to surveying or monitoring protocols that do not decrease the level of mitigation or increase take. A request for a minor amendment to the HCP may be made with written notice to USFWS and DLNR. The amendment will be implemented upon receiving written concurrence from both the agencies.

7.7.2 Formal Amendments

Formal amendments are required if the change(s) necessitating such amendment(s) could produce an adverse effect on any of the four Covered Species that is significantly different than any of those considered in the original HCP. For example, a formal amendment would be required if the documented level of take exceeds that covered by the HCP's adaptive management program.

A formal amendment also would be required if another listed species is found to occur in the project area and could be adversely affected by project activities. This HCP may be formally amended upon written notification to USFWS and DLNR with the same supporting information that was provided with the original application. The need for a formal amendment should be determined at least one year before permit expiration, as a formal amendment may require additional baseline surveys and data collection, additional or modified minimization and/or mitigation measures, and/or additional or modified monitoring protocols, a supplemental NEPA evaluation, and additional public review.

7.7.3 Renewal or Extension

This HCP can be renewed or extended, and amended if necessary, beyond its initial 20-year term with the approval of USFWS and DLNR. The process for seeking renewal of the Federal permit shall be governed by the regulations in effect at the time (currently codified at 50 CFR & 13.22). The following addresses the process to seek renewal of the State permit. The Applicant will submit a written request to both agencies, will either certify that the original information and conditions are still correct or provide a description of relevant changes, and will provide specific information concerning the level of take that has occurred under the HCP's implementation. Such a request shall be made at least 180 days prior to the conclusion of the permit term. Under State of Hawai'i law, the HCP will remain valid and in effect during processing only if the renewal or extension is processed during the original permit term. The permit may not be renewed for levels of take beyond those authorized by the original permit.

7.7.4 Other Measures

Issuance criteria under ESA Section 10(a)(2)(B) authorize USFWS to obtain such other assurances as may be required that the HCP will be implemented.

8.0 CONCLUSION -UPDATED

KWP II LLC looks forward to working with the USFWS and DLNR throughout the approval and long-term implementation of the HCP amendment for the KWP II project. While commercial wind energy generation facilities are acknowledged to be environmentally friendly endeavors, they are not without potential negative environmental impacts. The Applicant is committed to making all reasonable and appropriate efforts to avoid, minimize and compensate for these impacts as evaluated and determined through the HCP process and its adaptive management strategy.

9.0 REFERENCES CITED ***-UPDATED***

Adams, Josh. 2008. "Petrels in the Pacific: Tracking the Far-ranging Movements of Endangered 'Ua'u (Hawaiian Petrel)," U.S. Geological Survey, Western Ecological Research Center. www.microwavetelemetry.com/newsletters/spring_2007Page4.pdf

American Ornithologists' Union. 1998. *Check-list of North American Birds*. 7th ed. American Ornithologists' Union, Washington, DC. 829 pp.

Ainley, D.G., L. DeForest, N. Nur, R. Podolsky, G. Spencer, and T.C. Telfer. 1995. Status of the threatened Newell's Shearwater on Kaua'i: Will the population soon be endangered?

Ainley, D.G., T.C. Telfer, and M.H. Reynolds. 1997. Townsend's and Newell's Shearwater (*Puffinus auricularis*). In *The Birds of North America*, No. 297, edited by A. Poole and F. Gill. The Birds of North America, Inc., Philadelphia, PA.

Ainley, D.G., R. Podolsky, L. DeForest, G. Spencer, and N. Nur. 2001. The status and population trends of the Newell's shearwater on Kaua'i: insights from modeling. *Studies in Avian Biology* 22:108-123.

Arnett, E.B., ed. 2005. Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of bat fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. http://www.batcon.org/windliterature

Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley, Jr. 2008. "Patterns of Bat Fatalities at Wind Energy Facilities in North America." *Journal of Wildlife Management* 72(1):61–78.

Arnett, E.B., M. Schirmacher, M.M.P. Huso, and J. Hayes. 2009. Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas.

Arnett, E.B., M.M.P. Huso, M.R. Schirmacher, and J.P. Hayes. 2010. Changing wind turbine cut-in speed reduces bat fatalities at wind facilities. Frontiers in Ecology and the Environment 9(4): 209–214; doi:10.1890/100103 (published online 1 November 2010).

Arnett E.B., G.D.Johnson, W.P Erickson, and C.D. Hein. 2013. A synthesis of operational mitigation studies to reduce bat fatalities at wind energy facilities in North America. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International. Austin, Texas, USA.

Arnett, E. B., C. D. Hein, M. R. Schirmacher, M. M. P. Huso, and J. M. Szewczak. 2013. Evaluating the effectiveness of an ultrasonic acoustic deterrent for reducing bat fatalities at wind turbines. PLoS ONE 8(6): e65794. Doi:10.1371/journal.pone.0065794

APLIC (Avian Power Line Interaction Committee). 1994. Mitigating Bird Collisions with Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington, DC.

———. 2006. Suggested Practices for Avian Protection On Power Lines: The State of the Art in 2006. Edison Electric Institute, APLIC, and the California Energy Commission. Washington, DC and Sacramento, CA.

Auwahi Wind Energy LLC. 2014. Auwahi Wind Farm Habitat Conservation Plan FY2014 Annual Report. PO Box 901364, Kula, HI. 18 pp + app.

———. 2015. Auwahi Wind Farm Habitat Conservation Plan FY2015 Annual Report. PO Box 901364, Kula, HI. 19 pp + app.

———. 2016. Auwahi Wind Farm Habitat Conservation Plan FY2016 Annual Report. PO Box 901364, Kula, HI. 16 pp + app.

———. 2017. Auwahi Wind Farm Habitat Conservation Plan FY2017 Annual Report. PO Box 901364, Kula, HI. 16 pp + app.

Baerwald, E.F., and R.M.R. Barclay. 2009. Geographic Variation in Activity and Fatality of Migratory Bats at Wind Energy Facilities. *Journal of Mammology* 90(6):1341-1349.

Baerwald, E.F., G.H. D'Amours, B.J. Klug, and R.M.R. Barclay. 2008. Barotrauma is a Significant Cause of Bat Fatalities at Wind Turbines. *Current Biology* 18(16):695-696.

Baker, P. E. and H. Baker. 1996. Nene report: egg and gosling mortality in Haleakala National Park, 1994-95. Honolulu: Final report submitted to Hawai'i Dept. of Land and Natural Resources, Div. of Forestry and Wildlife.

Baker, H., and P.E. Baker. 1999. Nēnē gosling mortality in Haleakalā National Park, Maui, 1995/96 breeding season. Report to Hawaiʽi Department of Land and Natural Resources, Division of Forestry and Wildlife. Unpublished document. 31 pp.

Baldwin, P.H. 1950. Occurrence and behavior of the Hawaiian bat. *Journal of Mammalogy* 31:455-456.

Banko, P.C. 1988. Breeding biology and conservation of the Nēnē, Hawaiian goose (*Nesochen sandvicensis*). Ph.D. dissertation, University of Washington, Seattle. 255 pp.

———. 1992. Constraints on productivity of wild Nēnē or Hawaiian Geese *Branta sandvicensis*. *Wildfowl* 43:99–106.

Banko, P.C., J.M. Black, and W.E. Banko. 1999. Hawaiian Goose (Nēnē) (*Branta sandvicensis*). In *The Birds of North America*, No. 434, edited by A. Poole and F. Gill. The Birds of North America, Inc., Philadelphia, PA.

Banko, P., R. Peck, S.G. Yelenik, E. Paxton, F. Bonaccorso, K. Montoya-Aiona, and D. Foote. 2015. Dynamics and Ecological Consequences of the 2013-2014 Koa Moth Outbreak at Hakalau Forest National Wildlife Refuge. Hawaii Cooperative Studies Unit Tech. Rep. HCSU-058, 82 pp.

Bat Conservation International & the National Renewable Energy Laboratory. 2013. Acoustic Deterrent Workshop, National Wind Technology Center, Louisville, CO. August 23, 2013. 15 pp.

Bell, M., B. D. Bell, and E. A. Bell. 2005. Translocation of fluttering shearwater (*Puffinus gavia*) chicks to create a new colony. Notornis 52:11–15

Bellwood, J.J., and J.H. Fullard. 1984. Echolocation and Foraging Behavior in the Hawaiian Hoary Bat, *Lasiurus cinereus semotus*. *Canadian Journal of Zoology* 62:2113-2120.

Black, J.M., and P.C. Banko. 1994. Is the Hawaiian Goose (*Branta sandvicensis*) saved from extinction? In Creative Conservation: Interactive Management of Wild and Captive Animals, edited by P.J.S. Olney, G.M. Mace, and A.T.C. Feistner. pp. 394-410. London: Chapman and Hall.

Bolton, M., R. Medeiros, *et al.* 2004. "The use of artificial breeding chambers as a conservation measure for cavity-nesting procellariiform seabirds: A case study of the Madeiran storm petrel (*Oceanodroma castro*)." Biological Conservation 116: 73-80.

Bonaccorso, F. 2008. Annual Summary Report: Hawaiian Hoary Bat Occupancy in Hakalau Forest National Wildlife Refuge. Special Use Permit: 12516-07008.

Bonaccorso, F.J. 2011. Opeʽapeʽa – solving the puzzles of Hawaii's only bat. *Bats* 28(4):10-12.

Bonaccorso, F.J., and C.M. Todd, A.C. Miles and P.M Gorresen. 2015. Foraging range movements of the endangered Hawaiian hoary bat, *Lasiuris cinereus semotus* (Chiroptera: Vespertilionidae). *Journal of Mammalogy*, 96(1):64-71, 2015.

Bradley, J.S., R.D. Wooller, I.J. Skira, and D.L. Serventy. 1989. Age-dependent survival of breeding short-tailed shearwaters *Puffinus tenuirostris*. *Journal of Animal Ecology* 58:175–188.

Byrd, G. V., D. I. Moriarity, *et al.* 1983. "Breeding biology of the wedge-tailed shearwater at kilauea point, hawaii." The Condor 85: 292-296.

Cooper, B.A., and R.H. Day. 1998. Summer behavior and mortality of Dark-rumped Petrels and Newell's Shearwaters at power lines on Kauaʽi. *Colonial Waterbirds* 21:11–19.

———. 2003. Movement of Hawaiian Petrels to inland breeding sites on Maui Island, Hawaiʽi. *Waterbirds* 26:62–71.

———. 2004. Results of Endangered Bird and Bat Surveys at the Proposed Kaheawa Pastures Wind Energy Facility on Maui Island, Hawaiʽi, Fall 2004. Prepared by ABR, Inc., Forest Grove, OR and Fairbanks, AK for Kaheawa Wind Power, LLC, Makawao, HI and UPC Wind Management, LLC, Newton, MA. 16 pp.

———. 2009. Radar and Visual Studies of Seabirds at the Proposed KWP II Down-Road Alternative Wind Energy Facility, Maui Island, Hawaii, Summer 2009. Prepared for First Wind.

Cryan, P.M. 2008. Mating Behavior as a Possible Cause of Bat Fatalities at Wind Turbines. *Journal of Wildlife Management* 72(3):845-849.

Cryan, P.M. 2011. Wind turbines as landscape impediments to the migratory connectivity of bats. *Environmental Law* 41:355-370.

Cryan, P.M., and A.C. Brown. 2007. Migration of Bats Past a Remote Island Offers Clues Toward the Problem of Bat Fatalities at Wind Turbines. *Biological Conservation* 129(1-2):1-11.

Cryan, P.M., P.M. Gorresen, C.D. Hein, M.R. Schirmacher, R.H. Diehl, M.M. Huso, D.T.S. Hayman, P.D. Fricker, F.J. Bonaccorso, D.H. Johnson, K. Heist, and D.C. Dalton. 2014. Behavior of Bats at Wind Turbines. *Proceedings of the National Academy of Sciences* 111(42):15126–15131.

Dalthorp, D. H., M. M. P. Huso, D. Dail, and J. Kenyon. 2014. Evidence of Absence Software. Corvallis, OR: USGS. ISBN. Available online at http://pubs.usgs.gov/ds/0881/.

Dalthorp, D., M.M.P. Huso, and D. Dail. 2017. Evidence of absence (v 2.0) software user guide: U.S. geological Survey Data Series 1055, 109p. https://doi.org/10.3133/ds1055 .

Day, R.H., and B.A. Cooper. 1995. Patterns of movement of Dark-rumped Petrels and Newell's Shearwaters on Kauaʽi. *The Condor* 97:1011–1027.

———. 1999. Results of Endangered Bird and Bat Surveys at the Proposed Kaheawa Pastures Windfarm on Maui Island, Hawaiʽi, Summer 1999. Prepared by ABR, Inc., Forest Grove, OR and Fairbanks, AK for Zond Pacific, Wailuku, HI. 26 pp.

———. 2001. Results of petrel and shearwater surveys on Kauaʽi, June 2001. Unpublished report prepared for U.S. Fish and Wildlife Service, Honolulu, HI, by ABR, Inc., Fairbanks, AK, and

Forest Grove, OR. 21 pp.

———. 2002. Petrel and shearwater surveys near Kalaupapa, Molokai Island, June, 2002. Final report to the National Park Service, Hawaii National Park. ABR, Inc., Fairbanks, Alaska.

———. 2008. Interim Report: Oahu Radar & Audiovisual studies, Fall 2007 and Summer 2008. ABR, Inc. Environmental Research & Services.

Day, R.H., B.A. Cooper, and T.C. Telfer. 2003. Decline of Townsend's (Newell's) Shearwaters (*Puffinus auricularis newelli*) on Kaua'i, Hawai'i. *The Auk* 120:669-679.

del Hoyo, J., A. Elliott, and J. Sargatal. 1992. Ostrich to Ducks. In *The Handbook of the Birds of the World*, Vol. I. Barcelona: Lynx Editions.

Department of Land and Natural Resources (DLNR). 2007. Proposed hazard reduction and reforestation operations, in the aftermath of the Upper Waiohuli wildfire. January 23-February 5, 2007, Kula Forest Reserve.

DOFAW (DLNR's Division of Forestry and Wildlife). 2000. Survey of the Nēnē population on Maui. *'Elepaio* 60:25-28.

———. 2009a. Annual report. Pittman-Robertson Non-game management grant. Nēnē Surveys.

Division of Forestry and Wildlife. 2015. Endangered Species Recovery Committee Hawaiian Hoary Bat Guidance Document 2015. State of Hawai`i Department of Land and Natural Resources Division of Forestry and Wildlife. December 17, 2015.

Dobson A.F., and J. Madeiros. 2009. Threats facing Bermuda's breeding seabirds: measures to assist future breeding success. *Proceedings of the Fourth International Partners in Flight Conference Tundra to Tropics*, pp. 223-226.

Draft Habitat Conservation Plan or the Construction of the Advanced Technology Solar Telescope at the Haleakalā High Altitude Observatory Site Maui, Hawaii, 2010. http://hawaii.gov/dlnr/dofaw/pubs/DRAFT_HCP_ATST_OEQC.pdf

Ebbert, S.E., and G.V. Byrd. 2002. Eradications of invasive species to restore natural biological diversity on Alaska Maritime National Wildlife Refuge. In *Turning the Tide: the Eradication of Invasive Species*, edited by C. Veitch and M. Clout, pp. 102-109. IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, United Kingdom.

Erickson, W.P. 2003. Updated information regarding bird and bat mortality and risk at new generation wind projects in the West and Midwest. National Wind Coordinating Committee, Wildlife Workgroup Meeting, November 18, 2003. Resolve, Inc., Washington, DC. http://www.nationalwind. org/events/wildlife/2003 -2/presentations/erickson.pdf

Erickson, W.P., M.D. Strickland, G.D. Johnson, and J.W. Kern. 1998. Examples of statistical methods to assess risks of impacts to birds from wind plants. In *PNAWPPM-III: Proceedings of the Avian-Wind Power Planning Meeting III, San Diego, CA.* National Wind Coordinating Committee Meeting, Washington, DC, May 1998. Prepared for the Avian Subcommittee of the National Wind Coordinating Committee by LGL, Ltd., King City, Ontario.

Erickson, W.P., G.D. Johnson, M.D. Strickland, D.P. Young, Jr., K.J. Sernka, and R.E. Good. 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States. National Wind Coordinating Committee Publication.

Federal Register. 2004. Incidental Take Permit and Habitat Conservation Plan for the Kaua'i Island Utility Cooperative, Hawai'i. *Federal Register* 69(135):42447-42449.

Fiedler, J.K., T.H. Henry, C.P. Nicholson, and R.D. Tankersley. 2007. Results of bat and bird mortality monitoring at the expanded Buffalo Mountain Windfarm, 2005. Tennessee Valley Authority, Knoxville. http://www.batcon.org/windliterature

Follett P.A., P.A. Anderson-Wond, M.T. Johnson, and V.P. Jones. 2003. Revegetation in Dead *Dicranopteris* (Gleicheniaceae) Fern Patches Associated with Hawaiian Rain Forests. *Pacific Science* 57(4):347-357.

Fletcher C.H. 2009. Current Understanding of Global Sea-level Rise and Impacts in Hawai'i. Presentation by the Coastal Geology Group, accessible at: http://www.soest.hawaii.edu/coasts/sealevel/FletcherSeaLevel09_web.pps

Foote, D.E., E.L. Hill, S. Nakamura, and F. Stephens. 1972. Soil Survey of the Islands of Kaua'i, O'ahu, Maui, Moloka'i, and Lana'i, State of Hawai'i. U.S. Department of Agriculture, Soil Conservation Service.

Frick, W.F., E.F. Baerwald, J.F. Pollock, R.M.R. Barclay, J.A. Szymanski, T.J. Weller, A.L. Russell, S.C. Loeb, R.A. Medellin, and L.P. McGuire. 2017. Fatalities at wind turbines may threaten population viability of a migratory bat. *Biological Conservation*. 209:172-177.

Fullard, J.H. 2001. Auditory Sensitivity of Hawaiian Moths (Lepidoptera: Noctuidae) and Selective Predation by the Hawaiian Hoary Bat (Chiroptera: *Lasiurus cinereus semotus*) *Proceedings of the Royal Society of London B.* 268:1375-1380.

Gangloff, B., Raust, P., Thibault, J, and Bretagnolle, V. 2009. Notes on the Phoenix Petrel (*Pterodroma alba*) from Hatuta`a Island, Marquesas. Waterbirds 32(3):453-458.

Gehring, J., and P. Kerlinger. 2007. Avian Collisions at Communication Towers: II. The Role of Federal Aviation Administration Obstruction Lighting Systems. Prepared for State of Michigan.

Giambelluca, T., H. Diaz , O. Timm. 2009. Climate Variability and Change in Hawai'i. Abstract. In *Hawai'i Conservation Conference 2009 Hawai'i in a Changing Climate: Ecological, Cultural, Economic and Policy Challenges and Solutions*.

Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.-L. Chen, P.-S. Chu, J.K. Eischeid, and D.M. Delparte, 2013: Online rainfall atlas of Hawaii. Bulletin of the American Meteorological Society 94: 313 – 316. doi: 10.1175/BAMS-D-11-00228.1.

Good, R.E., W. Erickson, A. Merrill, S. Simon, K. Murray, K. Bay, and C. Fritchman. 2011. Bat monitoring studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana. Prepared for Fowler Ridge Wind Farm by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

Gorresen, P.M., A.C. Miles, C.M. Todd, F.J. Bonaccorso, and T.J. Weller. 2008. Assessing Bat Detectability and Occupancy with Multiple Automated Echolocation Detectors. *Journal of Mammalogy* 89(1):11–17, 2008.

Gorresen, MP, Bonaccorso FJ, Pinzari CA, Todd CM, Montoya-Aiona K, Brinck K. 2013. A five year study of Hawaiian hoary bat (*Lasiurus cinereus semotus*) occupancy on the island of Hawaii. Hawaii Cooperative Studies Unit Tech. Rep. HCSU-041, 48 pp.

Griesemer AM, ND Holmes. 2010. Newell's shearwater population modeling for HCP and recovery planning – Draft. University of Hawaii and State of Hawaii.

Gummer, H. 2003. Chick translocation as a method of establishing new surface-nesting seabird colonies: a review. New Zealand Department of Conservation report. 40 pp.

Harrison, C. 1990. *Seabirds of Hawaii*: *Natural History and Conservation*. Ithaca: Cornell University Press.

Haines, W. P., M.L. Heddle, P. Welton, and D. Rubinoff. 2009. A recent outbreak of the Hawaiian koa moth, *Scotorythra paludicola* (Lepidoptera: Geometridae), and a review of outbreaks between 1892 and 2003. Pacific Science 63:349-369.

Hayes, G. and G. J. Wiles. 2013. Draft Washington bat conservation plan. Washington Department of Fish and Wildlife, Olympia, Washington. 158+ vi pp.

Hays, W.S.T., and S. Conant. 2007. Biology and Impacts of Pacific Island Invasive Species. 1. A Worldwide Review of Effects of the Small Indian Mongoose, *Herpestes javanicus* (Carnivora :Herpestidae). *Pacific Science* 61(1):3-16.

Hayssen, V., A. van Tienhoven, and A. van Tienhoven. 1993. Asdell's Patterns of Mammalian Reproduction: A Compendium of Species-Specific Data. Cornell University Press, Ithaca, New York, viii+1023 pp.

Hobdy, R.W. 2004a. Botanical Resources Survey for the Kaheawa Pastures Wind Energy Project Access Road – Primary Route. Prepared for Kaheawa Wind Power, LLC. 18 pp.

———. 2004b. Botanical Resources Survey for the Kaheawa Pastures Wind Energy Project Access Road – Alternate Route Section. Prepared for Kaheawa Wind Power, LLC. 11 pp.

———. 2006a. Botanical Resources Survey. Kaheawa Pastures Wind Energy Project II, Ukumehame, Maui, Hawaii. Prepared for Kaheawa Windpower, LLC.

———. 2006b. UPC Kaheawa Wind Power Botanical Resources Assessment in the Turbine Fatality Search Plots, Kaheawa, Hana'ula, West Maui. Prepared for Kaheawa Wind Power, LLC.

———. 2009a. Botanical Resources Survey for the Kaheawa Wind Energy Project, Ukumehame, Maui, Hawaii.

———. 2009b. Post-Fire Botanical Survey and Assessment. Kaheawa Wind Power II, Ukumehame, Maui, Hawaii. Prepared for Kaheawa Wind Power II LLC. January 2009.

———. 2010. Biological Resources Survey, Kaheawa Wind Energy Project 2 (KWP 2), Kaheawa, Maui, Hawaii. Prepared for First Wind Energy, LLC.

Hodges, C.S. 1994. Effects of introduced predators on the survival and fledging success of the endangered Hawaiian Dark-rumped Petrel (*Pterodroma phaeopygia sandwichensis*). M.S. thesis, Univ. of Washington, Seattle.

Hodges, C.S.N., and R.J. Nagata. 2001. Effects of Predator Control on the Survival and Breeding Success of the Endangered Hawaiian Dark-rumped Petrel. *Studies in Avian Biology* 22: 308-318.

Horn, J.W., E.B. Arnett, and T.H. Kunz. 2008. Behavioral Responses of Bats to Operating Wind Turbines. *Journal of Wildlife Management* 72(1):123-132.

Hoshide, H.M., A.J. Price, and L. Katahira. 1990. A progress report on Nēnē *Branta sandvicensis* in Hawai'i Volcanoes National Park from 1974-89. *Wildfowl* 41:152–155.

Hu, D.E. 1998. Causes of endangerment and extinction in Hawaiian birds. Ph.D. dissertation, Univ. of California, Davis.

Hu, D., C. Glidden, J.S. Lippert, L. Schnell, J.S. MacIvor, and J. Meisler. 2001. Habitat use and limiting factors in a population of Hawaiian Dark-romped Petrels on Mauna Loa, Hawai'i. In *Ecology, conservation, and management of endemic Hawaiian birds: A vanishing avifauna*, edited by J.M. Scott, S. Conant, and C. van Riper III, pp. 234-242. *Studies in Avian Biology*, vol. 22.

Hull, C.L. and S. Muir. 2010. Search areas for monitoring bird and bat carcasses at wind farms using a Monte-Carlo model. *Australasian Journal of Environmental Management* 17:77-87.

Huso, M.M.P. 2008. Statistical properties of fatality estimators. Paper presented at NWCC Research Meeting, Milwaukee, Wisconsin. November 2008.

Huso, M.M.P. 2011. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics 22:318-329.

Huso, M. M. P., N. Som, and L. Ladd. 2012. Fatality estimator user's guide. U.S. Geological Survey Data Series 729.

Huso, M. M. P., and D. H. Dalthorp. 2014*a*. Accounting for unsearched areas in estimating wind turbine-caused fatality. Journal of Wildlife Management 78:347–358.

Huso, Manuela M.M.P., D.H. Dalthorp, D.A. Dail, and L.J. Madsen. 2015. Estimating wind-turbine caused bird and bat fatality when zero carcasses are observed. Ecological Applications, v. 25, no. 5, p. 1213-1225, http://dx.doi.org/10.1890/14-0764.1

IPCC (Intergovernmental Panel on Climate Change). 2007. Summary for Policymakers. In *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller. Cambridge, UK and New York: Cambridge University Press.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study–2006. Annual report prepared for PPM Energy and Horizon Energy, Curry and Kerlinger LLC, Cape May Point, New Jersey, USA. http://www.batcon.org/windliterature

Johnson, G.D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, and D.A. Shepherd. 2000. Final report, avian monitoring studies at the Buffalo Ridge, Minnesota wind resource area: results of a 4-year study. Prepared for Northern States Power Company, Minneapolis, by Western Ecosystems Technology, Inc.

Johnson, G.D., W.P. Erickson, and M.D Strickland. 2003a. Mortality of Bats at a Large-scale Wind Power Development at Buffalo Ridge, Minnesota. *American Midland Naturalist* 150(2):332-342.

———. 2003b. What is Known and Not Known About Bat Collision Mortality at Wind plants? In *Proc. Workshop on Avian Interactions at Wind Turbines*, edited by R.L. Carlton. October 16- 17, 2002, Jackson Hole, WY. Electric Power Research Inst., Palo Alto, CA.

Johnson, G.D. 2005. A review of bat mortality at wind-energy developments in the United States. *Bat Research News* 46:45–49.

Joyce, T., B. Zaun, D. Kuhn, and N. Holmes. 2008. A seabird social attraction project at Kilauea Point National Wildlife Refuge. Abstract from the 16th Hawaii Conservation Conference, 2008. http://hawaii.conference-services.net/resources/337/1232/pdf/HCC16_0225.pdf

Kaheawa Wind Power LLC. 2004. Kaheawa Pastures Wind Energy Generation Facility Final Environmental Assessment. Prepared by Kaheawa Wind Power LLC, Makawao, HI.

———. 2006. Kaheawa Pastures Wind Energy Generation Facility Habitat Conservation Plan. Ukumehame, Maui, Hawaiʻi.

———. 2007a. Kaheawa Pastures Wind Energy Generation Facility Habitat Conservation Plan 2006 Annual Report Part 1, 43 pp.

———. 2007b. Kaheawa Pastures Wind Energy Generation Facility Habitat Conservation Plan 2006 Annual Report Part 2, 52 pp.

———. 2008a. KWP I and KWP II Acoustic Monitoring of Bat Activity. Unpublished report.

———. 2008b. Kaheawa Pastures Wind Energy Generation Facility, Habitat Conservation Plan: Year 1 Annual Report (Part II). First Wind Energy LLC, Environmental Affairs, Newton, MA. 23 pp.

———. 2008c. Kaheawa Pastures Wind Energy Generation Facility, Habitat Conservation Plan: Year 2 Annual Report. First Wind Energy LLC, Environmental Affairs, Newton, MA. 26 pp.

———. 2009. Kaheawa Pastures Wind Energy Facility, Habitat Conservation Plan: Year 3 Annual Report. First Wind Energy LLC, Environmental Affairs, Newton, MA. 37 pp.

———. 2010. Kaheawa Pastures Wind Energy Facility, Habitat Conservation Plan: Year 4 Annual Report. First Wind Energy LLC, Environmental Affairs, Newton, MA. 35 pp + app.

———. 2011. Kaheawa Pastures Wind Energy Generation Facility, Habitat Conservation Plan: Year 5 Annual Report. First Wind Energy, LLC, Wailuku, HI. 24 pp + app.

———. 2012. Kaheawa Pastures Wind Energy Generation Facility, Habitat Conservation Plan: Year 6 Annual Report. First Wind Energy, LLC, Wailuku, HI. 25 pp + app.

———. 2014. Habitat Conservation Plan: Fiscal Year 2014 Annual Report. First Wind Energy, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 34 pp + app.

———. 2015. Habitat Conservation Plan: Fiscal Year 2015 Annual Report. First Wind Energy, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 25 pp + app.

———. 2016. Habitat Conservation Plan: Fiscal Year 2016 Annual Report. SunEdison, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 31 pp + app.

———. 2017. Habitat Conservation Plan: Fiscal Year 2017 Annual Report. Terraform Power, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 31 pp + app.

———. 2018. Habitat Conservation Plan: Fiscal Year 2018 Annual Report. Terraform Power, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 28 pp + app.

Kaheawa Wind Power I and II, LLC. 2013. Kaheawa Pastures Wind Energy Generation Facility, Habitat Conservation Plan: Year 1 Annual Report. First Wind Energy, LLC, Wailuku, HI. 21 pp + app.

Kaheawa Wind Power II Wind Generation Facility Habitat Conservation Plan. 2011. Ukumehame, Maui, Hawai'i.

Kaheawa Wind Power II, LLC 2014. Habitat Conservation Plan: Fiscal Year 2014 Annual Report. First Wind Energy, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 33 pp + app.

———. 2015. Habitat Conservation Plan: Fiscal Year 2015 Annual Report. First Wind Energy, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 27 pp + app.

———. 2016. Habitat Conservation Plan: Fiscal Year 2016 Annual Report. SunEdison, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 28 pp + app.

———. 2017. Habitat Conservation Plan: Fiscal Year 2017 Annual Report. Terraform Power, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 28 pp + app.

———. 2018. Habitat Conservation Plan: Fiscal Year 2018 Annual Report. Terraform Power, LLC, 3000 Honoapiilani Hwy, Wailuku, HI. 28 pp + app.

Kahuku Wind Power. 2012. Habitat Conservation Plan: Fiscal Year 2012 Annual Report. FirstWind, LLC, 56-1050 Kamehameha Hwy, Kahuku, HI. 17 pp + app.

-------. 2016. Habitat Conservation Plan: Fiscal Year 2016 Annual Report. SunEdison, LLC, 56-1050 Kamehameha Hwy, Kahuku, HI. 11 pp + app.

------. 2017. Habitat Conservation Plan: Fiscal Year 2017 Annual Report. Terraform Power, LLC, 56-1050 Kamehameha Hwy, Kahuku, HI. 11 pp + app.

Kawailoa Wind Power LLC. 2011. Kawailoa Wind Power Final Habitat Conservation Plan. Oahu, Hawai'i

Kawailoa Wind Power LLC. 2015. Kawailoa Wind Power Habitat Conservation Plan Fiscal Year 2015 Annual Report. SunEdison, LLC, Oahu, Hawai'i. 12 pp + app.

———. 2016. Habitat Conservation Plan: Fiscal Year 2016 Annual Report. Tetratech, LLC, 61-488 Kamehameha Hwy, Haleiwa, HI. 11 pp + app.

———. 2017. Habitat Conservation Plan: Fiscal Year 2017 Annual Report. Tetratech, LLC, 61-488 Kamehameha Hwy, Haleiwa, HI. 11 pp + app.

Kear, J. and, A.J. Berger 1980. The Hawaiian goose: an experiment in conservation. Vermillion, SD: Buteo Books.

Kepler, C.B., and J.M. Scott. 1990. Notes on distribution and behavior of the endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*), 1964–1983. *'Elepaio* 50:59–64.

Kerlinger, P. 2005. Bird studies: what we know and what has been done? 2nd Wind Power Siting Workshop: Siting Wind Power Projects in the Eastern U.S. Sponsored by the American Wind Energy Association. www.awea.org

Kerlinger, P., and J. Guarnaccia. 2005. Avian Risk Assessment for the Kenedy Wind Project, Kenedy County, Texas. Report Prepared for Superior Renewable Energy. Curry & Kerlinger, Cape May Point, New Jersey.

Kerns, J., W.P. Erickson, and E.B. Arnett. 2005. Bat and Bird Fatality at Wind Energy Facilities in Pennsylvania and West Virginia, edited by E.B. Arnett, pp. 24–95. In *Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Bat Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines*. A Final Report Submitted to the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas, USA. http://www.batcon.org/ windliterature. Accessed 1 Sept. 2007.

Kingsley, A., and B. Whittam. 2007. Wind Turbines and Birds: A Background Review for Environmental Assessment, Draft. Canadian Wildlife Service, Environment Canada, Gatineau, Quebec.

Kress, S. W. (1990). Egg rock update 1990. Newsletter of the Fratercula Fund of the National Audubon Society.

Kress, S. W. and R. V. Borzik (2002). "Egg rock update 2002." Newsletter of the Seabird Restoration Program of the National Audubon Society.

Kress, S. W. and D. N. Nettleship (1988). "Re-establishment of Atlantic puffins (*Fratercula artica*) at a former breeding site in the gulf of Maine." Journal of Field Ornithology 59: 161-170.

Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-energy Development on Nocturnally Active Birds and Bats: A Guidance Document. *Journal of Wildlife Management*

71: 2449–2486.

Lālāmilo Wind Farm Draft Habitat Conservation Plan. 2016. Lālāmilo, South Kohala, Hawai'i.

Kushlan, J.A., M. J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, DC.

Martin, E.M., and P.I. Padding. 2002. Preliminary Estimates of Waterfowl Harvest and Hunter Activity in the United States During the 2001 Hunting Season. United States Fish and Wildlife Service Division of Migratory Bird Management, Laurel, Maryland.

Menard, T. 2001. Activity Patters of the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) in Relation to Reproductive Time Periods. Master's thesis, Univ. of Hawai'i at Mānoa.

Miller, A.H. 1937. Structural modifications in the Hawaiian goose (*Nesochen sandvicensis*): a study in adaptive evolution. *University of California Publications in Zoology* 42(1):1-80.

Mineau, P. 2005. Direct Losses of Birds to Pesticides–Beginnings of a Quantification. In *Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference*, March 20–24, 2002, Asilomar, California, Vol. 2. Edited by C.J. Ralph and T.D. Rich, pp. 1065–1070. USDA Forest Service General Technical Report PSW-GTR-191.

Miskelly, C. and H. Gummer (2004). Third and final transfer of fairy prion (titiwainui) chicks from takapourewa to mana island, january 2004. Wellington, NZ, Department of Conservation.

Miskelly, C. M. and G. A. Taylor (2004). "Establishment of a colony of common diving petrels (*Pelecanoides urinatrix*) by chick transfers and acoustic attraction." Emu 104: 205-211.

Miskelly, C., G. Timlin, and R. Cotter. 2005. "Common diving petrels (*Pelecanoides urinatrix*) recolonize mana island." Notornis 51: 245-246.

Mitchell, C., C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. 2005. Hawaii's Comprehensive Wildlife Conservation Strategy. State Department of Land and Natural Resources. Honolulu, HI. Accessed August 21, 2008. http://www.state.hi.us/dlnr/dofaw/cwcs/index.html

Na Pua Makani Wind Farm Final Draft Habitat Conservation Plan. 2016. Kahuku, Oahu, Hawai'i.

National Renewable Energy Laboratory (NREL). 2003. Consumptive Water Use for U.S. Power Production. NREL/TP-550-33905. http://www.nrel.gov/docs/fy04osti/33905.pdf

National Wind Coordination Collaborative (NWCC). 2004. Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions. Fact Sheet: 2^{nd} ed. 7 pp.

NatureServe. 2008. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available at: http://www.natureserve.org/explorer. Accessed: December 24, 2008.

NatureServe. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. NatureServe, Arlington, Virginia. Available at: http://www.explorer.natureserve.org/. Accessed: July 23, 2016.

Nishibayashi, E. 1997. Downed wildlife survey at six leeward West Maui wind monitoring towers. Unpublished report prepared for Zond Pacific, Inc., Wailuku, HI, by Eric Nishibayashi Biological Consulting, Kahului, HI. 11 pp.

———. 1998. Native bird activity at proposed access road. Unpublished report prepared for Zond Pacific, Inc., Wailuku, HI, by Eric Nishibayashi Biological Consulting, Kahului, HI.

NSF (National Science Foundation). 2010. Draft Habitat Conservation Plan or the Construction of the Advanced Technology Solar Telescope at the Haleakalā High Altitude Observatory Site Maui, Hawaii, 2010. http://hawaii.gov/dlnr/dofaw/pubs/DRAFT_HCP_ATST_OEQC.pdf.

———. 2011. Environmental Assessment for the Issuance of an Incidental Take License and Proposed Conservation Measures Associated with the Advanced Technology Solar Telescope, Haleakalā, Maui, Hawaii.

Nur, N., W.J. Sydeman. 1999. Demographic processes and population dynamic models of seabirds: Implications for conservation and restoration. Current Ornithology 15:149-188.

O'Shea, T.J, P.M. Cryan, D.T.S. Hayman, R.K. Plowright, and D.G. Streicker. 2016. Multiple mortality events in bats: a global review. *Mammal Review*. DOI:10.1111/mam. 12064.

Pakini Nui Wind Farm Draft Habitat Conservation Plan. 2016. South Point, Hawai'i, Hawai'i.

Pascal, M., O. Lorvelec, V. Bretagnolle V., and J-M. Culioli. 2008. Improving the breeding success of a colonial seabird: a cost-benefit comparison of the eradication and control of its rat predator. *Endangered Species Research* 4:267-276.

Patriquin, K.J. and R.M.R. Barclay. 2003. Foraging by bats in cleared, thinned and unharvested boreal forest. Journal of Applied Ecology 40:646-657.

Pitman, R.L. 1986. *Atlas of Seabird Distribution and Relative Abundance in the Eastern Tropical Pacific*. La Jolla, California: NOAA, NMFS, Southwest Fisheries Center Administrative Report LJ-86-02C.

Planning Solutions, Inc. 2009a. Draft Environmental Impact Statement Kaheawa Wind Power II Wind Energy Generation Facility, Ukumehame, Maui, Hawaii.

———. 2009b. Revised Draft Environmental Impact Statement Kaheawa Wind Power II Wind Energy Generation Facility, Ukumehame, Maui, Hawaii.

———. 2010. Revised Final Environmental Impact Statement Kaheawa Wind Power II Wind Energy Generation Facility, Ukumehame, Maui, Hawaii.

Podolsky, R.H. 1990. Effectiveness of social stimuli in attracting Laysan Albatross to new potential nesting sites. *The Auk* 107 (1):119-125.

Podolsky, R. H. and S. W. Kress (1989a). Attraction and colonization of dark-rumped petrels (*Pterodroma phaeopygia*) to Santa Cruz island, Galapagos. In: Annual report of the National Audubon Society. Ithaca, NY, National Audubon Society.

Podolsky, R. H. and S. W. Kress (1989b). "Factors affecting colony formation in leach's storm-petrel." Auk 106: 332-336.

Podolsky, R., and S.W. Kress. 1992. Attraction of the endangered Dark-rumped Petrel to recorded vocalizations in the Galápagos Islands. *The Condor* 94:448-453.

Podolsky, R., D.G. Ainley, G. Spencer, L. DeForest, and N. Nur. 1998. Mortality of Newell's Shearwaters Caused by Collisions with Urban Structures on Kaua'i. *Colonial Waterbirds* 21:20–34.

Pratt, T.K. 1988. Recent observations, March-May 1988. *'Elepaio* 48:65–66.

Priddle, D. and N. Carlisle 1995. "An artificial nest box for burrow-nesting seabirds." Emu 95: 290-294.

Rechtman, R.B., J.R. Dudoit, and A.K. Dircks Ah Sam. October 2009. An Archaeological Inventory Survey for the Kaheawa Wind Power (KWP I) Phase 2 Project Area (TMK: 2-3-6-001: Por. 014 and 2-4-8-001: por. 001). Prepared for First Wind Energy LLC, Honolulu, Hawaiʽi.

Reynolds, M.H., B.A. Cooper, and R.H. Day. 1997. Radar study of seabirds and bats on windward Hawaiʽi. *Pacific Science* 51:97–106.

Reynolds, M.H., and G.L. Ritchotte. 1997. Evidence of Newell's Shearwater Breeding in Puna District, Hawaii. *Journal of Field Ornithology* 68(10):26-32.

Richardson, F., and D.H. Woodside. 1954. Rediscovery of the nesting of the Dark-rumped Petrel in the Hawaiian Islands. *The Condor* 56: 323-327.

Rollins, K.E., and D.K. Meyerholz, G.D. Johnson, A.P. Capparella and S.S. Loew. A Forensic Investigation into the Etiology of Bat Mortality at a Wind Farm: Barotrauma or Traumatic Injury? Veterinary Pathology 49-2:362-371.

Sanzenbacher P.M., and B.A. Cooper. 2009. Radar and Visual Studies of Seabirds at the Proposed KWP II Wind Energy Facility, Maui Island, Hawaii: Use of 2008 Data to Model Annual Collision Fatalities at Proposed Wind Turbines. Prepared for First Wind, Newton, MA. 28 pp.

Sawyer, S.L., and S.R. Fogle. 2010. Acoustic attraction of grey-faced petrels (*Pterodroma macroptera gouldi*) and fluttering shearwaters (*Puffinus gavia*) to Young Nick's Head, New Zealand. Notornis 57: 170-172.

Schreiber EA, J Burger. 2001. Biology of marine birds. Boca Raton (FL): CRC Press

Severns, P.M. 2009. An Assessment of Hawaiian Native Molluscan Fauna Kaheawa Pastures, West Maui, Hawaii.

Shoenfeld, P. S. 2004. Suggestions Regarding Avian Mortality Extrapolation. Report to the West Virginia Highlands Conservancy, Hillsboro, WV.

Simons T.R. 1983. Biology and conservation of the endangered Hawaiian dark-rumped petrel (*Pterodroma phaeophygia sandwichensis*). CPSU/UW 83-2, Summer 1983.

———. 1984. A population model of the endangered Hawaiian dark-rumped petrel. *J. Wildl. Mgmt.* 48(4) 1065-1076.

———. 1985. Biology and behavior of the endangered Hawaiian Dark-rumped Petrel. *The Condor* 87: 229-245.

Simons, T.R., and C.N. Hodges. 1998. Dark-rumped Petrel (*Pterodroma phaeopygia*). In *The Birds of North America*, No. 345, edited by A. Poole and F. Gill. The Birds of North America, Inc., Philadelphia, PA.

Spear, L. B., D. G. Ainley, N. Nur, and S. N. G. Howell. 1995. Population size and factors affecting at-sea distributions of four endangered *procellariids* in the tropical Pacific. *The Condor* 97:613-638.

Stantec Consulting Ltd. 2007. Environmental Review Report for Wolfe Island Wind Project. Kingston, Ontario.

SWCA Environmental Consultants. 2016. Draft Habitat Conservation Plan for Pakini Nui Wind Farm. South Point, Hawai`i. Tawhiri Power, LLC.

Szewczak, J.M., and E.B. Arnett. 2006. Field test results of a potential acoustic deterrent to reduce bat mortality from wind turbines. An investigative report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Taylor, G.A. 2000a. Action plan for seabird conservation in New Zealand. Part A: threatened seabirds. *Threatened Species Occasional Publication 16*. Department of Conservation, Wellington, New Zealand. 234 p.

Taylor, G.A. 2000b. Action plan for seabird conservation in New Zealand. Part B: non- threatened seabirds. *Threatened Species Occasional Publication 17*. Department of Conservation, Wellington, New Zealand. 199 pp.

Telfer, T.C. 1986. Newell's shearwater nesting colony establishment study on the island of Kaua'i. Final Report, Statewide Pittman-Robertson Program. State Department of Land and Natural Resources, Honolulu, HI.

Telfer, T.C., J.L. Sincock, G.V. Byrd, and J.R. Reed. 1987. Attraction of Hawaiian seabirds to lights: conservation efforts and effects of moon phase. *Wildlife Society Bulletin* 15: 406– 413.

Tetra Tech EC, Inc. 2008a. Draft Environmental Assessment For Issuance of an Endangered Species Act Section10 (a)(1)(B) Permit for the Incidental Take of Listed Species for the Lanai Meteorological Towers Project. Castle & Cooke Resorts, LLC. Prepared for U.S. Fish and Wildlife Service.

———. 2008b. DRAFT Habitat Conservation Plan for the construction and operation of Lanai met towers, Lanai, Hawaii (Revised February 8, 2008, TTEC-PTLD-2008-080). Unpubl. report by Tetratech EC, Honolulu, HI for Castle and Cooke LLC, Lanai City, HI. 52 pp. + appendices. Available at: http://www.state.hi.us/dlnr/dofaw/pubs/Lanai_ MetTowers_HCP.pdf

———. 2010. Environmental Impact Statement Preparation Notice/ Environmental Assessment for Auwahi Wind Farm Project Ulupalakua Ranch, Maui, Hawai'i. Auwahi Wind Energy LLC.

———. 2011a. Draft Environmental Impact Statement for Auwahi Wind Farm Project, Ulupalakua Ranch, Maui, Hawai'i. Auwahi Wind Energy LLC.

———. 2011b. Draft Habitat Conservation Plan for Auwahi Wind Farm Project, Ulupalakua Ranch, Maui, Hawai'i. Auwahi Wind Energy LLC.

Tomich, P.Q. 1986. Mammals in Hawai'i, 2nd ed. Bishop Museum. Spec. Pub. 76: 375 pp.

U.S. Climate Change Science Program 2009. Climate and Coasts. Abstract. In *Hawai'i Conservation Conference 2009 Hawai'i in a Changing Climate: Ecological, Cultural, Economic and Policy Challenges and Solutions*.

U.S.D.A Natural Resource Conservation Service. 2009. Bats of the U.S. Pacific Islands. Biology Technical Note No. 20.

USFWS. 1998. Recovery Plan for the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). U.S. Fish and Wildlife Service, Portland, OR. 50 pp.

———. 2003. Federal Register, Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for 60 Plant Species from the Islands of Maui and Kahoolawe, HI; Final Rule. 68(93):25934-25982.

———. 2004a. Draft revised recovery plan for the Nēnē or Hawaiian Goose (*Branta sandvicensis*). U.S. Fish and Wildlife Service, Portland, OR. 148 + xi pp.

———. 2004b. Interim Guidelines To Avoid and Minimize Wildlife Impacts From Wind Turbines.

http://www.fws.gov

———. 2005. Regional Seabird Conservation Plan, Pacific Region. U.S. Fish and Wildlife Service, Migratory Birds and Habitat Programs, Pacific Region, Portland, OR.

U.S. Fish and Wildlife Service. 2012. Land-based wind energy guidelines. http://www.fws.gov/windenergy/docs/WEG_final.pdf. U.S. Fish and Wildlife Service, Arlington, VA, USA.

Wagner, W.L., D.R. Herbst and S.H. Sohmer. 1999. Manual of the flowering plants of Hawai'i, Volumes I & II. Revised edition. University of Hawai'i Press: Honolulu, HI.

Warren-Hicks, William, James Newman, Robert Wolpert, Brian Karas, Loan Tran. (California Wind Energy Association.) 2013. ***Improving Methods for Estimating Fatality of Birds and Bats at Wind Energy Facilities.*** California Energy Commission. Publication Number: CEC-500-2012-086.

Webster, P.J., G.J. Holland, J.A. Curry, and H.R. Chang. 2005. Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment. Science 309(5742):1844-1846.

Whitaker, J.O., and P.Q. Tomich. 1983. Food Habits of the Hoary Bat, *Lasiurus cinereus*, from Hawaii. *Journal of Mammalogy* 64:151-52.

Williams, B.K., and E. Brown. 2009. Adaptive management: the U.S. Department of the Interior Applications Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC., 120 pp

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2009. Adaptive management: the U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC., 72 pp

Woog, F., and J.M. Black. 2001. Foraging behavior and the temporal use of grasslands by Nēnē: implications for management. *Studies in Avian Biology* 22:319-328.

Work, T. M., J. Dagenais, R. Rameyer, and R. Breeden. 2015. *Journal of Wildlife Diseases*, 51(3): 688-695.

Young, G.P. 2004. Letter to Michelle McLean dated 8 November 2004. Department of Army, Honolulu, HI.

Zimpfer, J. and F. Bonaccorso. 2010. Barbed Wire Fences and Hawaiian Hoary Bats: What We Know. 2010 Hawai'i Conservation Conference abstract. Hawai'i Convention Center, Honolulu.