Kaheawa Pastures Wind Energy Generation Facility

Habitat Conservation Plan

FY-2012 Annual Report: Year 6 HCP Implementation

State of Hawaii ITL No. ITL-08 and USFWS ITP No. TE118901-0

Prepared by

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KAHEAWA PASTURES WIND ENERGY GENERATION FACILITY HABITAT CONSERVATION PLAN

YEAR 6 HCP IMPLEMENTATION
July 1, 2011 – June 30, 2012

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I. EXECUTIVE SUMMARY

In June 2006 Kaheawa Wind Power, LLC (KWP) began operating the island of Maui's first commercial wind energy generation facility in the Kaheawa Pastures area of West Maui. The State Board of Land and Natural Resources approved a Conservation District Use Application (CDUA) for the proposed facility, which is situated on State conservation lands, in January 2003. Pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended, and under a similar program, Chapter 195-D, Hawai`i Revised Statutes, KWP developed a project-specific Habitat Conservation Plan (HCP) in cooperation with the USFWS, DLNR and the Hawai`i Endangered Species Recovery Committee (ESRC). Upon final approval of the HCP, the federal ITP (TE-118901-0) and state ITL (ITL-08) were issued in January 2006. The ITP and ITL were amended in April 2012 to reflect a reduction in the authorized take for Hawaiian petrels and Newell's shearwaters. The USFWS issued a separate ITP (TE72434A-0) while the DLNR amendment does not change reference to ITL-08. Both amended permits authorize the incidental take of 38 Hawaiian petrels and 8 Newell's shearwaters for the 20 year duration commencing at the time of original permit issuance. This report summarizes how KWP has implemented the provisions of the HCP during the sixth full year of project operations (July 1, 2011 through June 30, 2012), as specified under the HCP.

The HCP anticipates that the incidental take of four listed species (Hawaiian Petrel, Newell's Shearwater, Nene, and Hawaiian Hoary Bat) may potentially occur as a result of the operation of the wind farm.

Take of one Nene and two Hawaiian Petrels were documented at KWP during Year 6. In addition, four White-tailed tropicbirds, one Great Frigatebird, three Gray Partridges, one Myna, a Japanese White-eye, and a Black Francolin were also documented during downed wildlife monitoring in Year 6. Applying the results of monitoring, including Searcher Efficiency (SEEF), Carcass Removal (CARE), and Indirect Take we estimated adjusted take for Nene to be 1.42-1.68 birds during Year 6. Similar adjustments were used to estimate take of 4.54-6.10 Hawaiian Petrels in Year 6. An accounting through the end of the sixth year of the project estimates that, on average, 0.92-1.41 Hawaiian Hoary Bats, 1.10-1.44 Hawaiian Petrels, and 2.43-2.69 Nene takes may have occurred each year as a result of project operations. No take of Newell's Shearwater have been documented. Running average take for Nene and Hawaiian Hoary Bats crested above Baseline levels of 3/yr and 1/yr, respectively, for a portion of Year 6, but by the end of the year they had returned to within Baseline levels. Adjusted take of Nene for a single year exceeded 8 in FY-2011, triggering adaptive management as prescribed in the HCP. KWP biologists identified risk factors, consulted with DOFAW, and corrective actions were taken to reduce Nene risk. Take of Nene sharply declined in FY 2012.

Construction of a new release pen for Nene on Maui is complete and the first group of 10 birds was released on May 5, 2011. An additional 12 birds were released in early September, 2011 followed by another 8 birds in April, 2012 totaling 30 birds released at the site.

In Year 6 the final mitigation plan for petrels and shearwaters at Makamaka'ole in West Maui was approved by DOFAW, USFWS and ESRC. Two sites were selected to install predator-resistant fences where social attraction would be used to attract birds to nest in artificial burrows. Implementation of the plan, scheduled for spring 2012 , was delayed due to concerns over the use of ranch lands at DLNR. These were resolved in June 2012, and we now expect to implement the project in fall of 2012 and begin

social attraction and monitoring in spring of 2013. Mitigation planning for seabirds is ongoing and includes contingency field studies and monitoring at other locations on Maui.

Mitigation for the baseline level of take for Hawaiian hoary bats was provided in 2006 in the form of funding for research. In addition, since August, 2008 KWP biologists have been conducting acoustic monitoring of bats at Kaheawa using remote acoustic data loggers. There were 46 individual bat call sequences which qualified as "passes" documented from July 1, 2011 through June 30, 2012. Consistent with past years, bat activity in 2012 appeared highest in the fall with 63% of bat passes documented during the months of August-October.

In addition to these specific mitigation measures for HCP covered species, KWP maintains an active wildlife education and outreach program (WEOP) for all personnel on site including staff, contractors, and visitors. In Year 6, First Wind and DOFAW agreed to implement an MOU that will enable the agency to perform field-proctoring of SEEF and CARE trials at KWP to independently assess the efficacy of the downed wildlife monitoring program.

I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate and complete.

8/22/2012

David P. Cowan
Vice President, Environmental Affairs
First Wind Energy, LLC as manager for Kaheawa Wind Power, LLC

II. INTRODUCTION

In June 2006 Kaheawa Wind Power, LLC (KWP) began operating the island of Maui's first commercial wind energy generation facility in the Kaheawa Pastures area of West Maui. The State Board of Land and Natural Resources approved a Conservation District Use Application (CDUA) for the proposed facility, which is situated on State conservation lands, in January 2003. One condition of the CDUA was a requirement to "comply with the Incidental Taking Permit requirements of the U.S. Fish and Wildlife Service, including the preparation of the Habitat Conservation Plan."

Pursuant to Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended, the U. S. Fish and Wildlife Service (USFWS) may permit, under certain terms and conditions, the "taking" of a listed species that is incidental to, and not the purpose of, an otherwise lawful activity. To qualify for a federal Incidental Take Permit (ITP) an applicant must develop, fund, and implement a USFWS-approved Habitat Conservation Plan (HCP) to minimize and mitigate the effects of the incidental take. Under a similar program, Chapter 195-D, Hawai`i Revised Statutes authorizes the Hawai`i Department of Land and Natural Resources (DLNR) to issue an Incidental Take License (ITL).

In fulfillment of this condition, KWP developed a project-specific HCP in cooperation with the USFWS, DLNR and the Hawai`i Endangered Species Recovery Committee (ESRC). Upon final approval of the HCP, the federal ITP (TE-118901-0) and state ITL (ITL-08) were issued in January 2006, each with a duration of twenty (20) years. Commercial operation of the project commenced in June 2006.

As described in Section VI of the HCP, KWP will provide annual monitoring and reporting on project activities. As specified in the federal permit, reporting will include a summary and discussion of incidental take, including adjusted take calculations pursuant to Section V of the HCP; results of searcher efficiency and carcass removal trials; results and discussion of seabird colony searches and management activities; results of nene nest surveys and protocols; vegetation monitoring of affected plant critical habitat areas; an overall summary of management activities; circumstances that triggered adaptive management and how the adaptive management was implemented; description of all occurrences of changed circumstances and how they were addressed; description of any unforeseen circumstances; progress made in achieving biological goals and objectives; any problems that occurred and how they were handled; description of cost expenditures and other information related to funding assurances; an annual work plan including an implementation schedule and entities responsible for implementation; and any other pertinent information such as actions taken by any State or Federal agencies related to implementation of the HCP.

This report summarizes how KWP has implemented the provisions of the HCP during the sixth year of project operations (July 1, 2011 through June 30, 2012). Year 6 activities have continued to include measures to monitor and minimize the risks of adverse effects (i.e., take) on the four listed species, and mitigate for take to accomplish a net ecological benefit for each covered species.

Table 1 (below) provides a summary of the provisions contained in the HCP that ensure compliance under the terms of the ITL, ITP, and Implementing Agreement (IA), including impact avoidance, minimization, monitoring, mitigation measures, funding assurance, and reporting.

Table 1. HCP-prescribed timeline and current status of prescribed wildlife monitoring and mitigation initiatives at the end of Year 6, Kaheawa Wind Power HCP.

Compliance Measure	Timeline per HCP	Year 6 Status
WEOP Implementation [1, 2, 3, 4]	Life of Project	Ongoing
Downed Wildlife Surveys [3, 4]	Life of Project	Ongoing
Searcher Efficiency Studies [3, 4]	Years 1-2	Ongoing
Carcass Removal Trials [3, 4]	Years 1-2	Ongoing
Nene Interaction Surveys [3, 4]	Year 1	Completed June, 2007
Funding for Nene Release Pen [5]	Permit Issuance	Completed January, 2008
5-years of Annual Funding for Nene Gosling Production or Translocation [5]	Years 1-5	Completed February, 2011
Nene Contingency Fund [5]	Permit Issuance	Initiated January, 2006
Seabird Colony Searches and Mitigation [5]	Years 1-2 then implement management measures	In-progress
On-Site Seabird Radar Surveys [3, 4]	Year 1	Completed in Year 1
Seabird Contingency Fund [5]	Permit Issuance	Initiated January, 2006
On-Site Bat Surveys [3, 4]	Year 1	Completed in Year 1
Hoary Bat Research Fund [5]	Permit Issuance	Completed June, 2006
Hoary Bat Contingency Fund [5]	Permit Issuance	Initiated January, 2006
1 = impact minimization, 2 = impact avoidance, 3 = monitoring, 4 = documentation and reporting, 5 = mitigation		

III. AVIAN AND BAT FATALITY MONITORING

Monitoring Surveys to Document Downed Wildlife

KWP biologists have been implementing a year-round monitoring program to document downed (i.e., injured or dead) wildlife incidents involving HCP-listed and non-listed species on the project site and its vicinity since operations began in June, 2006.

Since systematic intensive surveys began in June, 2006, foot searches by trained monitoring personnel as prescribed in the HCP have been the standard method used to conduct surveys for downed wildlife around the 20 wind turbines at KWP. In addition, three meteorological (met) towers are surveyed in a circular pattern roughly 10 meters beyond their anchor points. In the six years since project operations

began there has been no observed take documented at any of the met towers, though at one time there were as many as 7 guyed met towers in place. Downed wildlife monitoring in Year 6 consisted of systematic searches of all 20 WTG search plots and three met towers search plots on a weekly basis in order to maintain a search frequency of 7 days, on average (Table 2). A complete search log is contained in Appendix 1.

Table 2. Average number of days between searches of downed wildlife monitoring plots at Kaheawa Wind Power during Year 6.

Month	Search Interval (days)	
	WTGs	Mets
July	6.8	6.75
August	7.00	7.00
September	7.00	7.00
October	6.95	7.00
November	6.61	7.00
December	7.28	7.33
January	6.78	6.78
February	7.00	7.00
March	6.96	7.00
April	7.00	7.00
May	7.16	7.90
June	9.83	11

An exception occurred during one week in June. During this week, search activities were severely restricted due to a prolonged episode of extraordinarily high winds at the project site. Combined with precipitation and poor visibility, work conditions were deemed unsafe for field monitoring and the resultant lag affected our search interval for that month.

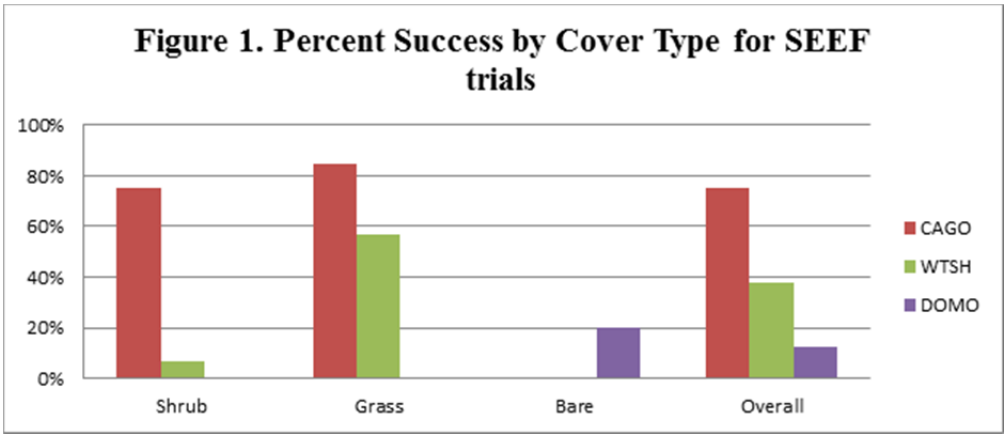
Searcher Efficiency Studies

Searcher efficiency studies (SEEF) provide estimates of carcass detection probability and are an important component of downed wildlife monitoring at KWP. SEEF trials are controlled by a proctor and conducted in conjunction with the daily search plan. Searchers are not informed in advance that a trial is being initiated.

Vegetation and habitat are known to affect the ability of searchers to detect avian and bat fatalities. At the recommendation of USFWS and DOFAW, KWP developed a coarse habitat (i.e., ground cover) classification (bare, grass, shrub) to account for the effects of ground cover variability on carcass detection (Year 4 Annual Report, Appendix 10). While not specifically prescribed in the HCP, it was

implemented as an adaptive measure that should improve the accuracy of our take estimates. In Year 6 we added 2 additional ground cover categories and concluded that 11% of the search plot area consists of shrub, 45% grass, 6% mix of shrub and bare ground, 11% grass-shrub mixture, 2% grass and bare, and 23% bare ground.

In Year 6 there were 44 SEEF trials performed at KWP using carcasses of medium-sized seabirds (WTSH, N=11), Lesser Canada Goose (CAGO, N=12), and small mammals (DOMO, N=21) (Appendix 2). A clear difference in detection rates for all taxa depending on ground cover type is evident at KWP with a steady decline in detection rates overall going from bare ground to shrub (Fig. 1).



Using GIS, KWP plans to combine SEEF data with the 5 habitat classes to generate more precise estimates of success rates among different cover types. KWP will use habitat/ground cover covariates in the estimation of SEEF. A bootstrap analysis was performed using the R-estimator developed by Huso et. al. (2011) to evaluate searcher detection efficiency for WTSH and CAGO carcasses based on data from trials conducted during 2011-2012 in grass and shrub habitat at KWP (Table 3). Data for WTSH include trials proctored by KC Environmental in 2011.

Table 3. Bootstrap estimates (5000 resamples, α=0.05) of searcher efficiency (SE) using carcasses of WTSH and CAGO as surrogates for Hawaiian petrels and Nene in grass and shrub trial habitats at KWP, 2011-2012.

Species	Habitat	Found	Placed	SE Estimate	Lower CL	Upper CL
WTSH	Grass	13	23	0.52	0.34	0.72
WTSH	Shrub	1	14	0.14	0	0.29
CAGO	Grass	10	12	0.91	0.74	1
CAGO	Shrub	7	10	0.61	0.33	0.9

Carcass Removal Trials

Trials to estimate the average time an avian or bat carcass remains detectable to searchers before being removed by scavengers or otherwise rendered undetectable (carcass persistence or CARE) were performed in Year 6 during December 2011 and January, 2012 using 11 small mammals (rats) and 3 Wedge-tailed shearwater carcasses as surrogates for bats and seabirds, respectively. The length of time that carcasses remained visible to monitors was determined for each carcass used in the trial and is expressed in days. To estimate carcass persistence time, we checked carcasses on each of the 14 days the trials were in progress (Appendix 3). On each day of the trial the status and condition of carcasses are assessed based on presence/absence, evidence of scavenging and/or decomposition, change in the location, and overall condition of the carcass. Mean carcass persistence time was calculated for each carcass size class and vegetation type by summing the retention time for each carcass and dividing by the total number of carcasses used in the trial (Table 4).

Table 4. Carcass persistence times for trials conducted at KWP in Year 6 using small mammal (DOMO) and Wedge-tailed shearwater (WTSH) carcasses.

December, 2011		
Taxa	Average retention time (days)	Range
WTSH	11.3	6-14
DOMO	6.8	2-14
January, 2012		
Taxa	Average retention time (days)	Range
DOMO	5.6	1-11

Results of the trials conducted in Year 6 are consistent with the carcass persistence times documented for these taxa in past trials. A bootstrap analysis using the R-estimator (Huso et. al. 2011) was performed using CARE data for WTSH and CAGO from 2009-2012 and is contained in Appendix 4.

Direct Observations of Incidental Take

Downed wildlife incidents documented at KWP during Year 6 are summarized in Table 5. Three of these incidents involved HCP-covered species - 1 Nene and 2 Hawaiian Petrels. These incidents were verbally reported to DOFAW and USFWS within 24 hours, and written reports detailing each incident were submitted to DOFAW and USFWS within 5-7 calendar days of discovery.

Table 5. Documented wildlife fatalities at Kaheawa Wind Power in Year 6 (FY-2012).

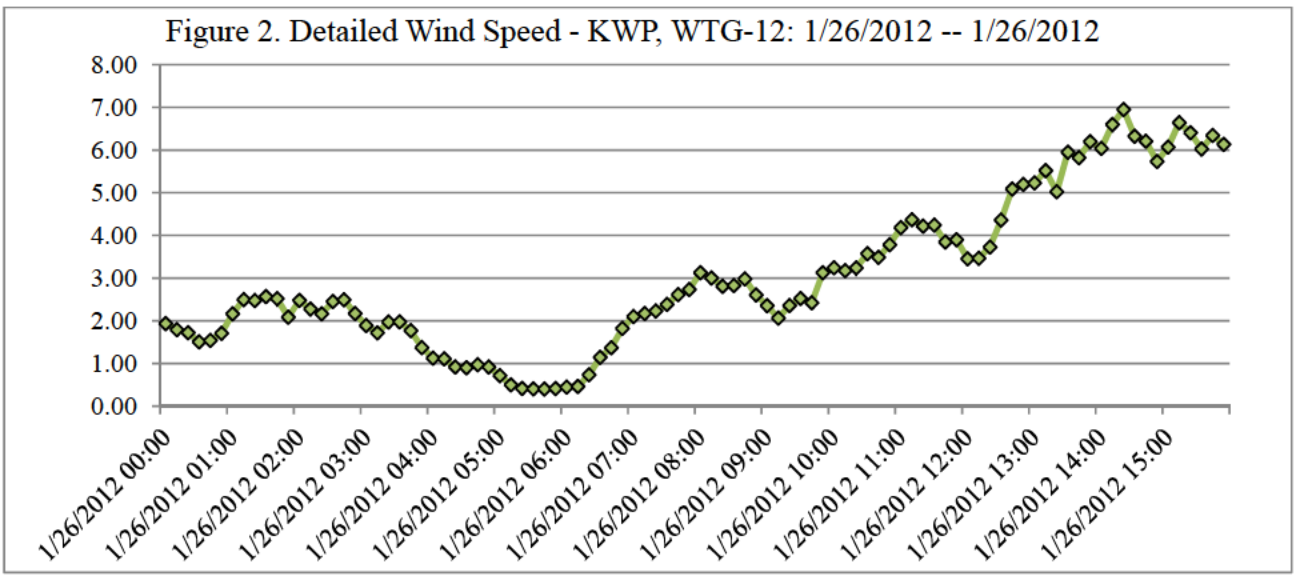
Species	Date	Location (WTG)	Distance to turbine (m)	Type of Detection
HCP-Covered Species				
Nene	January 26, 2012	12	36.5	Incidental
Hawaiian Petrel	August 3, 2011	15	71	Routine
Hawaiian Petrel	October 19, 2011	17	52	Incidental
MBTA and Other Non-Covered Species				
White-tailed Tropicbird	July 26, 2011	7	53.5	Incidental
White-tailed Tropicbird	August 23, 2011	7	43	Routine
White-tailed Tropicbird	December 12, 2011	17	72.5	Incidental
White-tailed Tropicbird	June 29, 2012	10	38.8	Routine
Great Frigatebird	February 15, 2012	6	50-70	Incidental
Japanese White-eye	February 28, 2011	12	1.5	Routine

HCP Covered Species

Nene

The Nene fatality at WTG 12 on January 26, 2012 was witnessed by construction contractors working near the KWP-2 substation and BESS facility at 3:18 p.m. A profile of wind speed data gathered from meteorological instrumentation on WTGs was examined for 15 hours prior to the time of collision (Fig. 2). It appears wind speeds were variable but steadily increasing at the time of the fatality, ranging between 6 and 7 meters per second (15 mph). Although wind speeds were somewhat low at the time the fatality was observed, eye-witnesses reported the birds were flying directly into the wind as they approached the project area from the east.

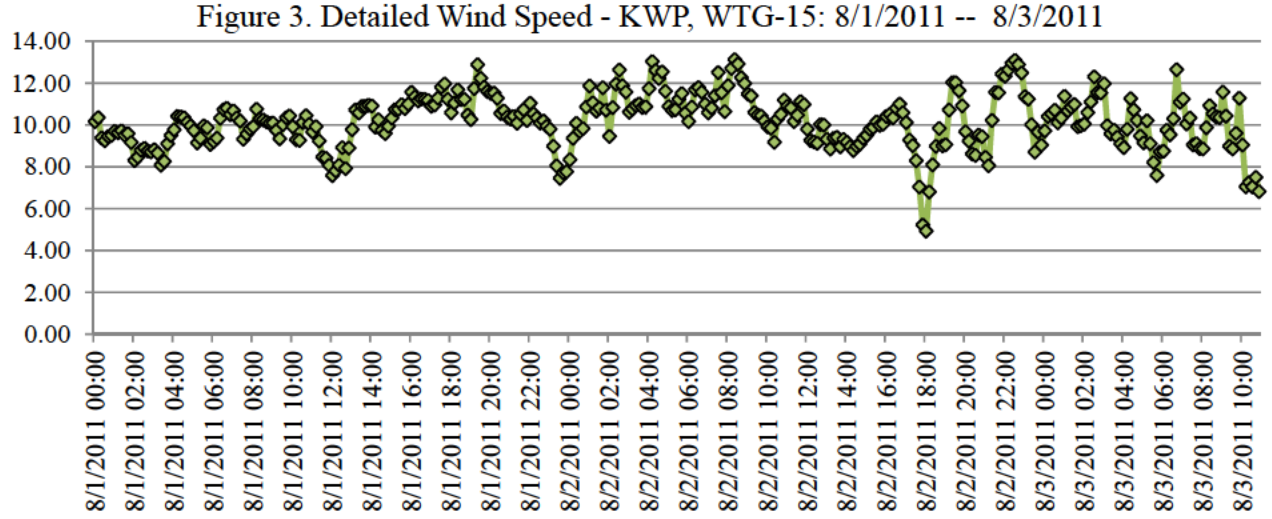
Figure 2. Detailed Wind Speed - KWP, WTG-12: 1/26/2012 -- 1/26/2012



Hawaiian Petrel

Two Hawaiian Petrel fatalities were found in Year 6 – the first on August 3, 2011 at WTG 15 and the second on October 19, 2011 at WTG 17. The incident report for the August fatality stated that the "carcass appeared relatively fresh with very few ants…". Wind data for the previous two days are shown in Figure 3 (below). Day and Cooper (1999) and Cooper and Day (2004) found that peak movements of petrel-like targets during the summer at KWP occur between 20:30-21:00 and 05:30-06:00. Fall movement periods are bi-modal in the evening with peaks evident between 18:30-19:00 and 20:00-20:30. Morning peak movement begins just after first light and lasts roughly 30 minutes.

Figure 3. Detailed Wind Speed - KWP, WTG-15: 8/1/2011 -- 8/3/2011



Estimating the Adjusted Take of Covered Species

The Observed Direct Take (ODT) is a fundamental variable that is adjusted by applying results of SEEF, Carcass Removal (CARE) Trials, and search frequency to estimate the Total Direct Take, as described in Section V of the HCP. In Year 6, there were three (3) occurrences of Observed Direct Take (ODT) of Covered Species documented at KWP. In each case the cause of death is assumed to be project-related based on eye-witness reports and the proximity of the remains to project structures.

As presented in Section V of the HCP, the components that go into estimating the Adjusted Take are, a) Observed Direct Take, b) Unobserved Direct Take, c) Indirect Take, and d) Loss of Productivity. The SEEF and CARE results are used to estimate the Unobserved Direct Take (UDT). To calculate adjusted estimates of the number of Nene and Hawaiian Petrel fatalities that may have occurred at KWP in Year 6, based on one ODT of Nene and two ODT of Hawaiian Petrels, we used an estimator, *m*, as proposed by Shoenfeld (2004) and Kerns and Kerlinger (2003) to estimate fatality rates using the formula:

$$m = \left(\frac{N*I*C}{k*t*p}\right)\left(\frac{e^{I/t}-1+p}{e^{I/t}-1}\right)$$

where *I* (search interval), represents the number of days between plot searches, *N* is equal to the number of turbine search plots, *k* is the number of plots searched (in the case of KWP, *N* and *k* are the same value), *t* is the mean carcass retention time, *p* is used to represent the detection probability (searcher efficiency), $e^{I/t}$ is a logarithmic value, and *C* is the actual number of carcasses observed (ODT). As a comparison to the estimates provided by Shoenfeld (2004), an estimator proposed by Huso (2008) was also used to calculate take of covered species using the same adjustment variables for carcass retention, searcher detection efficiency, and search frequency. Lastly, we performed a bootstrap analysis using the R-estimator developed by Huso et. al. (2011) which generates upper and lower confidence limits around mortality estimates based on user-defined model covariates (e.g., habitat) and 95% confidence intervals (α=0.05).

Indirect take resulting from the loss of eggs or dependent young is taken into consideration on a species-specific basis and is dependent on the time of year in which the take occurs. Timing of each incident provides a basis for applying indirect take, while necropsy or examination reports are expected to provide information on cause of death, condition of the individual, gender, maturity, and reproductive status. The Nene incident in late January, 2012 was documented during the known breeding season for Nene on Maui which makes it plausible that the bird downed in the collision may have been actively breeding. However, by late January, the vast majority of breeding birds has already established secure nest sites and would not be expected to be flying between areas to much degree. The behavior observed by eye-witnesses suggest the bird that was killed is unlikely to have been actively nesting or caring for dependent young at the time the take occurred. The petrel take documented in August, 2011 coincided with the period when many non-breeders and failed breeders are beginning to depart the breeding colonies. At this time, most breeding birds should be provisioning newly hatched chicks, and on this basis we assumed that Indirect Take was at least possible, if not likely. Conversely, the October, 2011 petrel take was documented at a time when dependent chicks are receiving final provisioning prior to fledging, and likely already have achieved a body mass that would enable them to fledge successfully. Thus, Indirect Take was not assessed for the October fatality.

Because they are resident at Kaheawa on a year-round basis, Nene may be taken at any time during the year at KWP. Seabirds are present in the vicinity of the project area only between April-November, corresponding with their migratory breeding season, and therefore take is only expected to occur during these months (roughly 60% of the year). Table 6 (below) provides a summary of the variables used in the Shoenfeld (2004) mortality estimator for Nene and Hawaiian Petrels in Year 6, where the search interval (I) corresponds to the mean inter-search interval during the month the take was observed (and which is fairly constant throughout the year) and the most-recently estimated carcass retention time (t) or an average of all retention times, whichever is more representative.

Table 6 Variables used in Shoenfeld (2004) to estimate Total Direct Take of Nene and Hawaiian Petrels at Kaheawa Wind Power during Year 6 (FY-2012).

Species	Date	C	N	K	I	t	p	$e^{t/I}$	Indirect take	m
NENE	1/26/12	1	20	20	6.78	14	0.75	1.62		1.423
HAPE	8/3/11	1	20	20	7.00	13	0.63	1.69	0.79	2.387
HAPE	10/19/11	1	20	20	6.95	11	0.44	1.881		2.153

[1] Incidental Take License No. ITL-08, Special Condition Nos. 4 and 6.

Estimating the total adjusted take for Nene and Hawaiian petrels in Year 6 using the Huso estimator (2008) yielded similar, albeit somewhat higher estimates of take than results using Shoenfeld (2004) (Table 7). To assess variability in these estimates, we also ran the data through bootstrap analysis using the R-estimator (Huso et. al. 2011) which generates lower and upper confidence limits around estimates (α=0.05) of fatality, searcher efficiency (SE), and carcass persistence (CP) and these are shown in Table 8. Data output summaries for R-estimator runs (5,000 re-samples, α=0.05) and adjusted take estimates are contained in Appendix 4.

Table 7 Equation values used in the Huso (2008) estimator of mortality to estimate the Total Direct Take of Nene and Hawaiian Petrels at KWP in fiscal year 2012.

Parameter	**Nene**	**HAPE**	**HAPE**
Observed Direct Take (c_{ij})	1	1	1
Carcasses Retained through I (r_{ij})	0.79	0.78	0.75
Carcass Detection Probability (p_{ij})	0.75	0.63	0.44
Search Interval (I)	6.78	7.00	6.95
Proportion of Plots Searched	1.0	1.0	1.0
Effective Search Interval (e_{ij})	1.0	1.0	1.0
m_{ij} =	**1.68**	**2.04**	**3.04**

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

Table 8 Results of fatality estimates for Nene and Hawaiian petrels in Year 6 using R-estimator bootstrap analysis (Huso et. al. 2011) and 95% confidence intervals (α=0.05).

Factor	Level	Number Found	Site Total Estimate	Site Total Lower	Site Total Upper	Per Turbine Estimate	Per Turbine Lower	Per Turbine Upper
Overall		3	6	5	8	0.29	0.24	0.39
Species	HAPE	2	4	2	8	0.2	0.09	0.36
Species	NENE	1	2	2	6	0.1	0.08	0.29

The estimates of adjusted take in Year 6 based on results using Shoenfeld (2004) and Huso (2008) indicate that the annual running average take for Nene appear well within Baseline. After adjustments are applied, the estimated take levels for Hawaiian Petrels approximate the annual threshold for

triggering the development and implementation of adaptive management while the running average continues to remain within the expected Baseline (Table 9).

Table 9 Comparison of estimated take levels for Nene and Hawaiian petrels during Year 6 using Shoenfeld (2004) and Huso (2008).

Total Estimated Adjusted Take in Year 6					
Estimator	Species	Year 6 Take Estimate[1]	Running Average[2]	Total Adjusted Take (Years 1-6)	Annual Threshold for Adaptive Management
Shoenfeld (2004)	NENE	1.42	2.43	15.82	8
	HAPE	4.54	1.10	7.18	5
	NESH	0	0	0	5
	HHBA	0	1.00	6.00	2
Huso (2008)	NENE	1.68	2.80	17.50	8
	HAPE	6.10	1.56	9.36	5
	NESH	0	0	0	5
	HHBA	0	1.53	9.19	2

[1] Take estimates for Hawaiian petrel (HAPE) include indirect take for the fatality in August, 2011.

[2] Running Averages based on 6.5 years since ITL and ITP issuance.

The take estimates reported here are based on calculations using mortality estimators proposed by Shoenfeld (2004) and Huso (2008). The Huso (2008) estimator generates a slightly higher take estimate than the estimator proposed by Shoenfeld (2004) which appears driven by greater sensitivity to searcher efficiency. Estimating adjusted take using bootstrap analysis with the R-estimator (Huso et. al. 2011) provides a statistically robust treatment of fatality, carcass persistence, and searcher efficiency data and helps validate the take estimates based on the earlier models.

IV. MITIGATION INITIATIVES

Seabird Mitigation at Makamaka'ole

Mitigation for the two seabird species (Hawaiian petrel and Newell's shearwater) is being implemented in conjunction with KWP II. The primary mitigation entails construction and management of two predator-free fenced enclosures (one for each species), provisioned with artificial burrows and social attraction, at the Makamaka'ole site in West Maui (commonly referred to as "the Maka site"). The Maka site straddles three state land management jurisdictions: Natural Area Reserve (NAR), State Forest, and state land leased to a private ranching interest. Implementation of the plan requires

approvals from the NARS Commission, DLNR Division of Forestry and Wildlife (DOFAW), the State Land Division, and the Office of Conservation and Coastal Lands (OCCL), as well as adherence to other applicable statutes and regulations.

Permitting began in fall of 2011 with the goal of constructing the enclosures in late winter/early spring of 2012, and commencement of social attraction activities in the 2012 breeding season. In early November, 2011 First Wind submitted a Special Use Permit application to the NARS Commission, which addressed agency comments that were received during the drafting of the application materials. In late November, during the NARS review process, First Wind presented an overview of the project to the NARS Commission in Honolulu, and the project received support for Special Use Permit issuance.

Authorization from OCCL was applied for on December 21, 2011 and approval received on January 11, 2012. Early in 2012, First Wind met with the Maui DOFAW Forestry Managers to review requirements for an Access Permit that would cover the scope of the proposed project in the West Maui Forest Reserve. An Access Permit application was submitted along with revisions in February, 2012. The Special Use and Access Permit applications share much of the same descriptive and technical detail concerning the project, enabling NARS and Forestry officials to collaborate during the review process. Several rounds of comments and requests for clarification were received over the course of several weeks to finalize the permits and obtain approval to proceed. First Wind met with the Land Division, NARS, and DOFAW on Maui in late February, 2012 to discuss the remaining comments and concerns and to obtain guidance from the Land Division concerning the process for approving the proposed use of state lands for the project.

The rancher leasing the balance of the state land, [redacted], has consistently expressed support for the proposal, which will not infringe on his use of the land because the proposed seabird enclosures are located within an area he previously allowed to be fenced off by DLNR for conservation purposes. The Maui Land Division agent did not foresee a problem securing their approval for the proposed use.

Unexpectedly, in early April, 2012 DLNR officials in Honolulu requested that the enclosures be redesigned to exclude the leased ranch land. This would have required significant alterations and could have rendered the project unacceptable to USFWS. Numerous options to reconfigure the enclosures were considered and discussed with USFWS and DOFAW. Finally in July, 2012, First Wind met with DLNR in Honolulu and was able to reach agreement on a path forward to allow the ranch lands to be reincorporated into the project. The end result was a delay of approximately 4 months, and new requirements added to the DLNR authorization process including a metes and bounds survey and formal access agreements both for the prior existing fence and the new proposed enclosures and surrounding buffer areas.

As of July, 2012 fence building materials are being staged on Maui and contractors are ready to get underway. The Special Use Permit and Access Permit applications from the NARS and DOFAW,

respectively, are being finalized to reflect the return to the original configurations prior to resubmittal for final approval. First Wind is in the process of retaining a survey team on Maui for the metes and bounds survey, and is coordinating with DLNR to draft the required access agreements. In addition, we have retained a cultural and archeological consultant to delineate any existing cultural artifacts, features, and important cultural and/or historic uses to be avoided in the project area. First Wind expects to see final approvals in Q1-2013 that will enable the fence installation phase of the project to get underway by fall, 2012.

Supplemental Seabird Mitigation Investigations

In accordance with the approved KWP II HCP, during the first 5 years following ITP issuance, First Wind 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.

First Wind biologists initiated these efforts at the Kahakuloa study area in June 2012 by trialing the use of state-of-the-art acoustic detection technology. The use of remote detection devices reduces disturbance of habitats and intrusion into potentially sensitive habitats, and has the added advantages of being able to record over extended periods without repeated helicopter visits, overnight camping, and human safety risks. Using these methods to evaluate the presence/absence and activity levels of remotely nesting species (birds and bats) has received considerable attention in recent years and is currently being utilized by DOFAW at Limahuli Valley, Kauai and near Hookipa, Maui to study seabirds. The expectation is that using remote methods will enable greater sampling effort without the need for human observers to perform each survey.

The Wildlife Acoustics SM2 (Song Meter)^{TM} was selected by First Wind as well-suited for these purposes (Fig. 1). These instruments have been used successfully for studies of several other seabird species where frequent visits to conduct audio detection surveys are impractical or otherwise limit the ability of observers to collect data. First Wind has purchased several SM2s and consulted with collaborators on the mainland to identify the most suitable survey methodology for deployment in environmental conditions encountered in the mountainous interior of Maui.

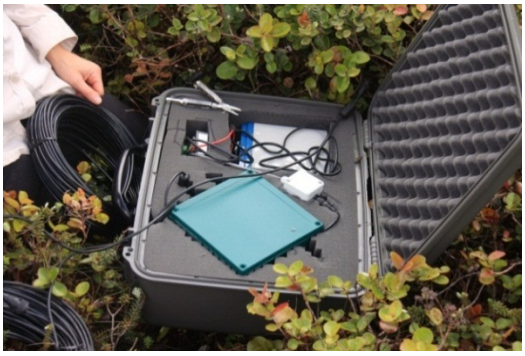


Figure 4. The Wildlife Acoustics SM2 (left) and the SM2 system contained in a water-tight case ready for use in the field (right).

First Wind received a Special Use Permit from the NARS in late June, 2012 to conduct field studies in Kahakuloa Natural Area Reserve in West Maui that included deploying up to 6 SM2 units at 3-4 deployment sites in upper Kahakuloa Valley in 2012. Selecting the sites required concurrence with Maui NARS personnel and entailed aerial reconnaissance surveys of the proposed areas to ensure sufficient helicopter landing sites were present and to identify the sites prior to deployment of instruments. KWP II biologists and Maui NARS personnel conducted several aerial missions and identified several sites that met the criteria for safe landing and foot travel to deploy the instruments. The first deployments were made on June 15, 2012. Two SM2s on dual channels (2 mics each) were placed in an area close to our 2011 audio-visual point count site (Fig. 6). The next deployment was on July 2, 2012 and was just upslope of the initial deployment site, closer to the head of the valley. During the second deployment we landed personnel briefly at the first deployment site in order to check the SM2 systems and ensure each unit was operating properly. The elevations at the deployment sites range between 960-990 meters amsl.

The SM2s are set on a duty cycle to record for the first 3.5 hours after sunset, then for 1 minute every 10 minutes until 2.5 hours before sunrise, when they revert back to continuous recording until sunrise. On this duty cycle the data cards provide enough storage capacity for roughly 60 consecutive days before cards need to be replaced, downloaded, and/or the systems may be re-deployed elsewhere or retrieved. KWP II plans to retrieve data cards and begin analyses of the audio data in August, 2012.

Figure 5. First Wind wildlife biologist securing an SM2 microphone on a 50 meter cable extension to native shrubbery in upper Kahakuloa Valley, West Maui.

Hawaiian Hoary Bat

Hawaiian Hoary Bats continue to be monitored using Anabat acoustic detection and recording instruments. The location of Anabat stations are presented in Figure 7. Since bat monitoring using acoustic sensors began in 2008, 4 stations have been set up and maintained as reference stations (Units 10, 14, 18 and 19). Several additional Anabat stations were moved among locations between Year 5 and Year 6 to obtain additional data. Station 17 was previously located between WTG 5 and WTG 6 and has been removed. Station 26 has been added mauka of WTG 1.

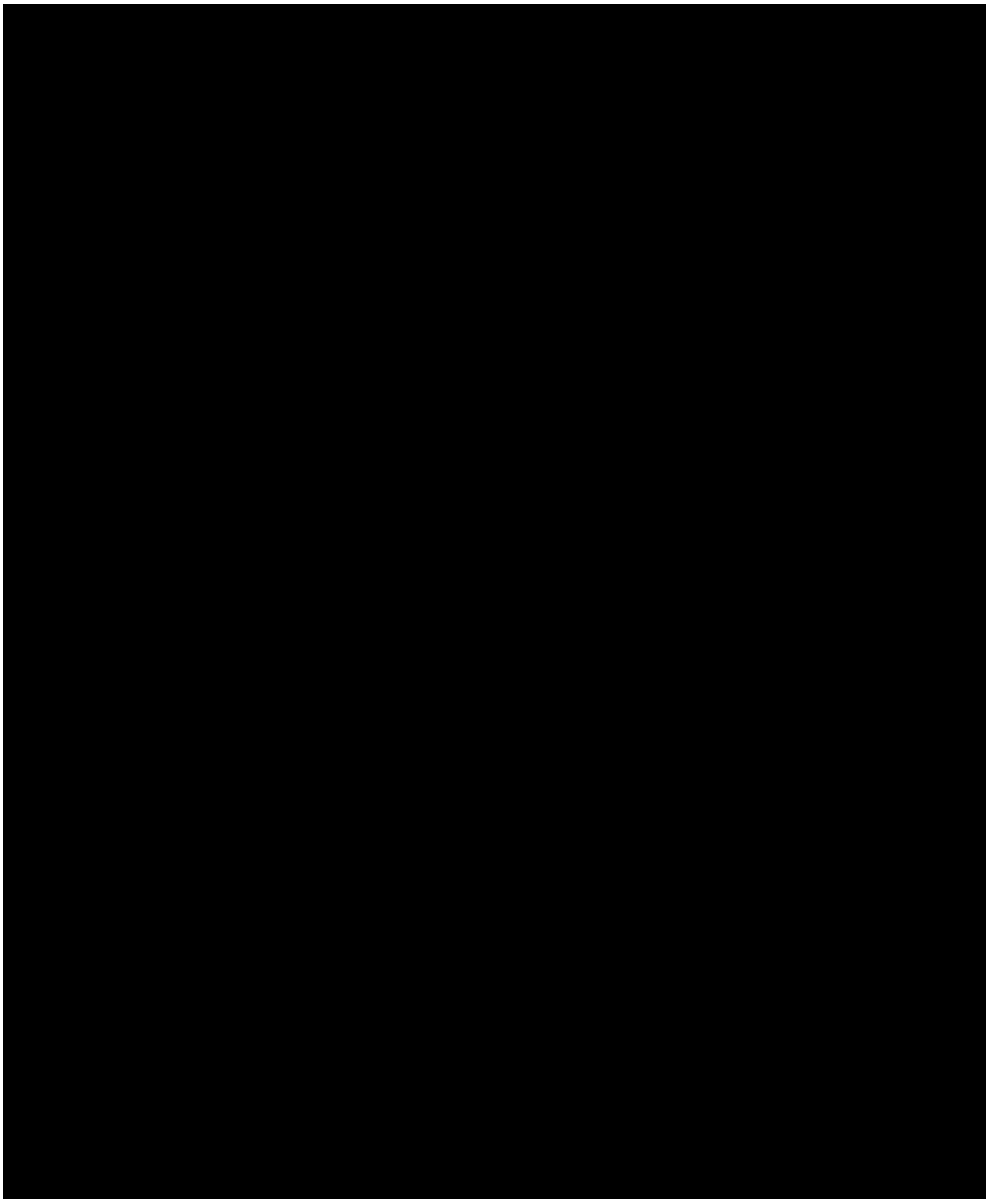


Figure 6. Locations of Anabat acoustic bat detectors adjacent to the Kaheawa Pastures wind energy facilities in Year 6.

Summary data provided in Table 10 (below) include the total qualifying bat passes recorded for operating detectors in Year 6. Passes are defined as call sequences containing three or more distinct call pulses. Detection rates were calculated for each detector based on the number of bat passes and the number of nights during the deployment period in which the detectors were fully operational (also known as detector-nights).

Table 10. Frequency of Hawaiian Hoary Bat passes recorded by Anabat acoustic detectors at Kaheawa Wind Power, West Maui, July 2011 – June 2012.

Detector ID	Deployment Dates	Detector Nights	Passes	Total Detection Rate (passes/detector night)
10	07/01/11-06/30/12	366	14	0.038
14	07/01/11-06/30/12	364	15	0.041
17	07/01/11-05/05/12	301	4	0.013
18	07/01/11-06/30/12	315	8	0.025
19	07/01/11-06/30/12	366	0	0.000
22	10/13/11-06/30/11	273	3	0.011
23	10/20/11-06/30/12	126	0	0.000
24	10/13/11-06/30/12	226	1	0.004
26	05/03/12-06/20/12	65	1	0.015

Overall, 46 qualifying bat passes were documented within the monitoring area from July 1, 2011 through June 30, 2012. The majority of the documented passes (63%) were recorded during the months of September and October. Figure 8 (below) shows the detection rates by month for all stations.

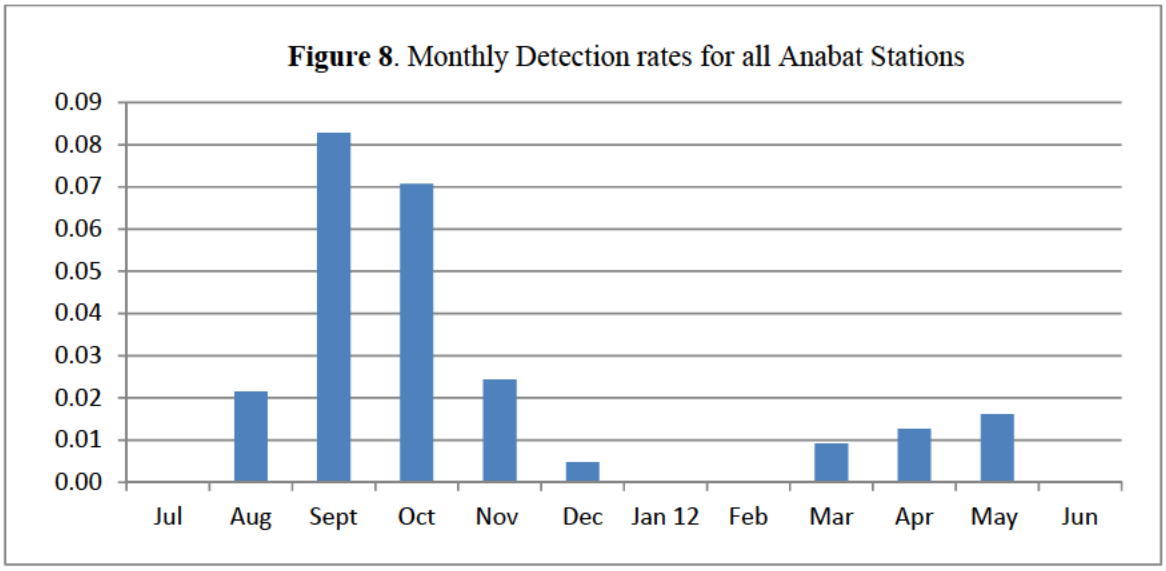
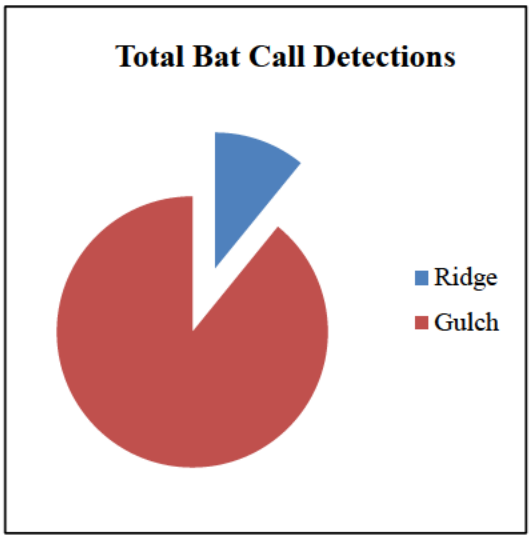


Figure 8. Monthly Detection rates for all Anabat Stations

Along with seasonal differences it was also noted that there is a likely correlation between the location of Anabat stations and the number of calls. Of the nine units, five are located adjacent to a gulch and four are located on the ridge top. Approximately 89% of total calls for the year came from stations located adjacent to a gulch. Within stations that were located near a gulch results were highly variable. Stations 10 and 14 recorded 29 of the 46 calls detected or 63% of all calls. Taking into account the operational days of each station the gulch units have 3 to 4 times the detection rate than that of ridge units. There is no apparent difference in call detection rates relative to elevation within the study area.



V. WILDLIFE EDUCATION AND OBSERVATION PROGRAM

Personnel Orientations and Incidental Reporting

The Wildlife Education and Observation Program (WEOP) orientations include verbal and visual descriptions of the covered species, an overview of requirements and guidelines for minimizing interactions and disturbance to wildlife, and instructions for reporting observations. In addition, all staff and project personnel are issued two laminated fact sheets explaining the natural history of each HCP covered species along with detailed procedures for promptly reporting any downed wildlife events. Throughout the year, and especially during the Nene breeding season, regular staff updates by KWP biologists, sometimes in coordination with DLNR/DOFAW, enable KWP and contractor personnel to anticipate the likelihood of encountering Nene on the site. These measures enable project personnel to report their observations and exchange important information with wildlife staff in a timely and proactive manner. During Year 6, 13 separate WEOP orientations were provided for various contractors, staff, and visitors and these are shown in Table 8 (below).

Table 11. Dates and affiliations of individuals that were provided WEOP orientations at KWP in Year 6.

Date	Name	Affiliation
7/13/2011	[redacted]	General Electric
7/19/2011	[redacted]	First Wind
7/26/2011	[redacted]	Makala Construction

Date	Name	Affiliation
9/2/2011	[redacted]	First Wind
9/29/2011	[redacted]	WHECO
11/9/2011	[redacted]	General Electric
11/9/2011	[redacted]	General Electric
1/16/2012	[redacted]	First Wind, Operations
1/18/2012	[redacted]	Looking Point
1/18/2012	[redacted]	First Wind, IT
4/16/2012	[redacted]	LM Wind Power
5/9/2012	[redacted]	General Electric
5/23/2012	[redacted]	General Electric
6/20/2012	[redacted]	First Wind, Operations

A Wildlife Observation Logbook is posted on site and enables all staff and contract personnel to record the details of their observations of HCP and non-HCP covered wildlife. The logbook contains fields for entering data that include:

- Observer Name, Date and Time of observations
- Species and Number of Individuals
- Location
- Proximity to Wind Turbine(s) and other Structures
- Apparent Behavior
- Estimated Height Above Ground (in meters) if observed in flight
- Flight Direction
- Pertinent Comments
- Weather

The Logbook has proven an effective means of obtaining observations that might otherwise have not been possible relying on verbal communication alone. Observations recorded for KWP in the WEOP logbook during Year 6 are summarized in Appendix 5. The WEOP guidelines and protocols have significantly improved our ability to track and monitor the movements of Nene and other wildlife on site, even when environmental staff can not directly observe their presence.

VI. BOTANICAL RESOURCES

Minimizing and Managing Invasive Species

KWP continues to work actively with stakeholders, agency staff, construction teams and contractors, and several conservation groups on Maui to minimize the ingress of undesirable invasive plant species in the Kaheawa area. Most of the invasive and incipient species that dominate portions of the Kaheawa landscape also degrade the value of available habitat for species like Nene. Though most of these

"pasture weeds" have been tolerated for years, KWP recognizes the need to identify and manage new ingress and to work pro-actively with the DLNR to manage invasive outbreaks as they arise.

Soon after Fireweed (*Senicio madagascariensis*) was first encountered at Kaheawa following the 2006 wildfires that swept through the region, KWP biologists co-established the Fireweed Working Group to address the Fireweed issue and its potential to affect the landscape of West Maui. The group is composed of representatives from the County of Maui, State of Hawaii, Maui Invasive Species Committee, Maui Cattleman's Association, USDA Rangeland Extension Office, State Plant Quarantine Division, KWP, and other concerned parties. Because fireweed typically first becomes established in disturbed areas at KWP (gravel areas, sides of roads, along swales) efforts to manage fireweed included spot treatments of plants on the bare turbine pads and along roadways, and manual removal of larger plants that may be responsible for seed dispersal. A noticeable reduction in the overall abundance of fireweed has been evident since more aggressive spot treatments have been implemented, but chemical treatments must continue alongside manual control in order to adequately manage fireweed in the project area. This species represents a considerable concern for rangeland managers throughout Hawaii because of its toxicity to livestock. KWP continues to welcome the support and collaboration we share with the Fireweed Working Group and others as advancements are made to control this invasive species.

Construction activities associated with the KWP II facility began in December, 2010 and were complete by June, 2012. An environmental consultant, Land Services, Inc. (LSI), was retained in part to inspect all incoming vehicles and equipment prior to proceeding to the KWP II and KWP project areas in order to minimize the likelihood of unwanted invasive species introductions during the KWP II construction phase. Prior to construction, First Wind and LSI consulted with the Maui Invasive Species Commission (MISC) to review minimization, avoidance, and monitoring protocols. During the planning process MISC personnel were consulted for their input to ensure adequate screening of incoming vehicles, raw materials, and equipment prior to entering the work site.

Several small outbreaks of fireweed occurred in Year 6, mostly in isolated areas where the seed bed was disturbed by construction activities. On June 12, 2012, several areas were treated behind the maintenance building and along a roadway fill slope where hydro-seeding had been applied. The area that had been hydro-seeded received only manual removal in order to avoid set-backs in KWP II construction-phase ground cover establishment. Another area adjacent to the road on the west side of the maintenance building which had also been hydro-seeded, was treated with Garlon. A third area where Fireweed was discovered is located near the BESS and this area was also treated with Garlon. Each of these areas will be carefully monitored and treated as necessary to prevent establishment of fireweed.

VII. ADAPTIVE MANAGEMENT CONSIDERATIONS

Adaptive management provisions are an inherent and necessary component of this HCP, providing a mechanism to make adjustments to mitigation and other project functions as new information derived from monitoring and reporting becomes available to inform success or address challenges as they arise.

In 2011 (Year 5) First Wind documented 5 observed takes of Nene at KWP – half of the total takes observed to date - resulting in adjusted take of just over 8 birds during the fiscal year. Take nonetheless remained below the Baseline level running average of 3 birds per year. In April, 2011 First Wind and LSI noted a gradual increase in the numbers and activities of Nene adjacent to KWP II construction activities at the BESS coincident with the emergence of newly seeded Annual rye grass which was applied to the fill slopes around the BESS to stabilize soils following construction. Peak numbers ranged between 18-24 individuals present at a given time over the course of a 1-week period in mid-April, and required LSI to provide daily monitoring presence, guidance, and diligent refresher training for construction workers in the vicinity of the BESS.

Three of the 5 observed fatalities of Nene in Year 5 occurred within an unprecedented 6 week time period. The fatality documented at WTG-12 in late May, 2011 led to a discussion of possible contributing factors. The fifth and last Nene take of fiscal year 2011 occurred on June 30, 2011 and was also documented at WTG-12.

Factors that may have increased the risk of take include:

- Birds being disturbed by construction activities and caused to flush in the vicinity of operating WTGs
- Greater overall numbers of birds transiting the project area (possibly related to increasing population)
- A source of interest attracting birds to the project area

Observations made at the time suggest that the emergence of Annual rye coincided with the flocking season for Nene, providing a source of browse, and facilitating social behavior.

Responses by First Wind and LSI to try to reduce these risk factors included:

1. Refreshment and enforcement of all procedures related to conducting activities while Nene are present, including adherence to vehicle operation and speed limits. This was done 1-on-1 at the construction site between LSI, First Wind, and contractors, in emails and memos, and at the daily Plan of the Day meetings.

2. In reviewing potential attractants First Wind and LSI concluded that Annual rye emergence coincident with the flocking season was one of the most likely factors contributing to a greater

take exposure risk for Nene in Year 5, especially toward the end of the fiscal year. First Wind requested that the KWP II construction team implement alternative measures to stabilize soils at the BESS and Substation facility to eliminate the attraction risk caused by the Annual rye. In July, 2011 the entire area that had been previously seeded with Annual rye was covered and compacted with rip rap. . Follow-up monitoring by First Wind and LSI confirmed that Nene numbers in the vicinity of the BESS decreased considerably once the rip rap was installed. At the same time, the flocking season had ended and the birds were dispersing.

3. Some birds remained and one group (affectionately referred to as the "Fab 4"), became so accustomed to loafing and wandering into the vicinity of the BESS work area that LSI maintained a continuous presence whenever this group was present. Concerned about continued risk to these birds, KWP II consulted with Maui DOFAW (John Medeiros) to see whether DOFAW might be willing to relocate these birds, at least until construction activities could be completed. DOFAW indicated that no facilities were available to temporarily contain the birds but agreed to capture and band them, suggesting that capture and handling might cause them to leave the area. DOFAW biologists successfully captured and banded all four birds on October 28, 2011. The birds did not depart the area altogether but did seem less willing to approach work areas and eventually dispersed without incident.

We conclude that the elevated take documented at KWP in Year 5 were attributable at least in part to the increase in construction activities along with the emergence of Annual rye grass adjacent to the KWP II BESS facility in April and May, 2011, which represented a strong attraction feature for Nene. Take levels in Year 6 were not unusual in comparison to Years 1-4, suggesting that the Year 5 take levels were anomalous.

First Wind is also preparing a stand-alone summary of our observations and adaptive management response, including factors that may have affected the elevated take (i.e., Nene behavioral patterns and habitat use observed near construction activities), at the request of USFWS and DOFAW.

Adaptive management was also necessary in Year 6 to work out the configurations of the fenced enclosures at Makamaka'ole. The process required KWP, DOFAW and USFWS to work closely to identify and evaluate solutions to the unexpected change in state land availability. While this challenge appears to be easing, adaptive management will probably continue to be essential as the project proceeds.

VIII. CHANGED OR UNFORESEEN CIRCUMSTANCES

There were no events or circumstances that would be considered changed or unforeseen circumstances during the Year 6 reporting period at the KWP site. However, DLNR's request that we remove an

important piece of Conservation District land planned for inclusion in the Makamaka'ole seabird mitigation project in early April, 2012 was not anticipated and came as a surprise. The removal of this land temporarily stalled progress on implementing the project according to the timeline outlined for the project in 2012. In addition, we were surprised to discover that in the view of USFWS, *any* change in the configuration of either fenced enclosure that deviated from the figures presented in the final KWP II HCP (clearly labeled "preliminary") would have required at least a minor amendment, and potentially a major amendment to the KWP II HCP, and thereby directly affecting KWP. We disagree with this view and maintain that going from preliminary to final design is clearly within the scope of adaptive management provisions of both HCPs.

IX. AGENCY COORDINATION AND REPORTING

During Year 6, KWP submitted quarterly progress reports to DOFAW and USFWS on December 5, 2011, February 8, 2012, and June 5, 2012. KWP met with the ESRC on September 7, 2011 to provide an update on Makamaka'ole, including how the mitigation was being defined in the context of the KWP II HCP. In January, 2012 we met with the ESRC to request approval of an Amendment to the HCP and ITL to reduce the authorized take of Hawaiian petrels and Newell's shearwaters. The Amendment was proposed to take into consideration new information related to the distribution and risk exposure of both seabird species in the project area (and relative to KWP II), which suggested fewer Newell's shearwaters move through the project area on an annual basis than previously estimated. Therefore, authorized take levels for Newell's shearwaters were reduced from 40 individuals down to 8 over the 20 year permit term while only a modest reduction from 40 to 38 individuals were requested and subsequently approved for Hawaiian petrels.

Following the Makamaka'ole project update KWP provided in writing to DOFAW and USFWS on April 13, 2012 a conference call was convened to discuss the issues affecting the enclosure configurations and decide upon a course of action. Several additional conference calls followed in May and June, attended by the USFWS PIFWO, Portland Regional Office, DOFAW, and First Wind in efforts to work through challenges and interpretation of HCP provisions with respect to the enclosure designs.

Going forward, KWP biologists wish to provide better communication with DOFAW and USFWS regarding downed wildlife monitoring activities at the site. Toward this end we created a Daily Searcher Activity Report form (see Appendix 6). Each day monitors fill out the activity report, certify that the report is accurate, scan and upload the reports into a database. In the event that weather or environmental conditions prohibit searching (i.e. winds over 35 mph, fog, heavy rain) the activity report will contain a description of the circumstances. The report also tracks which portions of the search areas need vegetation and/or search area maintenance, wildlife observations, and any carcasses that are found (including SEEFs). The Daily Search Activity Report was designed to facilitate more frequent information exchange between KWP and the agencies. KWP will begin uploading these reports to the

DOFAW Basecamp website on a regular basis starting in Year 7. The Daily Search Activity Report will not replace other forms of communication or reporting requirements already in place, but is hoped to facilitate communication and transparency.

X. FUNDING

A summary of HCP-related expenditures for Year 6 is contained in Appendix 7. This summary lists costs (including staff labor) that KWP has expended toward fulfilling the terms of the HCP in Year 6, as well as cumulatively, and compares them against the budgeted amounts specified in Appendix 11 of the HCP. Spending on seabird mitigation has exceeded the originally-budgeted amounts due to the costs associated with assessment and planning at the Makamaka`ole site. Spending has also significantly exceeded budgeted amounts for fatality monitoring and is expected to remain above budgeted levels in the coming year as intensive monitoring continues, and with the addition of State compliance proctoring of SEEF and CARE trials. The HCP anticipated that the rate of spending on monitoring would decrease markedly and level off after two years, however KWP has continued intensive monitoring without interruption since the project began operations (6+ years) at the request of USFWS and DOFAW. In addition, a summary of additional conservation measures being implemented by KWP and their approximate costs is provided to give a sense of the full scope of activities being implemented at the project site. These are either related to CDUP compliance, or voluntary on the part of KWP, and were not included in the budget presented in the approved HCP.

XI. CONCLUSION

The HCP provides for a wide range of avoidance, minimization, and mitigation measures intended to result in a net conservation benefit for the four covered species. KWP has continued to implement these measures in accordance with the HCP and the recommendations provided by DLNR, USFWS, and the ESRC through the sixth year of implementation. Several specific items have been presented that point to accomplishments and challenges encountered during Year 6. Finding innovative solutions and building on what has been learned during six years of successful monitoring are expected to result in continued fine-tuning and improvement.

KWP has made substantial advancement on mitigation for seabirds at Makamaka'ole and at several contingency sites in West Maui.

KWP anticipates implementing an MOU with DOFAW in Year 7 that will enable the agency to perform SEEF and CARE trial proctoring for compliance monitoring.

XII. LITERATURE CITED

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APPENDIX 1

Avian and Bat Fatality Monitoring Record

July, 2011

WTG Search Plot																				Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
7/5	7/5	7/5	7/5	7/5	7/6	7/6	7/6	7/6	7/6	7/6	7/7	7/7	7/7	7/7	7/7	7/1	7/1	7/1	7/1	
7/11	7/11	7/11	7/11	7/11	7/12	7/12	7/12	7/12	7/12	7/12	7/13	7/13	7/13	7/13	7/13	7/8	7/8	7/8	7/8	
7/19	7/19	7/19	7/19	7/19	7/19	7/19	7/20	7/20	7/20	7/20	7/21	7/21	7/21	7/21	7/21	7/14	7/14	7/14	7/14	6.8
7/25	7/25	7/25	7/25	7/25	7/26	7/26	7/26	7/26	7/26	7/26	7/27	7/27	7/27	7/27	7/27	7/22	7/22	7/22	7/22	
			7/28	7/28	7/28	7/28	7/28													

August, 2011

WTG Search Plot																				Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
8/1	8/1	8/1	8/1	8/1	8/2	8/2	8/2	8/2	8/2	8/2	8/3	8/3	8/3	8/3	8/3	8/4	8/4	8/4	8/4	
8/8	8/8	8/8	8/8	8/8	8/9	8/9	8/9	8/9	8/9	8/9	8/10	8/10	8/10	8/10	8/10	8/11	8/11	8/11	8/11	
8/16	8/16	8/16	8/16	8/16	8/17	8/17	8/17	8/17	8/17	8/17	8/18	8/18	8/18	8/18	8/18	8/19	8/19	8/19	8/19	7
8/22	8/22	8/22	8/22	8/22	8/23	8/23	8/23	8/23	8/23	8/23	8/24	8/24	8/24	8/24	8/24	8/25	8/25	8/25	8/25	
8/29	8/29	8/29	8/29	8/29	8/30	8/30	8/30	8/30	8/30	8/30	8/31	8/31	8/31	8/31	8/31					

September, 2011

WTG Search Plot																				Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
9/7	9/7	9/7	9/7	9/7	9/7	9/7	9/8	9/8	9/8	9/8	9/8	9/8	9/8	9/9	9/9	9/1	9/1	9/1	9/1	
9/12	9/12	9/12	9/12	9/12	9/13	9/13	9/13	9/13	9/13	9/13	9/14	9/14	9/14	9/14	9/14	9/9	9/9	9/9	9/9	
9/19	9/19	9/19	9/19	9/19	9/20	9/20	9/20	9/20	9/20	9/20	9/21	9/21	9/21	9/21	9/21	9/15	9/15	9/15	9/15	7
9/26	9/26	9/26	9/26	9/26	9/27	9/27	9/27	9/27	9/27	9/27	9/28	9/28	9/28	9/28	9/28	9/22	9/22	9/22	9/22	
																9/30	9/30	9/30	9/30	

October, 2011

WTG Search Plot																				Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
10/3	10/3	10/3	10/3	10/3	10/4	10/4	10/4	10/4	10/4	10/4	10/5	10/5	10/5	10/5	10/5	10/6	10/6	10/6	10/6	6.95
10/11	10/11	10/11	10/11	10/11	10/12	10/12	10/12	10/12	10/12	10/12	10/13	10/13	10/13	10/13	10/13	10/14	10/14	10/14	10/14	
10/17	10/17	10/17	10/17	10/17	10/18	10/18	10/18	10/18	10/18	10/18	10/19	10/19	10/19	10/19	10/19	10/20	10/20	10/20	10/20	
10/24	10/24	10/24	10/24	10/24	10/25	10/25	10/25	10/25	10/25	10/25	10/26	10/26	10/26	10/26	10/26	10/27	10/27	10/27	10/27	
10/31	10/31	10/31	10/31																	

November, 2011

WTG Search Plot																				Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
11/7	11/7	11/7	11/7	11/7	11/1	11/1	11/1	11/1	11/1	11/1	11/2	11/2	11/2	11/2	11/2	11/3	11/3	11/3	11/3	6.61
11/14	11/14	11/14	11/14	11/14	11/8	11/8	11/8	11/8	11/8	11/8	11/9	11/9	11/9	11/9	11/9	11/10	11/10	11/10	11/10	
11/21	11/21	11/21	11/21	11/22	11/15	11/15	11/15	11/15	11/15	11/15	11/16	11/17	11/18	11/19	11/16	11/17	11/17	11/17	11/17	
11/28	11/28	11/28	11/28	11/28	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/22	11/23	11/23	11/23	11/23	11/23	11/23	

December, 2011

WTG Search Plot																				Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
12/5	12/5	12/5	12/5	12/5	12/6	12/6	12/6	12/6	12/6	12/6	12/7	12/7	12/7	12/7	12/7	12/1	12/1	12/1	12/1	7.28
12/12	12/12	12/12	12/12	12/12	12/13	12/13	12/13	12/13	12/13	12/13	12/14	12/14	12/14	12/14	12/14	12/8	12/8	12/8	12/8	
12/20	12/20	12/20	12/20	12/20	12/21	12/21	12/21	12/21	12/21	12/21	12/22	12/22	12/22	12/22	12/22	12/15	12/15	12/15	12/15	
12/27	12/27	12/27	12/27	12/27	12/28	12/28	12/28	12/28	12/28	12/28	12/29	12/29	12/29	12/29	12/29	12/23	12/23	12/23	12/23	
																12/30	12/30	12/30	12/30	

January, 2012

WTG Search Plot																			Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1/3	1/3	1/3	1/3	1/3	1/4	1/4	1/4	1/4	1/4	1/4	1/5	1/5	1/5	1/5	1/5	1/6	1/6	1/6	1/6	6.78
1/9	1/9	1/9	1/9	1/9	1/10	1/10	1/10	1/10	1/10	1/10	1/11	1/11	1/11	1/11	1/11	1/12	1/12	1/12	1/12	
1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/18	1/19	1/19	1/19	1/19	1/19	1/20	1/20	1/20	1/20	
1/23	1/23	1/23	1/23	1/23	1/24	1/24	1/24	1/24	1/24	1/24	1/25	1/25	1/25	1/25	1/25	1/26	1/26	1/26	1/26	
1/30	1/30	1/30	1/30	1/30	1/31	1/31	1/31	1/31	1/31	1/31										

February, 2012

WTG Search Plot																			Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
2/6	2/6	2/6	2/6	2/6	2/6	2/6	2/7	2/7	2/7	2/7	2/1	2/1	2/1	2/1	2/1	2/2	2/2	2/2	2/2	7
2/13	2/13	2/13	2/13	2/13	2/14	2/14	2/14	2/14	2/14	2/14	2/8	2/8	2/8	2/8	2/8	2/9	2/9	2/9	2/9	
2/21	2/21	2/21	2/21	2/21	2/22	2/22	2/22	2/22	2/22	2/22	2/15	2/15	2/15	2/15	2/15	2/16	2/16	2/16	2/16	
2/27	2/27	2/27	2/27	2/27	2/28	2/28	2/28	2/28	2/28	2/28	2/23	2/23	2/23	2/23	2/23	2/24	2/24	2/24	2/24	
											2/29	2/29	2/29	2/29	2/29					

March, 2012

WTG Search Plot																			Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
3/5	3/5	3/5	3/5	3/5	3/6	3/6	3/6	3/6	3/6	3/6	3/7	3/7	3/7	3/7	3/7	3/1	3/1	3/1	3/1	6.96
3/12	3/12	3/12	3/12	3/12	3/13	3/13	3/13	3/13	3/13	3/13	3/14	3/14	3/14	3/14	3/14	3/15	3/15	3/15	3/15	
3/19	3/19	3/19	3/19	3/19	3/20	3/20	3/20	3/20	3/20	3/20	3/21	3/21	3/21	3/21	3/21	3/16	3/16	3/16	3/16	
3/26	3/26	3/26	3/26	3/26	3/27	3/27	3/27	3/27	3/27	3/27	3/28	3/28	3/28	3/28	3/28	3/22	3/22	3/22	3/22	

April, 2012

WTG Search Plot																			Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
4/2	4/2	4/2	4/2	4/2	4/3	4/3	4/3	4/3	4/3	4/3	4/4	4/4	4/4	4/4	4/4	3/29	3/29	3/29	3/29	
4/9	4/9	4/9	4/9	4/9	4/10	4/10	4/10	4/10	4/10	4/10	4/11	4/11	4/11	4/11	4/11	4/5	4/5	4/5	4/5	
4/16	4/16	4/16	4/16	4/16	4/17	4/17	4/17	4/17	4/17	4/17	4/18	4/18	4/18	4/18	4/18	4/12	4/12	4/12	4/12	7
4/23	4/23	4/23	4/23	4/23	4/24	4/24	4/24	4/24	4/24	4/24	4/25	4/25	4/25	4/25	4/25	4/19	4/19	4/19	4/19	
4/30	4/30	4/30	4/30	4/30												4/26	4/26	4/26	4/26	

May, 2012

WTG Search Plot																			Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
4/26	4/26	4/26	4/26	4/26	5/1	5/1	5/1	5/1	5/1	5/1	5/2	5/2	5/2	5/2	5/2	5/13	5/14	5/15	5/16	
4/26	4/26	4/26	4/26	4/26	5/8	5/8	5/8	5/8	5/8	5/8	5/9	5/9	5/9	5/9	5/9	5/18	5/18	5/18	5/18	
4/26	4/26	4/26	4/26	4/26	5/16	5/16	5/16	5/16	5/16	5/16	5/17	5/17	5/17	5/17	5/17	5/24	5/24	5/24	5/24	7.16
4/26	4/26	4/26	4/26	4/26	5/21	5/22	5/22	5/22	5/22	5/22	5/23	5/23	5/23	5/23	5/23					
					5/29	5/30	5/30	5/30	5/30	5/30										

June, 2012

WTG Search Plot																			Average Search Interval (days)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
6/4	6/4	6/4	6/4	6/4	6/4	6/5	6/5	6/5	6/5	6/5	6/7	6/7	6/7	6/7	6/7	6/8	6/8	6/8	6/8	
6/11	6/11	6/11	6/11	6/11	6/11	6/12	6/12	6/12	6/12	6/12	6/14	6/14	6/14	6/14	6/14	6/15	6/15	6/15	6/15	
6/27	6/27	6/27	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/29	6/28	6/28	6/28	6/28	6/28	6/21	6/21	6/21	6/21	9.83
																6/28	6/28	6/28	6/28	

July, 2011				**August, 2011**				**September, 2011**				**October, 2011**			
Met Plot			Average	Met Plot			Average	Met Plot			Average	Met Plot			Average
1	**2**	**3**	Interval	**1**	**2**	**3**	Interval	**1**	**2**	**3**	Interval	**1**	**2**	**3**	Interval
7/5	7/6	7/8		8/1	8/2	8/3		9/7	9/7	9/8		10/3	10/4	10/5	
7/11	7/12	7/13		8/8	8/9	8/10		9/12	9/13	9/14		10/11	10/12	10/13	
7/19	7/20	7/21	**6.75**	8/16	8/17	8/18	**7**	9/19	9/20	9/21	**7**	10/17	10/18	10/19	**7**
7/25	7/26	7/27		8/22	8/23	8/24		9/26	9/27	9/28		10/24	10/25	10/26	
				8/29	8/30	8/31						10/31			

November, 2011				**December, 2011**				**January, 2012**				**February, 2012**			
Met Plot			Average	Met Plot			Average	Met Plot			Average	Met Plot			Average
1	**2**	**3**	Interval	**1**	**2**	**3**	Interval	**1**	**2**	**3**	Interval	**1**	**2**	**3**	Interval
11/7	11/1	11/2		12/5	12/6	12/7		1/3	1/4	1/5		2/6	2/7	2/1	
11/14	11/8	11/9	**7**	12/12	12/13	12/14	**7.33**	1/9	1/10	1/11	**6.78**	2/13	2/14	2/8	**7**
11/21	11/15	11/16		12/20	12/21	12/22		1/18	1/18	1/19		2/21	2/22	2/15	
11/28	11/22	11/22		12/27	12/28	12/29		1/23	1/24	1/25		2/27	2/28	2/23	
	11/29	11/30						1/30	1/31					2/29	

March, 2012				**April, 2012**				**May, 2012**				**June, 2012**			
Met Plot			Average	Met Plot			Average	Met Plot			Average	Met Plot			Average
1	**2**	**3**	Interval	**1**	**2**	**3**	Interval	**1**	**2**	**3**	Interval	**1**	**2**	**3**	Interval
3/5	3/6	3/7		4/2	4/3	4/4		5/7	5/1	5/2		6/8	6/8	6/8	
3/12	3/13	3/14		4/9	4/10	4/11		5/14	5/8	5/9		6/14	6/14	6/14	
3/19	3/20	3/21	**7**	4/16	4/17	4/18	**7**	5/23	5/16	5/17	**7.90**				**11**
3/26	3/27	3/28		4/23	4/24	4/25			5/23	5/23					
				4/30											

APPENDIX 2

Searcher Efficiency Trials

Taxa	Drop Date	Search Date	Find/Recover Date	Location (WTG)	Cover Type	Found (Y/N)
CAGO	8/16/2011	8/16/2011	8/16/2011	6	GRASS	Y
CAGO	8/16/2011	8/16/2011	8/16/2011	7	GRASS	Y
CAGO	8/25/2011	8/25/2011	8/26/2011	16	SHRUB	Y
CAGO	9/1/2011	9/1/2011	9/2/2011	17	GRASS	N
CAGO	10/27/2011	10/27/2011	10/27/2011	18	SHRUB	Y
CAGO	11/10/2011	11/10/2011	11/10/2011	6	GRASS	Y
CAGO	11/15/2011	11/15/2011	11/16/2011	13	GRASS	Y
CAGO	6/5/2012	6/5/2012	6/5/2012	9	SHRUB	N
CAGO	6/7/2012	6/7/2012	6/7/2012	13	BARE	N
CAGO	6/12/2012	6/12/2012	6/12/2012	7	GRASS	Y
CAGO	6/15/2012	6/15/2012	6/15/2012	20	SHRUB	Y
CAGO	6/18/2012	6/18/2012	6/29/2012	9	GRASS	Y

Ground Cover	Efficiency (% Found)
Shrub	75 (N=4)
Grass	86 (N=7)
Bare	0 (N=1)
Overall	75 (N=12)

Taxa	Drop Date	Search Date	Find/Recover Date	Location (WTG)	Cover Type	Found (Y/N)
WTSH	7/10/2011	7/11/2011	7/12/2011	4	GRASS	N
WTSH	7/12/2011	7/13/2011	7/13/2011	14	GRASS	Y
WTSH	7/13/11	7/14/2011	7/15/2011	17	GRASS	N
WTSH	7/17/2011	7/18/2011	7/18/2011	2	SHRUB	N
WTSH	7/17/2011	7/18/2011	7/18/2011	3	SHRUB	N
WTSH	7/17/2011	7/18/2011	7/18/2011	3	SHRUB	N
WTSH	7/24/2011	7/25/2011	7/25/2011	2	SHRUB	N
WTSH	7/24/2011	7/25/2011	7/25/2011	3	SHRUB	Y
WTSH	7/24/2011	7/25/2011	7/25/2011	3	SHRUB	N
WTSH	7/27/2011	7/28/2011	7/28/2011	19	GRASS	Y
WTSH	7/27/2011	7/28/2011	7/28/2011	20	GRASS	Y
WTSH	10/17/2011	10/17/2011	10/17/2011	2	SHRUB	N
WTSH	10/17/2011	10/17/2011	10/17/2011	3	SHRUB	N
WTSH	10/17/2011	10/17/2011	10/17/2011	5	GRASS	Y
WTSH	10/17/2011	10/18/2011	10/18/2011	6	GRASS	Y
WTSH	10/17/2011	10/18/2011	10/18/2011	9	GRASS	Y
WTSH	10/17/2011	10/19/2011	10/19/2011	12	GRASS	N
WTSH	10/18/2011	10/19/2011	10/19/2011	15	GRASS	N

Taxa	Drop Date	Search Date	Find/Recover Date	Location (WTG)	Cover Type	Found (Y/N)
WTSH	10/18/2011	10/19/2011	10/19/2011	16	GRASS	N
WTSH	10/19/2011	10/20/2011	10/21/2011	18	GRASS	Y
WTSH	10/19/2011	10/20/2011	10/21/2011	19	GRASS	N
WTSH	10/24/2011	10/24/2011	10/26/2011	2	SHRUB	N
WTSH	10/24/2011	10/24/2011	10/26/2011	1	SHRUB	N
WTSH	10/24/2011	10/24/2011	10/26/2011	3	SHRUB	N
WTSH	10/24/2011	10/24/2011	10/26/2011	1	SHRUB	N
WTSH	10/26/2011	10/26/2011	10/26/2011	14	GRASS	N
WTSH	11/22/2011	11/22/2011	11/22/2011	8	GRASS	Y
WTSH	11/22/2011	11/22/2011	11/22/2011	10	GRASS	Y
WTSH	11/28/2011	11/28/2011	11/29/2011	1	SHRUB	N
WTSH	11/28/2011	11/28/2011	11/28/2011	4	GRASS	Y
WTSH	3/26/2012	3/26/2012	3/26/2012	3	SHRUB	N
WTSH	3/26/2012	3/26/2012	3/27/2012	4	GRASS	Y
WTSH	6/5/2012	6/5/2012	6/5/2012	7	GRASS	NO
WTSH	6/15/2012	6/15/2012	6/15/2012	19	GRASS	YES
WTSH	6/15/2012	6/15/2012	6/15/2012	17	GRASS	YES
WTSH	6/18/2012	6/29/2012	6/29/2012	8	GRASS	NO
WTSH	6/18/2012	6/29/2012	6/29/2012	10	GRASS	NO

Ground Cover	Efficiency (% Found)
Shrub	7 (N=14)
Grass	57 (N=23)
Bare	N/A
Overall	38 (N=37)

Taxa	Drop Date	Search Date	Find/Recover Date	Location (WTG)	Cover Type	Found (Y/N)
DOMO	8/25/2011	8/25/2011	8/26/2011	16	GRASS	N
DOMO	8/25/2011	8/25/2011	8/26/2011	19	BARE	N
DOMO	8/25/2011	8/25/2011	8/26/2011	19	SHRUB	N
DOMO	9/1/2011	9/1/2011	9/1/2011	17	BARE	N
DOMO	9/1/2011	9/1/2011	9/1/2011	17	BARE	Y
DOMO	9/1/2011	9/1/2011	9/1/2011	20	BARE	Y
DOMO	9/12/2011	9/12/2011	9/12/2011	3	SHRUB	N
DOMO	9/12/2011	9/12/2011	9/12/2011	4	GRASS	N
DOMO	10/24/2011	10/24/2011	10/24/2011	2	SHRUB	N
DOMO	10/24/2011	10/24/2011	10/24/2011	3	BARE	N

Taxa	Drop Date	Search Date	Find/Recover Date	Location (WTG)	Cover Type	Found (Y/N)
DOMO	10/24/2011	10/24/2011	10/24/2011	3	BARE	N
DOMO	11/8/2011	11/8/2011	11/8/2011	7	GRASS	N
DOMO	11/8/2011	11/8/2011	11/8/2011	7	BARE	Y
DOMO	1/25/2012	1/25/2012	1/25/2012	2	BARE	N
DOMO	1/25/2012	1/25/2012	LOST	2	BARE	N
DOMO	1/25/2012	1/25/2012	1/25/2012	3	BARE	N
DOMO	1/25/2012	1/25/2012	LOST	3	BARE	N
DOMO	2/9/2012	2/9/2012	2/9/2012	19	BARE	N
DOMO	2/9/2012	2/9/2012	LOST	19	GRASS	N
DOMO	2/9/2012	2/9/2012	2/9/2012	19	BARE	N
DOMO	2/23/2012	2/23/2012	2/23/2012	17	BARE	N
DOMO	2/23/2012	2/23/2012	LOST	17	BARE	N
DOMO	3/5/2012	3/5/2012	3/5/2012	4	GRASS	N
DOMO	3/5/2012	3/5/2012	3/3/2012	4	GRASS	N

Ground Cover	Efficiency (% Found)
Shrub	0 (N=3)
Grass	0 (N=6)
Bare	20 (N=15)
Overall	13 (N=24)

APPENDIX 3

Carcass Removal Trials

December 6-20, 2011	Trial Day	WTSH A	WTSH B	WTSH C	DOMO D	DOMO E	DOMO F	DOMO G
	Day 0	P	P	P	P	P	P	P
	Day 1	P	P	P	P	P	P	P
	Day 2	P	P	P	P	P	P	P
	Day 3	P	P	P	P	P	P	A
	Day 4	P	P	P	P	P	P	
	Day 5	P	P	P	P	P	P	
	Day 6	P	P	P	P	A	P	
	Day 7	P	P	A	A		P	
	Day 8	P	P				P	
	Day 9	P	P				P	
	Day 10	P	P				P	
	Day 11	P	P				P	
	Day 12	P	P				P	
	Day 13	P	P				P	
	Day 14	P	P				P	

Taxa	Average retention time (days)	Range
WTSH	11.3	6-14
DOMO	6.8	2-14

January 17-31, 2012	Trial Day	DOMO H	DOMO I	DOMO J	DOMO K	DOMO L	DOMO M	DOMO N
	Day 0	P	P	P	P	P	P	P
	Day 1	A	P	P	A	P	P	P
	Day 2		P	P		P	P	P
	Day 3		P	P		P	P	P
	Day 4		P	A		P	P	P
	Day 5		A			P	P	P
	Day 6					P	P	P
	Day 7					P	P	P
	Day 8					P	P	P
	Day 9					P	P	P
	Day 10					A	P	P
	Day 11						P	A
	Day 12						A	
	Day 13							
	Day 14							

Taxa	Average retention time (days)	Range
DOMO	5.6	1-11

APPENDIX 4

Calculations Using an Estimator Proposed by Huso (2008)

and

Bootstrap Estimations of Nene and Hawaiian Petrel Fatality, Carcass Persistence, and Searcher Efficiency (FY-2012)

Year 6 Calculations using Huso (2008)

Parameter	NENE 1/26/2012	HAPE 8/3/2011	HAPE 10/19/2011
Likelihood of detection (p_{ij})	0.75	0.63	0.44
Mean carcass removal time (t) (days)	14	13	11
No. of carcasses (c_{ij})	1	1	1
λ (Eq3)	0.07	0.08	0.09
d_{99}	64.47	59.87	50.66
I	7	7	7
d_{99} (Eq 2 applied)	7	7	7
e_{ij}	1	1	1
Eq4			
λd_{99}	0.48	0.52	0.62
r_{ij}	0.79	0.78	0.75
m_{ij}	**1.68**	**2.04**	**3.04**
sampled turbines	1.0	1.0	1.0

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

Year 6 Calculations of Adjusted Take for Nene and Hawaiian Petrels using Shoenfeld (2004)

Species	Date	C	N	K	I	t	p	$e^{t/I}$	Indirect take	m
NENE	1/26/12	1	20	20	6.78	14	0.75	1.62		**1.423**
HAPE	8/3/11	1	20	20	7.00	13	0.63	1.69	0.79	**2.387**
HAPE	10/19/11	1	20	20	6.95	11	0.44	1.881		**2.153**

$$m = \left(\frac{N*I*C}{k*t*p}\right)\left(\frac{e^{I/t}-1+p}{e^{I/t}-1}\right)$$

Lesser Canada Goose (*Branta canadensis parvipes*) and Wedge-tailed Shearwaters (*Puffinus pacificus*) were used as surrogates for Nene and Hawaiian Petrels in all field trials.

Bootstrap Estimations using R-estimator (Huso et. al. 2011) – Fatality estimates.

Turbine search areas were not provided.								
This study included all 20 turbines located at the study site.								
User-defined alpha level of 0.05; all reported confidence intervals are 95% confidence intervals.								
The number of observed casualties for some requested groups is less than 5, use caution when interpreting estimates.								
Factor	Level	Number Found	Site Total MH.Estimate	Site Total MH.Lower	Site Total MH.Upper	Per Turbine MH.Estimate	Per Turbine. MH.Lower	Per Turbine. MH.Upper
Overall		3	6	5	8	0.29	0.24	0.39
Species	HAPE	2	4	2	8	0.2	0.09	0.36
Species	NENE	1	2	2	6	0.1	0.08	0.29

Bootstrap Estimations using R-estimator (Huso et. al. 2011) – Searcher Efficiency (SE)

User-defined alpha level of 0.05; all reported confidence intervals are 95% confidence intervals.							
Searcher Efficiency Estimates; AIC for model = Species + Habitat:69.67							
SE.Cov.Ind	Species	Habitat	Found	Placed	Estimate	Lower	Upper
HAPE.Grass	HAPE	Grass	13	23	0.52	0.34	0.72
HAPE.Shrub	HAPE	Shrub	1	14	0.14	0	0.29
NENE.Grass	NENE	Grass	10	12	0.91	0.74	1
NENE.Shrub	NENE	Shrub	7	10	0.61	0.33	0.9

Lesser Canada Goose (*Branta canadensis parvipes*) and Wedge-tailed Shearwaters (*Puffinus pacificus*) were used as surrogates for Nene and Hawaiian Petrels in all field trials.

Bootstrap Estimations using R-estimator (Huso et. al. 2011) – Carcass Persistence (CP).

User-defined alpha level of 0.05; all reported confidence intervals are 95% confidence intervals.								
Carcass Persistence Estimates; AIC for model = Species and distribution = exponential:52.59								
Estimates and Confidence Intervals for r based on an interval of 1 days.								
CP.Cov.Ind	Species	Placed	CP	Lower	Upper	r	r.Lower	r.Upper
HAPE	HAPE	25	62.59	30.77	337.5	0.99	0.98	1
NENE	NENE	12	18463420283	18463420283	50188779846	1	1	1

User-defined alpha level of 0.05; all reported confidence intervals are 95% confidence intervals.							
Carcass Persistence Estimates; AIC for mean-only model and distribution = exponential:71.89							
Estimates and Confidence Intervals for r based on an interval of 1 days.							
CP.Cov.Ind	Placed	CP	Lower	Upper	r	r.Lower	r.Upper
mean	44	80.49	43.53	202.16	0.99	0.99	1

Lesser Canada Goose (*Branta canadensis parvipes*) and Wedge-tailed Shearwaters (*Puffinus pacificus*) were used as surrogates for Nene and Hawaiian Petrels in all field trials.

APPENDIX 6

Daily Search Activity Report

Daily Search Report for Kaheawa I Wind Power Habitat Conservation Plan

Date: ________________ Searchers: ____

Temp: _______ Rain Gauge data: Upper ________ Mid __________ Lower_________ Visibility:____________

Turbine: Start Time: End Time: Detected carcasses: Y / N
Needs Veg Management: Y / N Equipment on pad: Y / N
Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N
Needs Veg Management: Y / N Equipment on pad: Y / N
Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N
Needs Veg Management: Y / N Equipment on pad: Y / N
Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N
Needs Veg Management: Y / N Equipment on pad: Y / N
Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N
Needs Veg Management: Y / N Equipment on pad: Y / N
Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N
Needs Veg Management: Y / N Equipment on pad: Y / N
Comments: ____

Other HCP wildlife seen: Y / N If yes, what species and where: ____

Searcher signatures: ____

Other comments:

____
____
____
____
____

Daily Search Report for Kaheawa II Wind Power Habitat Conservation Plan

Date: ________________ Searchers: ____

Temp: _______ Rain Gauge data: Upper ________ Mid __________ Lower_________ Visibility:____________

Turbine: Start Time: End Time: Detected carcasses: Y / N

Needs Veg Management: Y / N Equipment on pad: Y / N

Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N

Needs Veg Management: Y / N Equipment on pad: Y / N

Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N

Needs Veg Management: Y / N Equipment on pad: Y / N

Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N

Needs Veg Management: Y / N Equipment on pad: Y / N

Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N

Needs Veg Management: Y / N Equipment on pad: Y / N

Comments: ____

Turbine: Start Time: End Time: Detected carcasses: Y / N

Needs Veg Management: Y / N Equipment on pad: Y / N

Comments: ____

Other HCP wildlife seen: Y / N If yes, what species and where: ____

Searcher signatures: ____

Other comments:

____

____

____

____

____

APPENDIX 7

Year 6 Expenditures for HCP Implementation

KWP Year 6 Expenditures through June 30, 2012 (Years 1-5 Previously Reported)

Baseline Measures					
General Measures	**HCP Budgeted Amounts (Years 1-5)**	**Actual Expenditures (Years 1-5)**	**HCP Budgeted Amounts (Year 6)**	**Actual Expenditures (Year 6)**	**Notes**
Annual vegetation management, mowing around turbines to facilitate searches	$2,500.00	$12,000.00	$500.00	$500.00	
Wildlife Education and Observation Program (WEOP) and Downed Wildlife Protocol	$5,000.00	$-	$1,000.00	$-	
KWP Biologist (Greg Spencer)	$-	$11,000.00	$-	$500.00	Pre- and post-construction
Consultant [redacted]	$-	$1,000.00	$-	$-	Pre-construction
KWP Staff [redacted]	$-	$3,300.00	$-	$500.00	Training and orientations for staff, contractors, and visitors
Wildlife Conservation signage	$-	$900.00	$-	$200.00	Avoidance and minimization
General Measures Sub-Totals	**$7,500.00**	**$28,200.00**	**$1,500.00**	**$1,700.00**	

KWP Year 6 Expenditures through June 30, 2012 (Years 1-5 Previously Reported)

Nene: Potential take of 3 per year	HCP Budgeted Amounts (Years 1-5)	Actual Expenditures (Years 1-5)	HCP Budgeted Amounts (Year 6)	Actual Expenditures (Year 6)	Notes
Pre-construction surveys	$8,000.00	$-	$-	$-	
On-site full-time/on-call environmental inspector during construction	$25,000.00	$-	$-	$-	
KWP Biologists	$-	$15,000.00	$-	$-	
[redacted] (Consultant)	$-	$24,000.00	$-	$-	
Spotting Scope and Accessories	$-	$200.00	$-	$-	
Regular on-site observations of nene response to turbines - staff biologists	$10,000.00	$-	$-	$-	
KWP Staff (Greg Spencer)	$-	$7,500.00	$-	$-	
KWP Staff (Ian Bordenave)	$-	$4,500.00	$-	$-	
Construction of new release pen (DOFAW)	$50,000.00	$50,000.00	$-	$-	
New DOFAW truck	$9,000.00	$9,000.00	$-	$-	
Labor for maintenance and predator control plus $1000 for helicopter logistics	$80,000.00	$80,000.00	$-	$-	
Cost of propagating 10 chicks/yr yrs 1-5, 4 chicks every 2 years thereafter	$125,000.00	$125,000.00	$-	$-	
Contingency Fund	$291,406.00	$291,406.00	$7,467.00	$7,467.00	
Nene Sub-Totals	**$598,406.00**	**$606,606.00**	**$7,467.00**	**$7,467.00**	

KWP Year 6 Expenditures through June 30, 2012 (Years 1-5 Previously Reported)

Seabirds: Potential take of 1.5 per year of each species	HCP Budgeted Amounts (Years 1-5)	Actual Expenditures (Years 1-5)	HCP Budgeted Amounts (Year 6)	Actual Expenditures (Year 6)	Notes
Vehicle, radar, night-vision and related survey equipment, including training	$50,000.00	$-	$-	$-	On-site radar survey equipment
2001 Ford F-150 incl. licensing, taxes, maint., and fees	$-	$43,530.00	$-	$-	
Furuno Radar (cost-share 50%)	$-	$8,100.00	$-	$-	
IR Night-vision goggles	$7,500.00	$7,500.00	$-	$-	
Miscellaneous support equip + supplies	$-	$500.00	$-	$-	
Conduct on-site radar and night-vision/thermal surveys to document sea bird interaction and response to turbines; 2 surveys in June and October using staff biologist and assistant	$16,000.00	$-	$-	$-	On-site radar surveys
KWP Biologist (Greg Spencer)	$-	$8,000.00	$-	$-	
KWP Staff (Ian Bordenave)	$-	$4,000.00	$-	$-	

KWP Year 6 Expenditures through June 30, 2012 (Years 1-5 Previously Reported)

Conduct searches to identify West Maui colonies in need of protection and implement protection measures - assume colonies found in first two years by staff biologist and intern	$165,000.00	$-	$15,000.00	$-	Field studies to located colonies and identify management opportunities
KWP Biologist (Greg Spencer)	$-	$80,000.00	$-	$-	
KWP Staff (Ian Bordenave)	$-	$35,000.00	$-	$-	
KWP Staff (David Medrano)	$-	$5,000.00	$-	$-	
KWP Staff (Mitch Craig)	$-	$3,000.00	$-	$-	
KWP Staff (Hank Oppenheimer)	$-	$4,500.00	$-	$-	
Radar surveys in West Maui	$-	$3,000.00	$-	$-	Makamakaole feasibility
Camping and Field Equipment	$-	$5,700.00	$-	$-	
Flight Equipment	$-	$1,400.00	$-	$-	Flight suits, PPE
Helicopter flights	$-	$12,000.00	$-	$8,000.00	Seabird (NESH) contingency studies
Coordination and project management	$-	$10,500.00	$-	$40,000.00	KWP Staff (G. Spencer)
Predator traps, fence marking supplies	$-	$1,500.00	$-	$18,000.00	Traps, track tunnels, etc.
Social attraction and Decoys	$-	$-	$-	$22,000.00	Makamakaole social attraction

KWP Year 6 Expenditures through June 30, 2012 (Years 1-5 Previously Reported)

Artificial burrow materials	$-	$-	$-	$5,000.00	Makamakaole social attraction
Wildlife Acoustics SM2 Sound Recorders	$-	$-	$-	$20,000.00	Seabird (NESH) contingency studies
Consulting fees for canine-assisted nesting burrow surveys (Ecoworks New Zealand)	$-	$78,000.00	$-	$-	Makamakaole feasibility
Consulting fees for fence surveys, site feasibility, trapping and predator control, burrow construction (Ecoworks New Zealand)	$-	$-	$-	$28,000.00	Makamakaole planning and preliminary implementation
Contingency Fund	$107,688.50	$107,688.50	$2,828.00	$2,828.00	
Seabirds Sub-Total	**$346,188.50**	**$418,918.50**	**$17,828.00**	**$143,828.00**	

Hawaiian Hoary Bats: Potential take of 1 per year	**HCP Budgeted Amounts (Years 1-5)**	**Actual Expenditures (Years 1-5)**	**HCP Budgeted Amounts (Year 6)**	**Actual Expenditures (Year 6)**	**Notes**
Conduct monthly 2-night surveys - staff biologists	$10,000.00	$-	$-	$-	
KWP Biologist (Greg Spencer)	$-	$7,000.00	$-	$-	
KWP Staff (Ian Bordenave)	$-	$5,000.00	$-	$-	
Up-front contribution to bat research cooperative	$20,000.00	$20,000.00	$-	$-	
Contingency Fund	$22,076.26	$22,076.26	$566.00	$566.00	
Hawaiian Hoary Bat Sub-Totals	**$52,076.26**	**$54,076.26**	**$566.00**	**$566.00**	

KWP Year 6 Expenditures through June 30, 2012 (Years 1-5 Previously Reported)

Downed Wildlife (Fatality) Monitoring	HCP Budgeted Amounts (Years 1-5)	Actual Expenditures (Years 1-5)	HCP Budgeted Amounts (Year 6)	Actual Expenditures (Year 6)	Notes
Systematic Downed Wildlife Searches, Searcher Efficiency and Carcass Removal Studies	$155,000.00	$-	$15,000.00	$-	
KWP Biologist (Greg Spencer)	$-	$62,000.00	$-	$15,000.00	
KWP Staff (Ian Bordenave)	$-	$65,000.00	$-	$-	
KWP Staff (David Medrano)	$-	$55,500.00	$-	$-	
KWP Staff (Karl Mokross)	$-	$25,500.00	$-	$-	
KWP Staff (Mitch Craig)	$-	$10,000.00	$-	$-	
KWP Staff (Danielle Fujii)	$-	$-	$-	$20,000.00	
KWP Staff (Elisse Deleissegues)	$-	$-	$-	$20,000.00	
KWP Staff (Cameron Grant)	$-	$-	$-	$18,000.00	
KWP Staff (Erica Thoele)	$-	$-	$-	$10,000.00	
Support equipment and supplies	$-	$7,300.00	$-	$4,500.00	Transect markers, PPE
Northwest Wildlife Consultants (Training)	$-	$3,200.00	$-	$-	Pre-operational training
Downed Wildlife Sub-Totals	**$155,000.00**	**$228,500.00**	**$15,000.00**	**$87,500.00**	
	HCP Budgeted Amounts (Years 1-5)	**Actual Expenditures (Years 1-5)**	**HCP Budgeted Amounts (Year 6)**	**Actual Expenditures (Year 6)**	
Overall Sub-Totals	**$1,159,170.76**	**$1,336,300.76**	**$42,361.00**	**$241,061.00**	
Cumulative Budgeted	**$1,201,531.76**				
Cumulative Expended	**$1,577,361.76**				

KWP Year 6 Expenditures through June 30, 2012 (Years 1-5 Previously Reported)

Supplemental In-House Expenditures (Non-HCP Budgeted)	Years 1-5	Year 6	Notes
Native Vegetation Re-establishment			
Nursery propagation	$65,000.00	$-	Hoolawa Farms and Native Nursery, Maui
Contract outplanting	$50,000.00	$-	Local contractor and volunteers
Project Management (KWP Staff)	$30,000.00	$-	
Sub-Totals	$145,000.00		
On-site acoustic bat detection surveys			
Anabat acoustic data loggers (includes servicing and repairs)	$15,000.00	$5,000.00	Cost for instruments and maintenance
System monitoring and data analysis (KWP Staff)	$12,000.00	$7,500.00	Set-up, monitoring, downloading, data analysis
Summarizng results (KWP Staff)	$3,000.00	$800.00	Summarizing for reports, data management
Sub-Totals	**$30,000.00**	**$13,300.00**	
Cumulative Expended	**$175,000.00**	**$13,300.00**	