

Kahuku Wind Power Habitat Conservation Plan FY 2022 Annual Report



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Incidental Take License ITL-10/ BO#2010-F-0190

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Executive Summary

This report summarizes work performed by Kahuku Wind Power, LLC (KAH) at the Kahuku Wind Power Project (Project) during the State of Hawai'i fiscal year (FY) 2022 (July 1, 2021 – June 30, 2022) under the terms of the approved Habitat Conservation Plan (HCP). The HCP is dated May 27, 2010, and describes KAH's compliance obligations under Kahuku Wind Power, LLC's state Incidental Take License ITL-10 and federal Incidental Take Statement BO 2010-F-0190. This HCP covers eight species: seven are federally and state-listed as threatened and endangered and one is exclusively a state-listed endangered species. The Project was constructed in 2010 and has been operating since March 23, 2011.

Wildlife fatality monitoring at the Project in FY 2022 continued within 35-meter radius circular search plots centered on the wind turbine generators (WTGs). Plots were searched by canine-handler teams once per week year-round. Bias correction trials were conducted quarterly at the Project in FY 2022 to measure the probability that a carcass persists until the next search (carcass persistence) and the probability that an available carcass would be found by a canine search team (searcher efficiency). The results of these trials showed mean probabilities of persistence until the next search of 0.76 (bat surrogates) and 0.96 (medium-sized bird surrogates). Searcher efficiency was 0.98 for bat surrogates and 1.00 for medium bird surrogates.

One Hawaiian hoary bat fatality was found in FY 2022. A total of six bat fatalities have been observed as direct take at the Project since beginning operations March 23, 2011. The cumulative fatality estimate using the Evidence of Absence estimator at the upper 80 percent credibility level is 13 bats, and the total indirect take for this estimate is 2.3 adult equivalents, rounded to 3. Combining these values, there is an approximately 80 percent chance that cumulative take of Hawaiian hoary bats from the start of operations through FY 2022 was less than or equal to 16 adults. No fatalities of other listed species have been observed at the Project.

During FY 2022, KAH monitored bat activity at the Project through four ground-based acoustic detectors located at Project WTGs. Between June 1, 2021 and May 31, 2022, Hawaiian hoary bats were detected on 23 nights out of 1,076 detector-nights (2.1 percent of detector-nights). Seasonal patterns of detection rate were comparable with previous years.

Baseline (Tier 1) mitigation obligations for the Hawaiian hoary bat were met prior to FY 2022. Higher Take (Tier 2) mitigation planning continued, and a draft Mitigation Plan was presented to agencies in FY 2022. Mitigation obligations for baseline levels of take of waterbirds, seabirds, and the Hawaiian short-eared owl were met prior to FY 2022.

KAH communicated actively with USFWS and DOFAW throughout FY 2022 with video and conference calls, submittal of quarterly reports, and e-mail communications related to the Project's HCP and associated mitigation. Communications included submittal of the Hawaiian hoary bat Tier 2 Mitigation Plan.

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Table of Contents

1.0	Introduction.....	1
2.0	Fatality Monitoring.....	1
3.0	Carcass Persistence Trials.....	2
4.0	Searcher Efficiency Trials.....	2
5.0	Vegetation Management.....	4
6.0	Scavenger Trapping.....	4
7.0	Documented Fatalities and Take Estimates.....	5
7.1	Hawaiian Hoary Bat.....	5
7.1.1	Estimated Take.....	5
7.1.2	Projected Take.....	7
7.2	Fatalities of Non-Covered Species.....	8
8.0	Wildlife Education and Observation Program.....	8
9.0	Mitigation.....	8
9.1	Hawaiian Hoary Bats.....	9
9.1.1	On-Site Acoustic Surveys.....	9
9.1.2	Kahikinui Forest Reserve Mitigation.....	12
9.1.3	Tier 2 Mitigation Planning.....	12
9.2	Other Covered Species.....	12
10.0	Adaptive Management.....	12
11.0	Agency Meetings, Consultations, and Visits.....	13
12.0	Expenditures.....	13
13.0	Literature Cited.....	14

List of Tables

Table 1. Observed Hawaiian Hoary Bat Fatalities at the Project through FY 20225
Table 2. Number of Detector-Nights Sampled and Proportion of Detector-Nights with
Bat Detections Between FY 2014 and FY 2022 10
Table 3. Summary of Agency Coordination and Communication in FY 2022..... 13
Table 4. HCP-Related Expenditures at the Project in FY 2022 14

List of Figures

Figure 1. HCP Implementation Components..... 3
Figure 2. Monthly Bat Acoustic Activity at Kahuku for FY 2022 with Corresponding
Reproductive Periods..... 11
Figure 3. Monthly Bat Acoustic Activity at Kahuku for FY 2014 through FY 2022 with
Corresponding Reproductive Periods..... 11

List of Appendices

Appendix 1. Dalthorp et al. (2017) Fatality Estimation for Hawaiian hoary bats at the Project
through FY 2022
Appendix 2. Hawaiian Hoary Bat 20-Year Projected Take at the Project in FY 2022
Appendix 3. Documented Fatalities at the Project during FY 2022

1.0 Introduction

The Habitat Conservation Plan (HCP) for the Kahuku Wind Project (Project) was approved by the Hawai'i Division of Forestry and Wildlife (DOFAW) in 2010. Kahuku Wind Power, LLC (KAH) received a federal Biological Opinion (BO 2010-F-0190) and associated Incidental Take Statement (ITS) from the U.S. Fish and Wildlife Service (USFWS), and a state Incidental Take License (ITL; ITL-10) from DOFAW in May and June of 2010, respectively. The ITS and ITL cover the incidental take of eight species: seven federal and state-listed threatened and endangered species, and one exclusively state-listed endangered species (collectively referred to as the Covered Species) over a 20-year permit term. The Covered Species include: the Hawaiian stilt or ae'o (*Himantopus mexicanus knudseni*), Hawaiian coot or 'alae ke'oke'o (*Fulica alai*), Hawaiian duck or koloa maoli (*Anas wyvilliana*), Hawaiian gallinule or 'alae 'ula (*Gallinula galeata sandvicensis*), Hawaiian petrel or ua'u, (*Pterodroma sandwichensis*), Newell's shearwater or 'a'o (*Puffinus newelli*), Hawaiian hoary bat or 'ōpe'ape'a (*Lasiurus cinereus semotus*), and the state-listed Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*).

The Project was constructed in 2010 and 2011 and commissioned for operation on March 23, 2011. Brookfield Renewable Partners, LP (Brookfield) acquired the Project's LLC through acquisition of a controlling interest in TerraForm, LLC in 2017; the Project continues to be operated by KAH.

On behalf of KAH, Tetra Tech, Inc. (Tetra Tech) has prepared this progress report which describes work performed for the Project during the 2022 fiscal year for the State of Hawaii (FY; July 1, 2021 – June 30, 2022) pursuant to the terms and obligations of the approved HCP, ITL, and ITS. Kahuku Wind submitted previous annual HCP progress reports for FY 2011 through FY 2021 to USFWS and DOFAW (Kahuku Wind 2011, Kahuku Wind 2012, Kahuku Wind 2013, Kahuku Wind 2014, Kahuku Wind 2015, Kahuku Wind 2016, Kahuku Wind 2017, Kahuku Wind 2018, Tetra Tech 2019, Tetra Tech 2020, Tetra Tech 2021).

2.0 Fatality Monitoring

In consultation with USFWS, DOFAW, and the Endangered Species Recovery Committee (ESRC), fatality search areas and search frequency have evolved over time from the start of operations in 2011 through the initiation of the current approach in April 2015.

- In March 2011, the wildlife fatality monitoring effort involved twice weekly searches within a 64-meter radius circular monitoring plot centered on each wind turbine generator (WTG) in addition to searches every other week within a larger 96-meter radius plot.
- In September 2014, the 96-meter radius plot searches were suspended, but searches within the 64-meter radius plots continued twice weekly.

- In December 2014, plots were reduced in size to the current 35-meter radius (Figure 1). Search frequency was monthly from December 2014 through March 2015.
- In April 2015, the search frequency of the 35-meter radius plots was increased to weekly. This search area continues to be used for monitoring in FY 2022.

Weekly searches of the 35-meter radius plots were completed throughout FY 2022. The plots were searched by trained detector dogs and their handlers (canine search teams). To accommodate the detector dogs, starting in January 2021 and continuing through FY 2022, weekly searches primarily occurred over 2 consecutive days with searches conducted at six of the 12 WTGs on each day. Occasionally, searches occurred on 1 day at all 12 WTGs. Fatality monitoring in FY 2022 achieved a mean search interval for WTGs of 6.9 days (Standard Deviation = 0.3 days). Should conditions prevent the use of dogs (e.g., weather, injury, availability of canine search team, etc.), plots would be visually surveyed by Project staff. In FY 2022, all searches were conducted by canine teams.

One Covered Species, Hawaiian hoary bat, was detected during fatality searches in FY 2022 (see Section 7.1). Other species fatalities are reported in Section 7.2, and no fatalities of other Covered Species have been observed at the Project.

3.0 Carcass Persistence Trials

A 28-day carcass persistence trial was conducted in each quarter of FY 2022 for a total of four trials. These trials used carcasses of black rats (*Rattus rattus*) as surrogates for Hawaiian hoary bats and wedge-tailed shearwaters (*Ardenna pacifica*) to represent medium-sized birds (surrogates for the avian Covered Species; see Section 1.0). In FY 2022, the mean probability that a bat surrogate carcass persisted until the next search was 0.76 (95 percent Confidence Interval [CI] = 0.60, 0.87; N=24) and for medium-sized bird carcasses was 0.96 (95 percent CI = 0.82, 0.99; N=8).

4.0 Searcher Efficiency Trials

Searcher efficiency trials occurred throughout the year to test wildlife carcass detection of canine search teams (no un-aided human only searches occurred in FY 2022). Sixty-nine searcher efficiency trials were administered to canine search teams over 24 trial days during FY 2022. Carcasses of black rats were used as surrogates for Hawaiian hoary bats. Carcasses of wedge-tailed shearwaters were used as surrogates for avian Covered Species. Of the 69 trial carcasses placed, ten bat surrogates were lost to scavenging. The overall searcher efficiency in FY 2022 for bat surrogates was 0.98 (95 percent CI = [0.90, 1.00]; N = 44) and for medium-sized bird carcasses was 1.00 (95 percent CI = [0.85, 1.00]; N = 15).

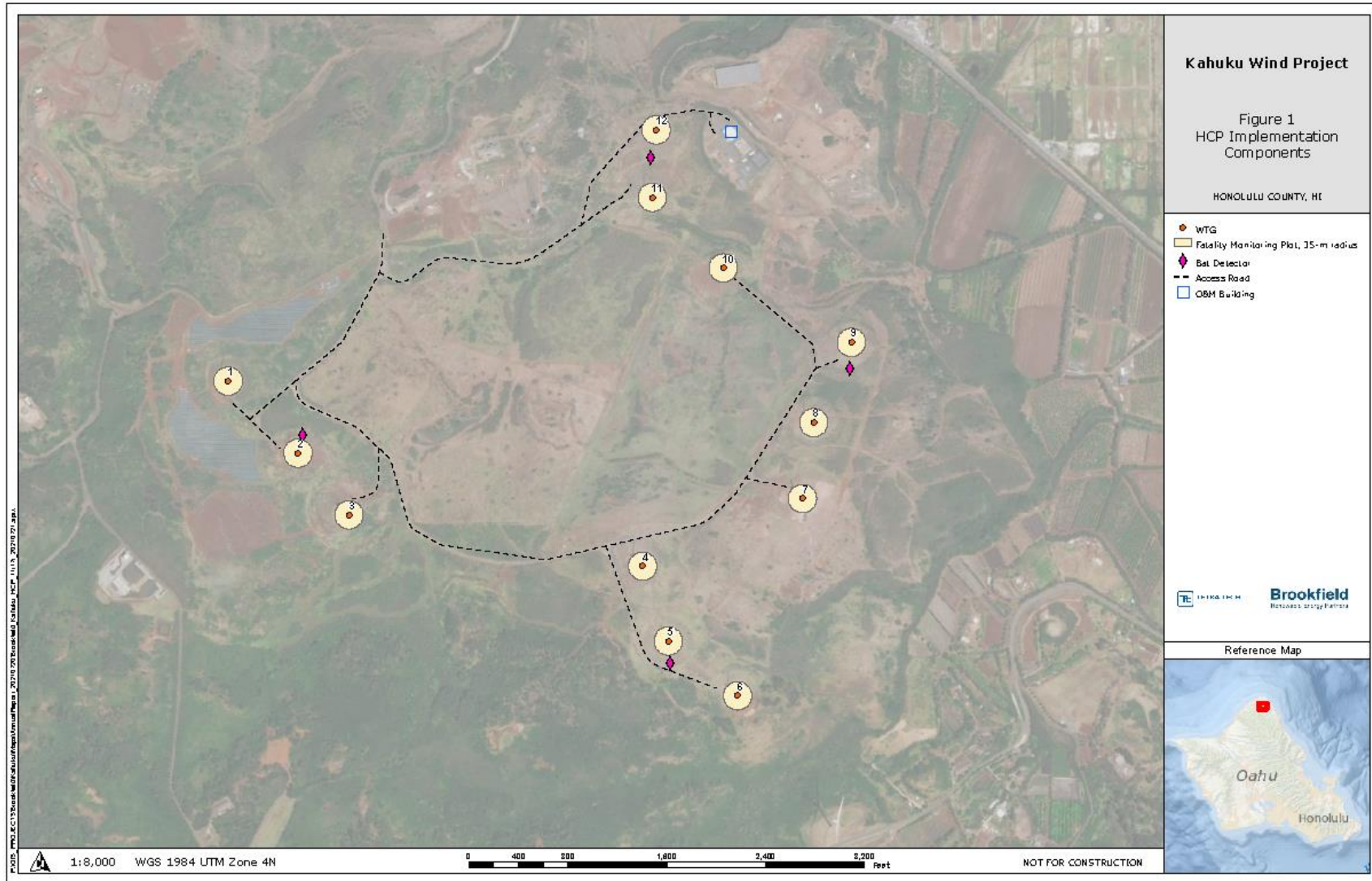


Figure 1. HCP Implementation Components

5.0 Vegetation Management

Search plots cover searchable area out to 35 meters from the base of the WTG. Search plots are comprised of bare ground and vegetation that is mowed when it reaches 4 to 6 inches in height. The search plots accommodate a relatively flat search area that is easily maintained; however, a small portion of the WTG 3 search plot has a slope that precludes vegetation management and is consequently not searched. Vegetation within the plots consists mainly of Bermuda grass (*Cynodon dactylon*), sensitive plant (*Mimosa pudica*), and Guinea grass (*Megathyrsus maximus*).

In FY 2022, all plots were mowed at regular intervals to maintain high visibility during fatality searches. Plots were checked weekly for vegetation conditions, and generally mowed two to three times per month during the wetter months of the year and at least once per month during the dryer months. Mowing consistently occurred following the weekly fatality searches at the specified WTGs. Livestock are grazed within search plot bounds, which keeps the vegetation low and reduces the need for mechanical mowing.

In June of FY 2020, the weed *Cenchrus echinatus* was identified within the search areas of WTG 12 and WTG 4. This invasive weed produces sharp, bur-like seed heads that are harmful to canine searchers. It was removed by hand from these areas after positive identification. Seed heads were collected and destroyed. These areas were monitored for reemergence in FY 2021. In October of 2021, surveys for the *C. echinatus* weed were conducted again at WTG 12 and WTG 4. At that time, it was observed that regular cattle grazing and mowing had reduced the spread of the weed at those two turbines. Plants found during the surveys were manually removed. Tetra Tech biologists have since been in communication with the canine searchers about the re-emergence status of this weed. As of the end of FY 2022, *C. echinatus* has not been observed at either WTG 12 or WTG 4.

6.0 Scavenger Trapping

In FY 2022, up to 75 Doc-250s, 15 Timms, and two Steve Allan traps were in use during trapping efforts. Trap set and check frequency was conducted once a month in July and August of 2021 and then every other week starting September 2021. During FY 2022, a total of 354 target animals were captured and removed including 277 mongooses (*Herpestes javanicus*), 65 rats (*Rattus* spp.), four mice (*Mus musculus*) and eight feral cats (*Felis catus*). Ten “other” miscellaneous non-native non-target captures occurred during this timeframe including common myna (*Acridotheres tristis*), spotted dove (*Streptopelia chinensis*), and cane toad (*Rhinella marina*).

7.0 Documented Fatalities and Take Estimates

All downed wildlife observed during the fatality monitoring were handled and reported in accordance with the Downed Wildlife Protocol provided by USFWS and DOFAW (DOFAW and USFWS 2020). One Covered Species, a Hawaiian hoary bat, was detected during FY 2022. No injured (live) downed wildlife were observed at the Project in FY 2022.

Various factors affect how the number of observed fatalities is scaled to estimate the unobserved fatalities. Unobserved fatalities are due to three primary factors:

- Carcasses may be scavenged before searchers can find them;
- Carcasses may be present and not detected by searchers; and
- Carcasses may fall outside of the search area.

Sections 3.0 and 4.0 describe methods that are used to estimate the effect of the first two factors. The search area for fatalities at the Project has evolved over time; therefore, the proportion of the carcass distribution searched has varied. However, no changes to the search area have been made since December 2014 (Section 2.0). Thus, the estimate of the proportion of the carcass distribution searched in FY 2022 remains the same as described in the FY 2018 annual report (Kahuku Wind 2018).

7.1 Hawaiian Hoary Bat

7.1.1 Estimated Take

A total of six Hawaiian hoary bat fatalities have been observed at the Project since operations began on March 23, 2011. The most recently documented Hawaiian hoary bat fatality was a female detected on August 18, 2021 during a regular search. The carcass was detected 17 meters from the base of WTG 2, and was collected and transferred to the U.S. Geological Survey (USGS) for genetic sexing. All previous bat fatalities have been transferred to USGS for genetic sexing.

All six bats have been detected inside of search plots; no incidental bat fatality detections have occurred to date. The observed Hawaiian hoary bat fatalities by fiscal year are listed in Table 1.

Table 1. Observed Hawaiian Hoary Bat Fatalities at the Project through FY 2022

Fiscal Year	Hawaiian Hoary Bat Observed Direct Take	Hawaiian Hoary Bat Incidental Fatality Observations	Total
2011	0	0	0
2012	3	0	3
2013	0	0	0
2014	0	0	0

Fiscal Year	Hawaiian Hoary Bat Observed Direct Take	Hawaiian Hoary Bat Incidental Fatality Observations	Total
2015	1	0	1
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	1
2020	0	0	0
2021	1	0	1
2022	1	0	1
Total	6	0	6

Cumulative take is estimated from three components: (1) observed direct take (ODT) during protocol (standardized) fatality monitoring, (2) unobserved direct take (UDT), and (3) indirect take. The Evidence of Absence software program (EoA; Dalthorp et al. 2017), an agency-approved analysis tool for analyzing direct take, uses results from bias correction trials and ODT to generate an upper credible limit (UCL) of direct take (i.e., ODT + UDT). USFWS and DOFAW have requested that estimates of direct take be reported at the 80 percent UCL. Direct take values from this analysis can be interpreted as: there is an 80 percent probability that actual direct take at the Project over the analysis period was less than or equal to the 80 percent UCL. Associated indirect take is estimated based on the sex and age characteristics of bat fatalities found at the Project, and the life history characteristics of (assumed to be representative of) the Hawaiian hoary bat, as described in the Project's approved HCP and current agency guidance (USFWS 2016).

The estimated direct take (ODT + UDT) for the six Hawaiian hoary bat fatalities found between the start of operation (March 23, 2011) and end of FY 2022 (June 30, 2022) is less than or equal to 13 bats (80 percent UCL). Details of the estimated direct take parameters are in Appendix 1.

Indirect take is estimated to account for the potential loss of future individuals (offspring) that may occur as the result of the loss of an adult female through direct take during the breeding period when females may be pregnant or supporting dependent young. Indirect take for the Project is calculated using the USFWS (2016) guidance as follows:

- The average number of offspring (pups) per female that survive to weaning is assumed to be 1.8.
- The sex ratio of Hawaiian Hoary bats taken through UDT is assumed to be 50 percent female unless there is evidence (10 or more bats) to indicate a different sex ratio.
- The assessment of indirect take from the modeled UDT accounts for the fact that it is not known when the unobserved fatality may have occurred. The period from pregnancy to end of pup dependency for any individual Hawaiian hoary bat female is estimated to be 3

months. Thus, the probability of taking a female bat that is pregnant or has dependent young is 25 percent.

- The indirect take assessment uses a conversion of one juvenile bat as equal to 0.3 adults.

Based on the USFWS (2016) guidance, the estimate of cumulative indirect take in FY 2022 is calculated as:

- **Total Juvenile Take Calculated from Observed Female Take (April 1 – September 15)**
 - $3 \text{ (observed females)} * 1.8 \text{ (pups per female)} = 5.4 \text{ juveniles}^1$
- **Total Juvenile Take Calculated from Observed Unknown Sex Take (April 1 – September 15)**
 - $1 \text{ (observed unknown sex)} * 0.5 \text{ (assumed sex ratio)} * 1.8 \text{ (pups per female)} = 0.9 \text{ juveniles}$
- **Total juvenile Take Calculated from Unobserved Take**
 - $7 \text{ (unobserved direct take)} * 0.5 \text{ (assumed sex ratio)} * 0.25 \text{ (proportion of calendar year females could be pregnant or have dependent pups)} * 1.8 \text{ (pups per female)} = 1.6 \text{ juveniles}$
- **Total Calculated Juvenile Indirect Take = 7.9 (5.4 + 0.9 + 1.6)**
- **Total Adult Equivalent Indirect Take = 0.3 (juvenile to adult conversion factor) * 7.9 = 2.4**

Therefore, based on the UCL of Hawaiian hoary bat direct take at the Project, the estimated indirect take is three adults (rounded up from 2.4).

The UCL for cumulative Project take of the Hawaiian hoary bat at the 80 percent credibility level is 13 adult bats (13 [estimated direct take] + 3 [estimated indirect take]). That is, there is an approximately 80 percent probability that actual take at the Project at the end of FY 2022 is less than or equal to 16 bats.

7.1.2 Projected Take

EoA includes a module that allows users to project future estimates of mortality based on results of past fatality monitoring. Due to the inherent uncertainty of these projections (including the potential future contribution of indirect take) and the amplification of this uncertainty resulting from the use of the 80 percent UCL as the estimate of take for regulatory compliance, long term projections have limited utility. Nevertheless, they do help gauge the likelihood of permitted take exceedance, and may help operators in their mitigation planning, assuming future management and monitoring conditions can be reasonably estimated.

¹ DNA results have identified the sex of five of the six bat fatalities detected at the Project, confirming that three of the fatalities were female (Pinzari and Bonaccorso 2022).

KAH projected take through the end of the permit term using the fatality monitoring data collected through FY 2022. The objective of this analysis was to evaluate the potential for the Project to exceed the permitted take limit at the 80 percent UCL prior to the end of the permit term (Appendix 2). For this analysis, the detection probability for future years is assumed to be constant at 0.52 (95 percent CI = [0.42, 0.62]) which is the overall detection probability achieved in FY 2022. As future indirect take is unknown and will potentially vary based on the timing of ODT, we assumed total indirect take for the Project over the permit term would be a maximum of five adult equivalents (16 juveniles based on assumed Hawaiian hoary bat survival rates; USFWS 2016), or 21.7 percent of the permitted take. Currently, the proportion of total take that is attributable to indirect take is 18.2 percent making the assumption of five adult equivalents conservative. Assuming five adult bat equivalents are attributed to the Project as indirect take, the permitted direct take under the Project's ITP and ITL would be 18 bats (i.e., 23 permitted take – 5 indirect take = 18 direct take).

Based on the analysis described above and presented in Appendix 2, there is a 30.8 percent chance that the 80 percent UCL of cumulative take will not be exceeded during the permit term (Appendix 2). The median number of years of operation without permit exceedance is estimated to be 18. It is important to note that the probability of permit exceedance at the Project may be overestimated, given that the estimate of indirect take is high, and the proportion of risk in the model was not adjusted to reflect that the Low Wind Speed Curtailment (LWSC) regime (Section 10.0) initiated in April 2012. LWSC will remain in place for the remainder of the Project's permit term.

7.2 Fatalities of Non-Covered Species

Four bird fatalities, representing three species, were documented at WTGs at the Project site in FY 2022. Two of the species observed in FY 2022 are protected by the Migratory Bird Treaty Act: wedge-tailed shearwater (one fatality) and house finch (*Haemorhous mexicanus*; one fatality). For a complete list of fatalities detected in FY 2022 see Appendix 3.

8.0 Wildlife Education and Observation Program

Wildlife Education and Observation Program trainings continue to be conducted on an as-needed basis to provide on-site personnel with the information to respond appropriately if they observe a Covered Species or encounter downed wildlife while on-site. Wildlife Education and Observation Program trainings were provided to 43 individuals over 12 dates in FY 2022.

9.0 Mitigation

The Project's mitigation requirements are described in Section 7.6 of the approved HCP.

9.1 Hawaiian Hoary Bats

9.1.1 On-Site Acoustic Surveys

The HCP commits to performing acoustic monitoring for bat activity during years when systematic fatality monitoring is conducted. Bat acoustic monitoring has been conducted continuously at the Project since the start of operations; Anabat detectors were replaced with Wildlife Acoustics detectors beginning in FY 2014 (July 2013). Between FY 2014 and FY 2017, monitoring was conducted at 12 locations distributed across the Project. However, due to the low frequency in the number of nights with recorded bat activity, monitoring efforts were reduced to seven locations beginning in FY 2018 (Kahuku Wind 2018), and then reduced to four locations (WTGs 2, 5, 9, and 12; Figure 1) beginning in FY 2019. Acoustic monitoring units were located within 50 meters of the WTGs and consisted of a ground-based Song Meter SM2BAT+ ultrasonic recorder equipped with one SMX-U1 ultrasonic microphone (Wildlife Acoustics, Maynard, MA, USA) positioned 6.5 meters above ground level.

The objective of monitoring is to better understand the annual and seasonal variations in bat activity at the project. Analysis of variance (ANOVA) and Tukey's HSD were used to test for differences in detection rates between FY 2014 and FY 2022. To test for a change in detection rates across all monitoring years, we used a linear mixed-effect model (LMM) which includes an interaction between year and sampling effort (i.e., the number of monitoring locations) and the site location as a random effect.

All data were normalized with an Ordered Quantile Normalization transformation using the 'bestNormalize' package in R (Peterson 2021). The distribution of residuals from the LMM were examined to check for violations of model assumptions. All tests were 2-tailed, employed an alpha value of 0.05, and were conducted in R version 4.05 (R Core Team, 2017). The reporting period for FY 2022 spans the months June 2021 to May 2022. All previous sampling years have been adjusted to reflect this same sampling period. This change was made in FY 2021 to allow adequate time for review of the annual dataset and analyses.

As demonstrated over the past nine sampling years, bat activity at the Project remains generally low. Across the four WTGs monitored during FY 2022, Hawaiian hoary bats were detected on 23 nights out of the 1,076 detector-nights sampled (2.1 percent). The annual detection rate in FY 2022 was higher but not significantly different (ANOVA: $F_{8,71} = 2.31$, $P < 0.031$; Tukey's HSD: $P = 0.456$) than the annual detection rate in FY 2021 (0.70 percent).

Among all monitoring years, annual detection rates were consistently low at less than 2.5 percent of detector nights sampled (Table 2). Significant differences were found between only two sets of annual detection rates, 2015 and 2022, and 2017 and 2022 (Tukey's HSD: 2015 – 2022, $P < 0.019$, 2017 – 2022, $P < 0.032$), out of 36 comparisons (5.6 percent). Thus, annual detection rates across all monitoring years appear to be stable, with no significant increasing or decrease trend, regardless of the variation in the sampling effort (LMM; Year: $t_{15,71} = -1.31$, $P > 0.195$; Year*sampling effort: $t_{15,71} = -1.63$, $P > 0.108$).

Table 2. Number of Detector-Nights Sampled and Proportion of Detector-Nights with Bat Detections Between FY 2014 and FY 2022

Dates	No. of Nights Sampled	No. of Nights with Detections	Proportion of Nights with Detection(s)
FY 2014 (July 2013 – May 2014) ¹	3,146	31	0.010
FY 2015 (June 2014 – May 2015) ¹	3,113	12	0.004
FY 2016 (June 2015 – May 2016) ¹	3,030	28	0.009
FY 2017 (July 2016 – June 2017) ¹	3,093	15	0.005
FY 2018 (June 2017 – May 2018) ²	1,458	10	0.007
FY 2019 (June 2018 – May 2019) ³	1,046	12	0.011
FY 2020 (June 2019 – May 2020) ³	1,413	6	0.004
FY 2021 (June 2020 – May 2021) ³	1,283	9	0.007
FY 2022 (June 2021 – May 2022) ³	1,076	23	0.021
1. Number of detectors = 12. 2. Number of detectors = 7. 3. Number of detectors = 4.			

In FY 2022, no activity was observed prior to August of the lactation reproductive period (mid-June to August)². Detection rates peaked in August (0.086) and September (0.083) during the late lactation and early post-lactation reproductive periods, consisting of five and eight nights with a single detection. Following the peak in September, detection rates steadily declined in the months of October and November. Between December and March of the pre-pregnancy reproductive period only a single night with one detection occurred during the month of February. Activity was observed again in April and May of the pregnancy reproductive period with two and three nights with a single detection (Figure 2). The temporal pattern of the detection rates in FY 2022 was similar to the pattern of detection rates observed in previous years (Figure 3). The general temporal pattern in the detection rates observed at the Project has also been previously reported in Hawaiian hoary bats monitored at other low elevation sites on O’ahu (Starcevich et al. 2019) and Hawai’i Island (Todd 2012).

² Corresponding reproductive periods defined by Gorresen et al. (2013).

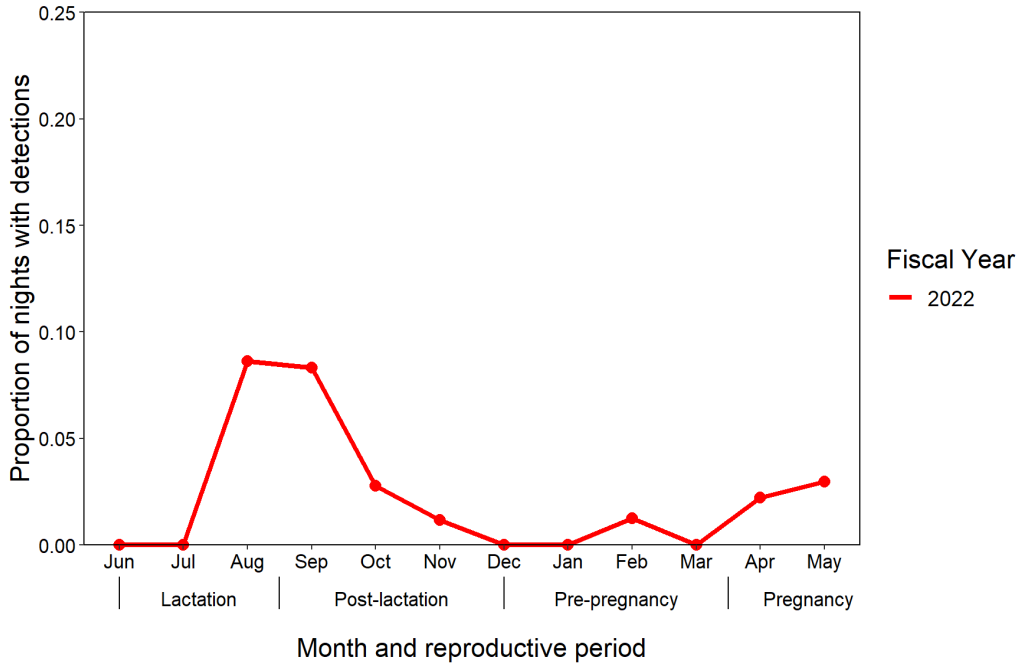


Figure 2. Monthly Bat Acoustic Activity at Kahuku for FY 2022 with Corresponding Reproductive Periods

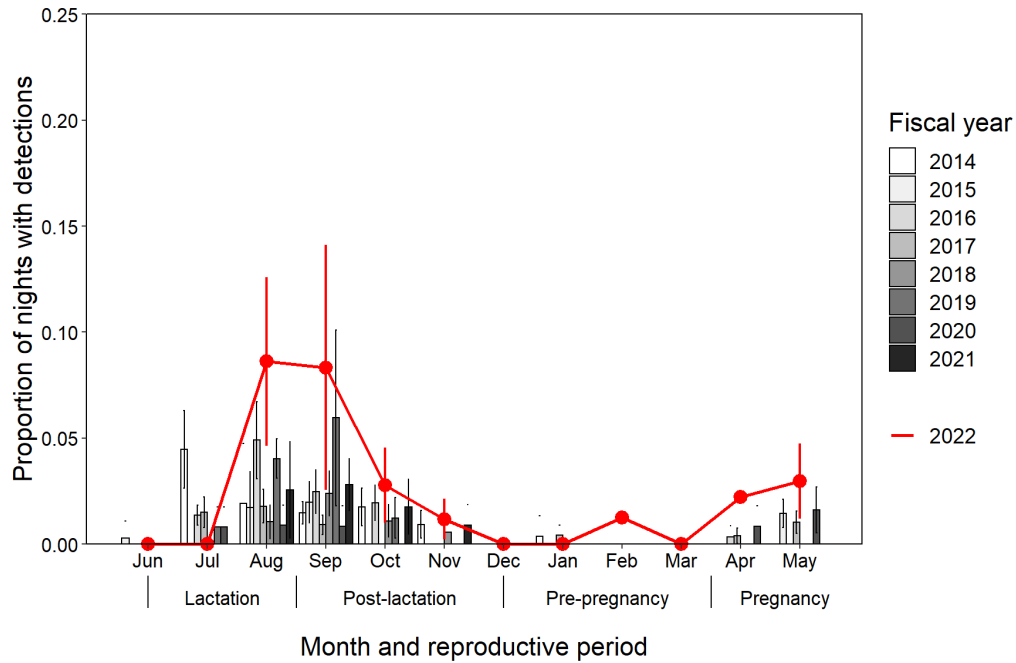


Figure 3. Monthly Bat Acoustic Activity at Kahuku for FY 2014 through FY 2022 with Corresponding Reproductive Periods

9.1.2 Kahikinui Forest Reserve Mitigation

The Baseline (Tier 1) Mitigation obligation for the Hawaiian hoary bat is complete. Kahuku Wind paid the full obligation of \$150,000 for Tier 1 bat mitigation conducted by DOFAW at the Kahikinui Forest Reserve on Maui in September 2011 (Kahuku Wind 2012). These funds were used for 2,500 meters of ungulate fencing around a 280-acre enclosed restoration area (Landon 2015).

9.1.3 Tier 2 Mitigation Planning

Mitigation planning for a Higher Take (Tier 2) was initiated in FY 2020. Based on input from USFWS and DOFAW, KAH is working with DOFAW O'ahu to fund management actions beneficial to bats at one of DOFAW's recent bat mitigation property acquisitions on O'ahu, the Helemano Section of the 'Ewa Forest Reserve. Within this area, opportunities exist to perform habitat modification that are likely to achieve required benefits for bats. KAH has drafted a Tier 2 Mitigation Plan identifying habitat modification actions that are additive and complementary to the broad management goals and forest management activities identified and previously executed by DOFAW O'ahu.

Due to the relatively low level of take identified in Tier 2 (8 bats) and the relatively short time left in the ITP and ITL terms, KAH is targeting a mitigation program that restores and enhances bat habitat quickly. KAH is currently in discussion with DOFAW and USFWS regarding the Tier 2 Mitigation Plan including the scale of and specific habitat modification actions necessary to meet the mitigation obligation.

9.2 Other Covered Species

Mitigation efforts for waterbirds were completed as of FY 2015 and no further reporting is required (Kahuku Wind 2016). All mitigation efforts for Newell's shearwater and Hawaiian petrel were completed as of FY 2017; no further reporting is required (Kahuku Wind 2017, Pacific Cooperative Studies Unit and DOFAW 2017). Mitigation efforts for the Hawaiian short-eared owl were completed as of FY 2017 and no further reporting is required (Kahuku Wind 2017).

10.0 Adaptive Management

KAH has implemented adaptive management steps in accordance with the adaptive management framework in Section 8.3 of the approved HCP to understand and reduce the risk to the Hawaiian hoary bat. Adaptive management measures that have been and continue to be implemented include adjustments in vegetation management and scavenger control efforts to maintain a high probability of detecting Project-related wildlife fatalities and implementing a Project-wide LWSC regime. Three bat fatalities have been observed over approximately 10 years since the initiation of LWSC implementation at KAH.

LWSC of all turbines at wind speeds of up to 5 meters per second began April 27, 2012 and is currently implemented between sunset and sunrise from April through November. Curtailment is

achieved by feathering blades to minimize rotation. On August 19, 2021, as a result of turbine operations inquiries following the observed bat fatality at WTG 2, KAH discovered the 2021 LWSC program had not been implemented in April in accordance with the LWSC adaptive management framework. The issue was corrected immediately and investigated thoroughly to verify that each of the 12 turbines was properly set to operate under the prescribed LWSC. The Project is operating under the LWSC regime described above, and KAH has implemented regular checks to confirm the LWSC programming is operating as intended.

11.0 Agency Meetings, Consultations, and Visits

KAH communicated actively with USFWS and DOFAW throughout FY 2022 through video teleconference, conference calls, submittal of quarterly reports, and e-mail communications related to the Project's HCP (Table 3). These communications included focused discussions of Hawaiian hoary bat Tier 2 mitigation planning and the development of the Mitigation Plan.

Table 3. Summary of Agency Coordination and Communication in FY 2022

Date	Communication	Participants
October 18, 2021	Annual HCP implementation review meeting (via teleconference)	KAH, Tetra Tech, USFWS, DOFAW
October 15, 2021	Submittal of Tier 2 Bat Mitigation Implementation Outline	Submitted to USFWS, DOFAW by Tetra Tech
October 28, 2021	Submittal of FY2022 Q1 report	Submitted to USFWS, DOFAW by Tetra Tech
November 23, 2021	Submittal of Final HCP FY 2021 annual report ¹	Submitted to DOFAW, USFWS by Tetra Tech
January 27, 2022	Submittal of FY 2022 Q2 report	Submitted to DOFAW, USFWS by Tetra Tech
February 3, 2022	Annual HCP implementation review by ESRC	KAH, Tetra Tech, ESRC
April 27, 2022	Submittal of FY 2022 Q3 report	Submitted to USFWS, DOFAW by Tetra Tech
May 10, 2022	Submittal of Draft Tier 2 Bat Mitigation Plan	Submitted to USFWS, DOFAW by Tetra Tech
June 1, 2022	Semi-annual HCP Implementation review meeting (via teleconference)	KAH, USFWS, DOFAW
June 29, 2022	Resubmittal of Tier 2 Bat Mitigation Plan	Submitted to USFWS, DOFAW by Tetra Tech
1. Final resubmittal March 14, 2022, without redline		

12.0 Expenditures

Total HCP-related expenditures for the Project in FY 2022 were \$235,900 (Table 4).

Table 4. HCP-Related Expenditures at the Project in FY 2022

Category	Amount
Permit compliance	\$59,000
Fatality monitoring	\$57,000
Acoustic monitoring for bats	\$9,500
Scavenger control	\$14,000
Vegetation management	\$50,000
Equipment and supplies	\$10,400
Staff labor ¹	--
Tier 2 Bat Mitigation	\$36,000
Total Cost for FY 2022	\$235,900
1. Staff labor costs are included in the overall costs for each other category.	

13.0 Literature Cited

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**Appendix 1. Dalthorp et al. (2017) Fatality Estimation for
Hawaiian hoary bats at the Project through FY 2022**

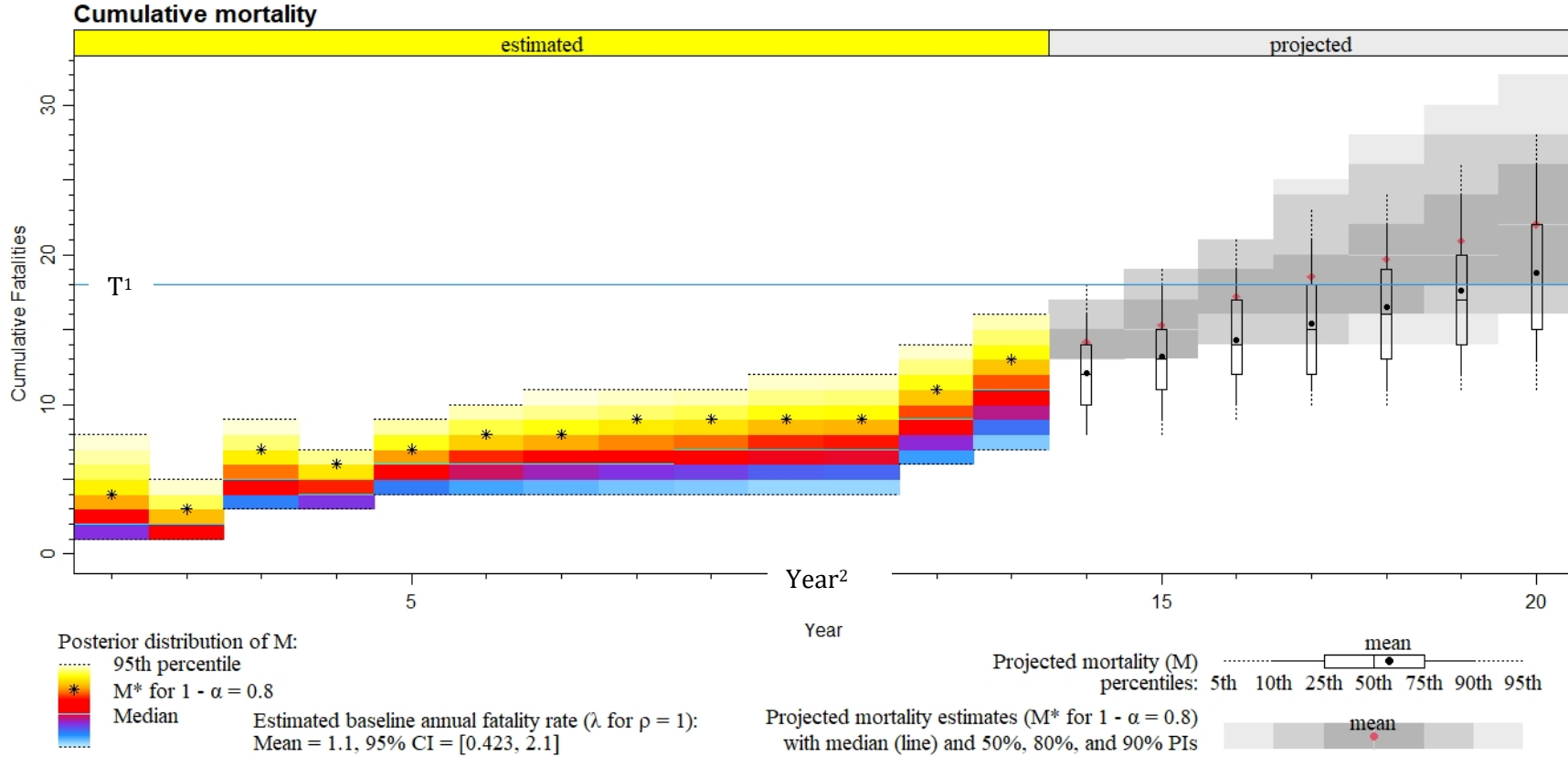
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Modelling parameter		Modelling Period												
		1	2	3	4	5	6	7	8	9	10	11	12	13 (current)
LWSC		N/A	N/A	Partial	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s	5 m/s
Date Range of Modelling Period	Begin	1/1/2011	10/1/2011	4/1/2012	9/1/2013	8/1/2014	11/1/2014	4/1/2015	7/1/2016	7/1/2017	7/1/2018	7/1/2019	7/1/2020	7/1/2021
	End	10/1/2011	3/31/2012	8/1/2012	7/31/2014	10/31/2014	3/31/2015	6/30/2016	6/30/2017	6/30/2018	7/1/2019	6/30/2020	6/30/2021	6/30/2022
Period length (days)		273	182	122	333	91	150	456	364	364	364	364	364	364
Percent of Year		0.75	0.50	0.33	0.91	0.25	0.41	1.25	1.00	1.00	1.00	1.00	1.00	1.00
Search Interval (days)		3.5	2.5	3.5	3.5	3.5	30.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Number of Searches in Modelling period		77	72	34	94	25	4	64	51	51	52	52	52	52
Observed fatalities (X)		1	0	2	0	1	0	0	0	0	0	0	1	1
K		0.7	0.7	0.7	0.7	0.7	0.7	1 ¹	1 ¹	1 ¹	1 ¹	1 ¹	1 ¹	1 ¹
DWP		1.0	1.0	1.0	1.0	1.0	1.0	0.7 ²	0.7 ²	0.7 ²	0.7 ²	0.7 ²	0.7 ²	0.7 ²
g	G	0.464	0.796	0.746	0.830	0.670	0.347	0.565	0.530	0.535	0.411	0.527	0.632	0.519
	95% LCI	0.262	0.675	0.611	0.647	0.460	0.166	0.486	0.465	0.464	0.326	0.434	0.549	0.421
	95% UCI	0.672	0.894	0.861	0.955	0.850	0.554	0.642	0.595	0.605	0.618	0.618	0.714	0.616
B	Ba	9.841	39.66	33.65	17.27	13.94	7.456	87.01	119.5	101.7	50.73	58.89	86.42	51.85
	Bb	11.38	10.18	11.43	3.528	6.853	14.05	67.09	105.8	88.60	72.82	52.93	50.40	48.05
M* ³		4	3	7	6	7	8	8	9	9	9	9	11	13
<p>1. Searches performed by canine teams which have a high probability of detecting a carcass during a subsequent search if initially missed.</p> <p>2. Reduced search area (See FY 2018 Annual Report for detailed analysis).</p> <p>3. Cumulative value representing estimate of total direct take from the start of operations through the identified monitoring period at the 80 percent UCL.</p>														

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**Appendix 2. Hawaiian Hoary Bat 20-Year Projected Take at the
Project in FY 2022**

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1. Permitted take for the Hawaiian hoary bat at the Project is 23; however, projected take as calculated using EoA only includes direct take. To account for indirect take in this analysis, an approximate take threshold (T) of 18 is shown, representing permitted bat take (23) minus 5 adult equivalents of indirect take (21.7 percent of the permitted limit). Currently, the proportion of total take that is attributable to indirect take is 18.2 percent.
2. The “years” 1 – 7 represent unique modelling periods rather than FY and cumulatively represent 5.5 years of operation. In contrast, starting with year 8 the years represent FYs. Therefore, the length of time displayed represents 19.5 years, or the actual time turbines are anticipated to be operational during the 20-year permit term.

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**Appendix 3. Documented Fatalities at the Project during FY
2022**

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Species	Date Documented	WTG	Distance to WTG (meters)	Bearing from WTG (degrees)	Search/ Incidental³
<i>Lasiurus cinereus semotus</i> (Hawaiian hoary bat, 'ōpe'ape'a) ¹	8/18/2021	2	17	193	Search
<i>Ardenna pacifica</i> (wedge-tailed shearwater, 'ua'u kani) ²	8/26/2021	9	71	225	Incidental
<i>Streptopelia chinensis</i> (spotted dove)	11/11/2021	10	1	135	Search
<i>Streptopelia chinensis</i> (spotted dove)	1/26/2022	4	2	100	Search
<i>Haemorhous mexicanus</i> (house finch) ²	3/9/2022	3	8	235	Search
<p>1. Federally and State endangered species. 2. Species protected under the MBTA. 3. Incidental was found outside of the searched area and/or outside of the regularly scheduled search time.</p>					

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