ENVIRONMENTAL ASSESSMENT
FOR THE KAHEAWA WIND POWER II (KWP II) FACILITY
HABITAT CONSERVATION PLAN

PREPARED FOR

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
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COVER SHEET

Title for Proposed Action: Issuance of an Endangered Species Act Section 10(a)(1)(B) permit for the incidental take of four federally listed threatened and endangered species during construction and operation of Kaheawa Wind Power (KWP) II, Kaheawa Pastures, Ukumehame Ahupuaa, Island of Maui, Hawaii.

Unit of the U.S. Fish and Wildlife Service Proposing the Action: Regional Director, Region 1, U.S. Fish and Wildlife Service, Portland, Oregon.

Legal Mandate for Proposed Action: Endangered Species Act of 1973, as amended, Section 10(a)(1)(B), as implemented by 50 CFR 17.22.

Applicant: Kaheawa Wind Power II LLC (KWP II LLC), 33 Lono Avenue, Suite 380, Kahului, HI.

Permit Number: N/A

Funding Plan: Proposed monitoring and mitigation measures will be provided by KWP II LLC in the form of a bond, letter of credit, or similar instrument naming U.S. Fish and Wildlife Service (USFWS) and/or State Department of Land and Natural Resources (DLNR) as beneficiaries.

Duration: 20 years

Document prepared by: SWCA Environmental Consultants, 201 Merchant Street, Suite 2310, Honolulu, HI.

U.S. Fish and Wildlife Service Contact: Dawn Greenlee, Pacific Islands Fish and Wildlife Office, U.S. Fish and Wildlife Service, 300 Ala Moana Boulevard, Room 3-122, Honolulu, HI.

SUMMARY

Kaheawa Wind Power II LLC ("KWP II LLC" or the "Applicant"), a fully owned subsidiary of First Wind, proposes to construct and operate a new 21-megawatt (MW), 14-turbine wind energy generation facility at Kaheawa Pastures above Maalaea in the southwestern portion of the Island of Maui, Hawaii. The proposed project, known as Kaheawa Wind Power II (KWP II), is situated on approximately 143 acres (ac) or 58 hectares (ha) of leased State Conservation Land southeast of the existing 30-MW Kaheawa Wind Power (KWP) project along the existing access road. Like the KWP project, KWP II would supply wind-generated electricity to Maui Electric Company Ltd. (MECO).

Construction and operation of the KWP II project has the potential to result in the incidental take of four federally listed threatened and endangered species: the Hawaiian petrel or uau (*Pterodroma sandwichensis*), Newell's shearwater or ao (*Puffinus auricularis newelli*), Hawaiian goose or nene (*Branta sandvicensis*), and Hawaiian hoary bat or opeapea (*Lasiurus cinereus semotus*). These species are known to fly in the vicinity of the project area and could be injured or killed if they collide with wind turbine generators (WTGs), permanent meteorological towers, overhead lines, and other project components. The four federally listed species could also be struck by vehicles and construction equipment during construction and operation.

In accordance with Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended, KWP II LLC has prepared a Habitat Conservation Plan (HCP) to comply with Incidental Take Permit (ITP) requirements of the U.S. Fish and Wildlife Service (USFWS). Additionally, an incidental take license (ITL) must also be obtained from the State Department of Land and Natural Resources (DLNR) in accordance with Chapter 195-D of the Hawaii Revised Statutes (HRS). Upon issuance of the ITP and ITL, KWP II LLC will be authorized for the incidental take of the four federally listed threatened and endangered species in connection with the construction and operation of the proposed wind energy generation facility.

Because the decision to issue an ITP is a federal action, it is subject to compliance with the National Environmental Policy Act (NEPA). As part of the NEPA process, an Environmental Assessment (EA) is required to evaluate the potential environmental and socioeconomic impacts of, and potential alternatives to, issuing an ITP and approving the implementation of the proposed HCP. A Draft EA was made available for public review through publication of a Notice of Availability of an EA and receipt of an application for a Permit published in the *Federal Register* on November 9, 2010. The notice and supporting documents were mailed to agencies and private organizations with interest in the proposed action. Although publication of the notice initiated a 30-day comment period, the comment period lasted 60 days because a request for an extension motivated the Service to re-open the comment period for an additional 30 days. This Final EA describes the existing environment in the KWP II project area; discusses alternatives to the Proposed Action (including the Downwind/ Downstring Alternative and the No Action Alternative); and evaluates the potential impacts of the alternatives. USFWS has determined that the issuance of an ITP and approval of an HCP for KWP II will not result in significant impacts. Therefore, an Environmental Impact Statement (EIS) is not required and USFWS will issue a Finding of No Significant Impact (FONSI).

The Proposed Action (Alternative 1) is the issuance of an ITP and approval of an HCP for the Downroad Siting Area to authorize the potential incidental take of four federally listed threatened and endangered species during the construction and operation of the KWP II facility, and to adequately avoid, minimize, and mitigate the anticipated incidental take. Construction of the proposed KWP II facility would disturb approximately 43 ac (17 ha) of land or roughly 30% of the 143-ac site; the remainder would remain undisturbed.

This EA also evaluates the potential impacts of issuing an ITP and approving an HCP for the Downwind/Downstring Siting Area (Alternative 2). The Downwind/Downstring Siting Area is located on 333 ac (135 ha) at a higher elevation immediately to the west and south of the existing 30-MW KWP facility. This alternative would include 14 WTGs, of which 11 would be in a line roughly parallel to the existing turbines (i.e., Downwind) and the remaining three WTGs would be constructed just south of the existing KWP WTGs (i.e., Downstring), as well as other project components. In addition, a No Action Alternative (Alternative 3) is evaluated in the EA, which consists of non-issuance of an ITP and HCP by USFWS for KWP II. This alternative represents a "no build scenario" because KWP II LLC

would not construct the wind energy facility due to the risk of the facility causing unauthorized incidental take of listed species.

A summary of the potential impacts of the Proposed Action (Alternative 1), the Downwind/Downstring Siting Area (Alternative 2), and the No Action Alternative (Alternative 3) is provided in Table i. This table is primarily derived from the State *Final KWP II EIS* (Planning Solutions, Inc. 2010).

Table i. Summary of comparison of No Action Alternative to Action Alternatives.

Resource	No Action Alternative	Downroad Siting Area Alternative 1 (Proposed Action)	Downwind/Downstring Siting Area Alternative 2
Climate	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to climate.	Construction Period: Construction of the facility in the Downroad Siting Area will result in temporary, low level emissions of CO_2. Thus, there will be no significant changes to climate. Operational Period: The proposed WTGs do not have the potential to affect temperature, rainfall, humidity, or most other meteorological parameters. The project will reduce the combustion of fossil fuels and, therefore, the emissions of greenhouse gases that are contributing to climate change.	Construction Period: Construction of the facility in the Downwind/ Downstring Siting Area will result in temporary, low level emissions of CO_2. Thus, there will be no significant changes to climate. Operational Period: The proposed WTGs do not have the potential to affect temperature, rainfall, humidity, or most other meteorological parameters. The project will reduce the combustion of fossil fuels and, therefore, the emissions of greenhouse gases that are contributing to climate change.
Topography	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to topography.	Construction Period: Grading will cause minor alterations of local topography, but will not alter major topographic features. Thus, there will be no significant changes to major topographic features. Operational Period: No impacts to topography.	Construction Period: Grading will cause minor alterations of local topography, but will not alter major topographic features. Thus, there will be no significant changes to major topographic features. Operational Period: No impacts to topography.
Geology, Soils, and Geologic Hazards	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to geology and soils.	Construction Period: The existing road network serving KWP will be extended and sites for the proposed facilities will be graded. The preliminary engineering plans indicate that this will require the disturbance of 43 acres/ 200,000 cubic yards of material. The area of disturbance and cut and fill volumes were minimized to the maximum extent practicable during the project design process. Operational Period: The design features that have been incorporated into KWP II to minimize erosion (i.e. minimal road construction, drainage culverts under site roads, minimization of cut/fill volumes), in addition to the revegetation plan for the facility will minimize the potential for erosion during operation of the KWP II.	Construction Period: Alternative 2 will require the disturbance of 60 acres/ 400,000 cubic yards of material. These are preliminary estimates and therefore conservative; the actual area of disturbance and cut and fill volumes would be minimized to the extent practical during the final design process. Operational Period: The design features that have been incorporated into KWP II to minimize erosion (i.e., minimal road construction, drainage culverts under site roads, minimization of cut/fill volumes), in addition to the revegetation plan in place for the facility will insure that the potential for erosion is minimized during operation of the proposed facility.

Resource	No Action Alternative	Downroad Siting Area Alternative 1 (Proposed Action)	Downwind/Downstring Siting Area Alternative 2
Water Resources	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to water resources.	Construction Period: No water resources will be directly affected under this alternative. Site and access road grading will alter storm water runoff paths, but the runoff will continue to flow into existing drainage basins. The project will not significantly increase the volume or alter the quality of storm water runoff leaving the project site. All water used on site during construction and operation will be trucked in; the small amount of domestic wastewater will be collected in a septic tank or portable toilets and trucked away for disposal. Operational Period: Same as above.	Construction Period: No water resources will be directly affected under this alternative. Site and access road grading will alter storm water runoff paths, but the runoff will continue to flow into existing drainage basins. The project will not significantly increase the volume or alter the quality of storm water runoff leaving the project site. All water used on site during construction and operation will be trucked in; the small amount of domestic wastewater will be collected in a septic tank or portable toilets and trucked away for disposal. Operational Period: Same as above.
Air Quality	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to air quality.	Construction Period: Project-related construction activities will generate fugitive dust from earthmoving operations and exhaust emissions from construction vehicles; the former will be limited to the project area. Small quantities of construction-related fugitive dust emissions will also result from vehicles carrying equipment and workers up and down the existing Kaheawa access road. Operational Period: Once operational, the proposed facilities have limited potential to affect air quality aside from the indirect benefits of reducing fossil fuel consumption and minor emissions from certain project-related activities such as maintenance work, vehicle-trips made by staff and vendors traveling to and from the site, and the operation of the electrical substation and BESS equipment.	Construction Period: Project-related construction activities will generate fugitive dust from earthmoving operations and exhaust emissions from construction vehicles; the former will be limited to the project area. Small quantities of construction-related fugitive dust emissions will also result from vehicles carrying equipment and workers up and down the existing Kaheawa access road. Operational Period: Once operational, the proposed facilities have limited potential to affect air quality aside from the indirect benefits of reducing fossil fuel consumption and minor emissions from certain project-related activities such as maintenance work, vehicle-trips made by staff and vendors traveling to and from the site, and the operation of the electrical substation and BESS equipment.

Resource	No Action Alternative	Downroad Siting Area Alternative 1 (Proposed Action)	Downwind/Downstring Siting Area Alternative 2
Noise	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to noise.	Construction Period: Construction noise from excavators, trucks, and other heavy equipment will occur at the project area. Because mechanical equipment alone will not be able to fracture all areas of rock, it is expected that some use of explosives (i.e., drill-and-shoot) will be required. No noise-sensitive uses are located nearby, but a construction noise permit may be required. If a permit is obtained, the contractor will employ reasonable and standard practices to mitigate noise. Operational Period: KWP II may exceed the State nighttime property line sound level limit of 45 dBA at the parcel boundary, but would be in general compliance with the 55 dBA daytime limit. The areas that might experience sound levels in excess of 45 dBA are uninhabited, but hikers would be exposed to WTG sound for only a small portion of the trail.	Construction Period: Construction noise from excavators, trucks, and other heavy equipment will occur at the project area. There is a low probability that explosives (i.e., drill-and-shoot) will be used during construction. No noise-sensitive uses are located nearby, but a construction noise permit may be required. If a permit is obtained, the contractor will employ reasonable and standard practices to mitigate noise. Operational Period: Sound from the proposed turbines may be audible along parts of the Lahaina-Pali Trail but are predicted to be lower than the 45 dBA night-time limit.
Scenic Resources	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to scenic resources.	Construction Period: During construction, visible components of the project will include construction equipment, transport and assembly of facility parts, and temporary dust and smoke from construction vehicles. The contractor will be required to minimize fugitive dust in accordance with applicable law, and the other visible activities during construction will be minor and temporary. Operational Period: In general, the proposed WTGs are slightly taller in size compared to those existing at KWP, and are situated lower on the hillside and slightly to the east which makes them more visible to the more populous areas of Maui. Once constructed, the KWP II facility will produce no visible airborne emissions.	Construction Period: During construction, visible components of the project will include construction equipment, transport and assembly of facility parts, and temporary dust and smoke from construction vehicles. The contractor will be required to minimize fugitive dust in accordance with applicable law, and the other visible activities during construction will be minor and temporary. Operational Period: In general, the proposed WTGs are slightly taller in size compared to those existing at KWP. People living in most of the areas from which the new WTGs would be visible can already see the existing turbines, and in general the existing turbines are more visible than the new array would be under this alternative. Once constructed, the KWP II facility will produce no visible airborne emissions.

Resource	No Action Alternative	Downroad Siting Area Alternative 1 (Proposed Action)	Downwind/Downstring Siting Area Alternative 2
Hazardous Substances and Materials	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to public health and safety.	Construction Period: Construction will involve the use of small amounts of several hazardous materials that require special handling and storage. These will be identified, along with measures for containment and spill prevention, in a Spill Prevention, Countermeasure, and Control (SPCC) Plan for the KWP II facility. The risk of harm will be minimized by requiring the contractor to follow best management practices. Operational Period: Operation of the facility will require on-site storage of cleaning products and mineral, hydraulic and lubricating oils for maintenance of the substation and WTG equipment. Best management practices, including a SPCC Plan, will be employed to minimize the risk of harm and for containment and spill prevention for the KWP II facility.	Construction Period: Construction will involve the use of small amounts of several hazardous materials that require special handling and storage. These will be identified, along with measures for containment and spill prevention, in a Spill Prevention, Countermeasure, and Control (SPCC) Plan for the KWP II facility. The risk of harm will be minimized by requiring the contractor to follow best management practices. Operational Period: Operation of the facility will require on-site storage of cleaning products and mineral, hydraulic and lubricating oils for maintenance of the substation and WTG equipment. Best management practices, including a SPCC Plan, will be employed to minimize the risk of harm and for containment and spill prevention for the KWP II facility.
Land Use	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to land use.	Construction Period: The project will not interfere with other existing or potential uses of the State land that the proposed facilities will occupy. The presence of the WTGs, site access roads, and related facilities will not limit access to other land served by the existing access road. Operational Period: Same as above.	Construction Period: The project will not interfere with other existing or potential uses of the State land that the proposed facilities will occupy. The presence of the WTGs, site access roads, and related facilities will not limit access to other land served by the existing access road. Operational Period: Same as above.
Flora	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to flora.	Construction Period: No sensitive or endangered plants occur in the areas to be directly affected by construction, although limited native vegetation does occur within the project area. The project includes a plan for immediate and long-term revegetation/restoration, as well as invasive species prevention and control. KWP II LLC proposes to install 5,000 individual native plants during the first three years following construction. Operational Period: Same as above.	Construction Period: No sensitive or endangered plants occur in the areas to be directly affected by construction. However, native plants do occur within the project area and the vicinity. The project includes a plan for immediate and long-term revegetation/restoration, as well as invasive species prevention and control. KWP II LLC proposes to install 10,000 individual native plants during the first three years following construction. Operational Period: Same as above.

Resource	No Action Alternative	Downroad Siting Area Alternative 1 (Proposed Action)	Downwind/Downstring Siting Area Alternative 2
Wildlife	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to wildlife.	Construction Period: Construction of the project has the potential to impact four federally listed species including the Hawaiian petrel, Newell's shearwater, nene, and Hawaiian hoary bat (collectively the Covered Species). Incidental take of these species may occur as a result of collision with construction equipment and materials, and vehicles. This document (as well as the HCP) includes measures to avoid, minimize, and mitigate take, which will result in a net conservation benefit to the Covered Species. Thus, construction of the project will not have a significant impact on the Covered Species. Operational Period: Same as above, except that the WTGs will have greater potential to adversely affect the Covered Species once they begin operating than during the construction period (i.e., when the rotors are not turning).	Construction Period: The risk of incidental take of the four Covered Species is believed to be similar to the Proposed Action, with the exception of nene. Nene are more likely to occur in the Downwind/ Downstring Siting Area and thus are believed to be at greater risk under Alternative 2. Operational Period: Same as above, except that the WTGs will have greater potential to adversely affect the Covered Species once they begin operating than during the construction period (i.e. when the rotors are not turning).
Socioeconomic Characteristics	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to socioeconomic conditions.	Construction Period: Direct socioeconomic effects of the proposed facilities include: (1) construction employment and business activity; (2) ongoing employment of facility staff (which will be relatively limited); (3) ongoing expenditures for materials and outside services; and (4) State revenues in the form of taxes and lease revenues. OHA will receive a portion of the amount that KWP II LLC pays to DLNR for the lease of the project area. No disproportionate adverse health or environmental impacts will occur to any low-income or minority population. Operational Period: Same as above.	Construction Period: Direct socioeconomic effects of the proposed facilities include: (1) construction employment and business activity; (2) ongoing employment of facility staff (which will be relatively limited); (3) ongoing expenditures for materials and outside services; and (4) State revenues in the form of taxes and lease revenues. OHA will receive a portion of the amount that KWP II LLC pays to DLNR for the lease of the project area. No disproportionate adverse health or environmental impacts will occur to any low-income or minority population. The overall construction costs for Alternative 2 are greater. Operational Period: Same as above.

Resource	No Action Alternative	Downroad Siting Area Alternative 1 (Proposed Action)	Downwind/Downstring Siting Area Alternative 2
Historical, Archaeological, and Cultural Resources	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to historical, cultural, or archaeological resources.	Construction Period: The proposed development will not affect the heiau adjacent to KWP, the Lahaina-Pali Trail or the Maalaea branch of the trail. No artifacts or burials were encountered during construction of KWP I, which indicates a low probability of encountering subsurface remains at the KWP II project area. If any deposits or human burials are encountered, the contractor will halt work and contact the State Historic Preservation Division (SHPD). Cultural consultation and impact assessment conducted for the project show that so long as the measures that KWP II has agreed to are implemented, the project will not have a significant adverse effect on these resources. Operational Period: The project will have virtually no potential to negatively impact archaeological or historic sites or cultural resources so long as the Heiau Preservation Plan and the outreach programs that have been initiated in conjunction with the existing wind generation facilities are continued and expanded. The project will not preclude or limit access to the area by cultural practitioners beyond existing conditions.	Construction Period: Although alternative 2 is closer to the heiau, the proposed development will not affect the heiau adjacent to KWP, the Lahaina-Pali Trail or the Maalaea branch of the trail. No artifacts or burials were encountered during construction of KWP I, which indicates a low probability of encountering subsurface remains at the KWP II project area. If any deposits or human burials are encountered, the contractor will halt work and contact the State Historic Preservation Division (SHPD). Cultural consultation and impact assessment conducted for the project show that so long as the measures that KWP II has agreed to are implemented, the project will not have a significant adverse effect on these resources. Operational Period: The project will have virtually no potential to negatively impact archaeological or historic sites or cultural resources so long as the Heiau Preservation Plan and the outreach programs that have been initiated in conjunction with the existing wind generation facilities are continued and expanded. The project will not preclude or limit access to the area by cultural practitioners beyond existing conditions.
Utilities and Public Services	If the facility is not constructed and operated, there will be no change in existing conditions and no impacts to utilities and public services.	Construction Period: The project has little potential to adversely affect utilities and public services. It will consume only small amounts of electrical power. All of the water needed for the facility will be trucked up to the site; no new potable water service will be required. Minor traffic delays could result during transport of large parts and components to the site. KWP II LLC will require its contractors to coordinate and implement the traffic control measures to minimize potential delays. Operational Period: The proposed project would place no additional burden on public services. The proposed project does not require utility connections. Operation would generate fewer than 20 vehicle-trips per day.	Construction Period: The project has little potential to adversely affect utilities and public services. It will consume only small amounts of electrical power. All of the water needed for the facility will be trucked up to the site; no new potable water service will be required. Minor traffic delays could result during transport of large parts and components to the site. KWP II LLC will require its contractors to coordinate and implement the traffic control measures to minimize potential delays. Operational Period: The proposed project would place no additional burden on public services. The proposed project does not require utility connections. Operation would generate fewer than 20 vehicle-trips per day.

Resource	No Action Alternative	Downroad Siting Area Alternative 1 (Proposed Action)	Downwind/Downstring Siting Area Alternative 2
Cumulative Impacts	If the facility is not constructed and operated, no cumulative impacts will occur.	Construction Period: No cumulative impacts from past, present, and reasonably foreseeable future projects, authorized or under review, are expected. KWP is the only past development in the Kaheawa Pastures area and no other developments are currently planned. Auwahi Wind Farm is the only other foreseeable wind project on Maui. The Advanced Technology Solar Telescope (ATST) also has the potential to impact the endangered Hawaiian petrel. The four resource areas most relevant to potential cumulative impacts are climate change, noise, scenic resources, and wildlife. Greenhouse gas emissions caused by construction and operation of the proposed project, as well as other projects on Maui, will be more than offset by decreasing the amount of petroleum currently burned on Maui to generate electricity. Cumulative noise impacts from KWP and other sources are not expected due to the distance between the project and potential receptors. The project will add to the amount of structural development within the visual landscape of Kaheawa Pastures, although it will not introduce different visual features into the viewshed. Although some of the causes of decline of the Covered Species may be on the increase due to continued real estate development on Maui, all impacts associated with previously issued Section 10 permits for the Covered Species have been mitigated and impacts from future projects are anticipated to resemble those discussed for the Proposed Action. Because the proposed mitigation is expected to offset the anticipated take and provide a net benefit to the Covered Species, significant cumulative impacts are not anticipated. Operation Period: Same as above.	Construction Period: No cumulative impacts from past, present, and reasonably foreseeable future projects, authorized or under review, are expected. KWP is the only past development in the Kaheawa Pastures area and no other developments are currently planned. Auwahi Wind Farm is the only other foreseeable wind project on Maui. The Advanced Technology Solar Telescope (ATST) also has the potential to impact the endangered Hawaiian petrel. The four resource areas most relevant to potential cumulative impacts are climate change, noise, scenic resources, and wildlife. Greenhouse gas emissions caused by construction and operation of the proposed project, as well as other projects on Maui, will be more than offset by decreasing in the amount of petroleum currently burned on Maui to generate electricity. Cumulative noise impacts from KWP and other sources are not expected due to the distance between the project and potential receptors. The project will add to the amount of structural development within the visual landscape of Kaheawa Pastures, although it will not introduce different visual features into the viewshed. A relatively smaller cumulative impact to scenic resources is expected because the siting area is less visible from most vantage points. Although some of the causes of decline of the Covered Species may be on the increase due to continued real estate development on Maui, all impacts associated with previously issued Section 10 permits for the Covered Species have been mitigated and impacts from future projects are anticipated to resemble those discussed for the Proposed Action. Because the proposed mitigation is expected to more than offset the anticipated take and provide a net benefit to the Covered Species, significant cumulative impacts are not anticipated. Operation Period: Same as above.

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CHAPTER 1: INTRODUCTION

1.1 Proposed Development and Location

Kaheawa Wind Power II LLC ("KWP II LLC" or the "Applicant") is proposing to develop the 21-megawatt (MW) Kaheawa Wind Power II (KWP II) facility at Kaheawa Pastures above Maalaea in the southwestern portion of the Island of Maui, Hawaii (Figures 1-1 and 1-2). The proposed project is situated southeast of the existing 30-MW Kaheawa Wind Power (KWP) facility along the existing access road. The project area consists of 143 acres (ac) or 58 hectares (ha), including approximately 135 ac (55 ha) of land within parcel (2) 3-6-001:014 and 8 ac (3 ha) of land within parcel (2) 4-8-001:001. Both parcels are owned by the State of Hawaii and designated as State Conservation Land. The site is accessible from Honoapiilani Highway (State Highway 30) via an existing State-owned road that was improved during construction of the KWP facility.

The proposed project consists of construction of 14 General Electric (GE) 1.5-MW wind turbine generators (WTGs), a maintenance building (and renovations to the existing Operations and Maintenance building), an electrical substation, a Battery Energy Storage System (BESS), an underground electrical collection system carrying electrical power from the individual WTGs to the electrical substation, a short overhead transmission line to connect the substation to the Maui Electric Company Ltd. (MECO) transmission system, a permanent unguyed meteorological (met) tower, and short service roads to connect the new WTGs and other facilities to the existing main access road serving KWP. The site layout for the proposed project is shown in Figure 1-3. A more detailed description of the proposed infrastructure for the project is provided in Section 2.1 and in the Hawaii State *Final KWP II EIS* for the project (Planning Solutions, Inc. 2010).

1.2 Purpose and Need for Action

KWP II LLC is voluntarily applying for an Incidental Take Permit (ITP) from the USFWS under Section 10(a)(1)(B) of the Endangered Species Act (ESA). This permit is being sought to authorize the incidental take of four federally listed species that are known to occur in the project area and that are believed to have the potential to collide with the proposed WTGs or other project infrastructure. These species include the Hawaiian petrel or uau (*Pterodroma sandwichensis*), Newell's shearwater or ao(*Puffinus auricularis newelli*), Hawaiian goose or nene (*Branta sandvicensis*), and Hawaiian hoary bat or opeapea (*Lasiurus cinereus semotus*). Hereafter, these four species are collectively referred to as the "Covered Species." If granted, an ITP would authorize the incidental take of the four federally listed species identified above during construction and operation of the KWP II facility. KWP II LLC is also seeking an Incidental Take License (ITL) in accordance with Chapter 195-D of the Hawaii Revised Statutes (HRS) to authorize potential impacts to these same four species. The ITL is issued by the State Department of Land and Natural Resources (DLNR).

A detailed description of the purpose and need for the KWP II facility is provided in the State *Final KWP II EIS* (Planning Solutions, Inc. 2010) and the *KWP II HCP* (SWCA 2010).

1.2.1 Purpose of the Proposed Action for the USFWS

For the USFWS, the purpose of the Proposed Action includes the following:

- Respond to KWP II LLC's application for an ITP for the Covered Species related to activities that have the potential to result in take, pursuant to the ESA Section 10(a)(1)(B) and its implementing regulations and policies;
- Protect, conserve, and enhance the Covered Species and their habitat for the continuing benefit of the people of the United States (per Section 2(a)(4) of the ESA); and
- Ensure species needs are met through minimizing and mitigating to the maximum extent practicable.

Figure 1-1. Location Map.

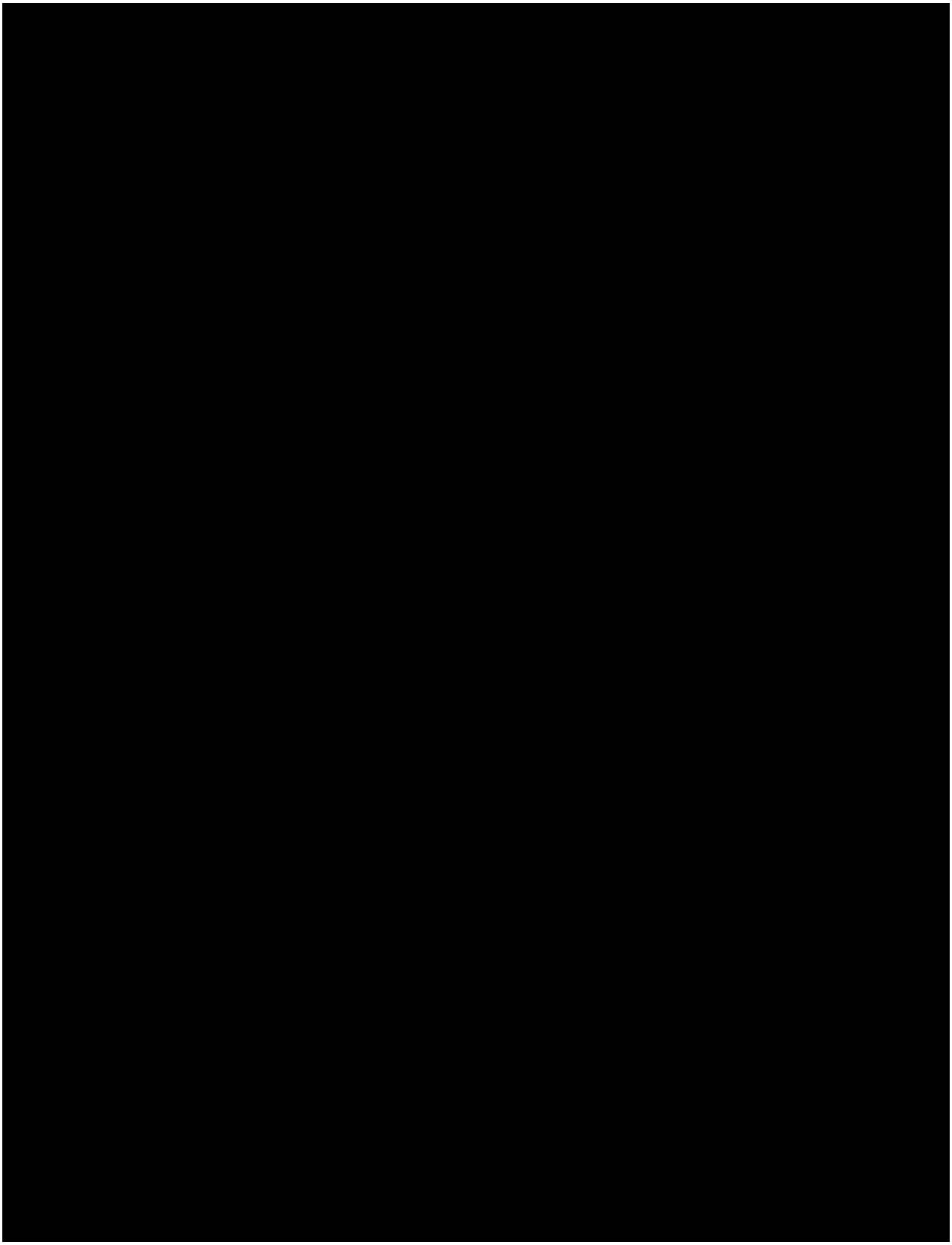


Figure 1-2. Vicinity Map.

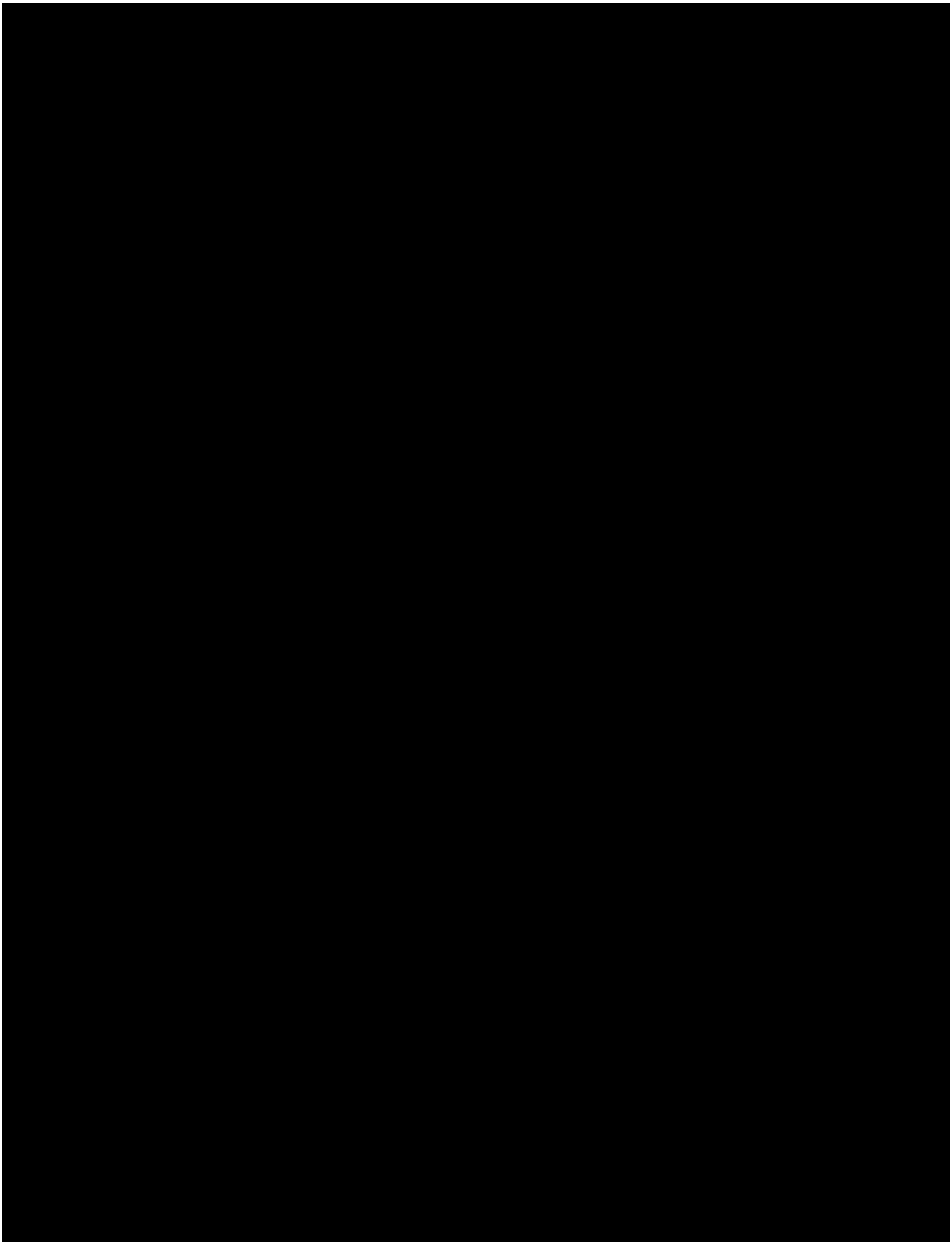
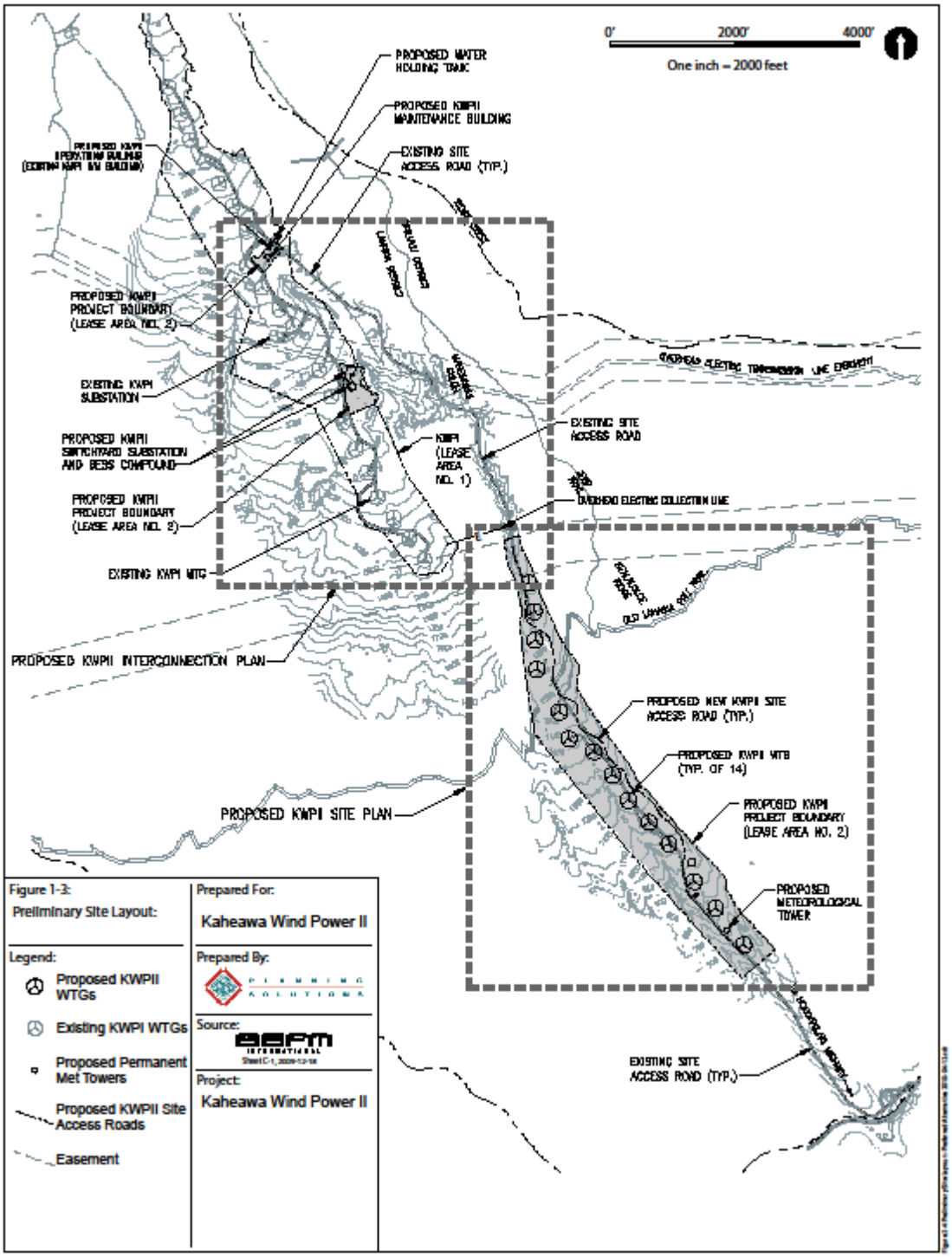


Figure 1-3. Site Layout – Proposed Action.



1.2.2 Need for the Proposed Action for the USFWS

For the USFWS, the need for the Proposed Action includes the following:

- Provide a means and take steps to conserve the ecosystems depended on by the Covered Species;
- Ensure the long-term survival of the Covered Species through protection and management of the species and their habitat; and
- Ensure compliance with the ESA, National Environmental Policy Act (NEPA), and other applicable Federal laws and regulations.

The proposed issuance of an ITP by the USFWS is a Federal action that may affect the human environment and therefore is subject to review under NEPA. USFWS has prepared this EA to evaluate the impacts of KWP II LLC's Proposed Action (Alternative 1), the Downwind Downstring Alternative (Alternative 2), and a No Action Alternative (Alternative 3) on the natural and human environment. The scope of the analysis in this EA covers the direct, indirect, and cumulative environmental impacts of approving the HCP and issuing an ITP, and the anticipated future impacts of implementing the HCP. The following documents will also be included in the record for this proceeding and will supplement the analyses contained in this EA: (1) an ESA Section 7 Biological Opinion concerning Permit issuance; (2) ESA Section 10 Statement of Findings; and (3) a NEPA analysis decision document.

1.2.3 Permit Issuance Criteria

Under provisions of the ESA, the Secretary of the Interior (through the USFWS) may issue a permit for the incidental taking of a listed species if the application conforms to the issuance criteria identified in Section 10(a)(2)(B) of the ESA. In order to issue a permit, the ESA requires:

- The taking will be incidental;
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
- The applicant will ensure that adequate funding for the conservation plan and procedures to deal with unforeseen circumstances will be provided;
- The taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild; and
- That measures required under Section 10(a)(2)(A)(iv), if any, are met and such other assurances that may be required that the HCP will be implemented.

As a condition of receiving an ITP, an applicant must prepare and submit to the USFWS for approval an HCP containing the mandatory elements of Section 10(a)(2)(A). An HCP must specify the following:

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

The ESA Section 10 assessment will be documented in the respective Section 10 findings document produced by the USFWS at the end of the process. If the USFWS makes the above findings, the USFWS will issue the ITP. In such case, the USFWS will decide whether to issue a permit conditioned on implementation of the proposed HCP as submitted or to issue a permit conditioned on implementation of the proposed HCP as submitted together with other measures specified by the agency. If the USFWS finds that the above criteria are not satisfied, the permit request shall be denied.

1.3 Relationship to Laws, Regulations, Plans, and Policies

The primary laws, regulations, plans, and policies that affect development and implementation of an HCP, ITP, ITL and the covered activities are summarized below to assist the reviewer by adding additional context for the KWP II HCP. Section 4.9.1.2 discusses how the proposed project is compliant with these laws, plans, and policies.

1.3.1 Federal Regulatory Context

1.3.1.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 (42 USC 4321 et seq.) requires that Federal agency decision-makers, in carrying out their duties, use all practicable means to create and maintain conditions under which people and nature can exist in productive harmony and fulfill the social, economic, and other needs of present and future generations of Americans. NEPA provides a mandate and a framework for Federal agencies to consider all reasonably foreseeable environmental effects of their proposed actions and to involve and inform the public in the decision-making process. This Act also established the Council on Environmental Quality (CEQ) in the Executive Office of the President to formulate and recommend national policies which ensure that the programs of the Federal government promote improvement of the quality of the environment. The CEQ set forth regulations (40 CFR Parts 1500-1508) to assist Federal agencies in implementing NEPA during the planning phases of any Federal action. These regulations together with specific Federal agency NEPA implementation procedures help to ensure that the environmental impacts of any proposed decisions are fully considered and that appropriate steps are taken to mitigate potential environmental impacts.

Although the requirements of the ESA and NEPA overlap considerably, the scope of NEPA exceeds the ESA by considering impacts of a Federal action on other natural and human resources besides endangered and threatened species and their habitats. Depending on the scope and impact of the HCP, NEPA requirements can be satisfied by one of the three following documents or actions:

- Categorical exclusion (CATEX)
- Environmental Assessment (EA)
- Environmental Impact Statement (EIS).

Activities that do not individually or cumulatively have a significant effect on the environment can be categorically excluded from NEPA. An EA is prepared when it is unclear whether a more comprehensive EIS is needed or when the project does not require an EIS but is not eligible for a CATEX. An EA culminates in either a decision to prepare an EIS or a Finding of No Significant Impact (FONSI). An EIS is required when the project or activity that would occur under the HCP is a major Federal action significantly affecting the quality of the environment, though an agency may produce an EIS at its discretion even in cases where significant effects are not likely to occur.

1.3.1.2 Federal Endangered Species Act

The ESA provides broad protection for plants, fish, and wildlife that have been listed as threatened or endangered in the U.S. or elsewhere and conserves ecosystem in which the species depend (16 U.S.C. 1531-1544). Section 9 of the ESA prohibits the unauthorized “take” of any endangered or threatened species of fish or wildlife listed under the ESA. “Take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect species listed as endangered or threatened, or to attempt to engage in any such conduct (50 CFR 17.3). “Harm” has been defined by USFWS to mean an act which actually kills or injures wildlife, and may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). “Harass” has been defined to mean an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR 17.3). Section 10 of the ESA contains exceptions and exemptions to Section 9, if such taking is incidental to the carrying out of an otherwise lawful activity, and outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species.

1.3.1.3 Federal Migratory Bird Treaty Act

All native migratory birds of the United States are protected under the Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 U.S.C. 703-712 *et. seq.*). The three bird species covered in the HCP, and several other non-listed bird species in the project vicinity, are protected under the MBTA. This act states that it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product. "Take" is defined as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect." No process for authorizing incidental take of MBTA-protected birds or providing permits is described in the MBTA (USFWS and NMFS 1996). In this case, if the HCP is approved and USFWS issues an ITP to KWP II LLC, the terms and conditions of that ITP will also constitute a Special Purpose Permit under 50 CFR 21.27 and any take of the three listed bird species would not be in violation of the MBTA.

1.3.1.4 Federal National Historic Preservation Act

The National Historic Preservation Act of 1966 (NHPA) is the primary federal law protecting cultural, historic, Native American, and Native Hawaiian resources. Section 106 of the NHPA (36 CFR 800) requires Federal agencies to assess and determine the potential effects of their proposed undertakings on prehistoric and historic resources (e.g., sites, buildings, structures, and objects) and to develop measures to avoid or mitigate any adverse effects. Detailed requirements for complying with Section 106 of the NHPA are addressed in regulations promulgated by the Advisory Council on Historic Preservation (ACHP) under 36 CFR 800.

USFWS issuance of an ITP under ESA Section 10(a)(1)(B) is considered an "undertaking" covered by the ACHP and must comply with Section 106 of NHPA. Accordingly, USFWS must consult with the ACHP, the State Historic Preservation Officer (SHPO), affected Tribes, the Applicant, and other interested parties, and make a good-faith effort to consider and incorporate their comments into project planning.

Section 800.16(d) of the ACHP regulations requires agencies to determine the area of potential effects (APE), defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist." The USFWS generally interprets the APE as the specific location where incidental take may occur and where ground-disturbing activities may affect historic properties.

1.3.1.5 Executive Order 12898 - Environmental Justice

President Clinton issued Executive Order 12898 on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations on February 11, 1994. Executive Order 12898 requires Federal agencies to take appropriate steps to identify and avoid disproportionately high and adverse effects of Federal actions on the health and surrounding environment of minority and low-income persons and populations. All Federal programs, policies, and activities that substantially affect human health or the environment shall be conducted to ensure that the action does not exclude persons or populations from participation in, deny persons or populations the benefits of, or subject persons or populations to discrimination under such actions because of their race, color, income level, or national origin. The Executive Order was also intended to provide minority and low-income communities with access to public information and public participation in matters relating to human health and the environment.

The U.S. Environmental Protection Agency (USEPA), working with the Enforcement Subcommittee of the National Environmental Justice Advisory Council, has developed technical guidance to ensure that environmental justice concerns are effectively identified and addressed throughout the NEPA process. The State of Hawaii has also developed its own legislation and guidance related to environmental justice. Act 294 was signed by Governor Lingle in July 2006 to define environmental justice in the unique context of Hawaii and to develop and adopt environmental justice guidance document that addresses environmental justice in all phases of the environmental review process (Kahihikolo 2008).

1.3.2 State and Local Regulatory Context

1.3.2.1 Hawaii State Plan

The *Hawaii State Plan* is a policy document intended to guide the long-range development of the State of Hawaii by: identifying goals, objectives, and policies for the State of Hawaii and its residents; establishing a basis for determining priorities and allocating resources; and providing a unifying vision to enable coordination between the various counties' plans, programs, policies, projects and regulatory activities to assist them in developing their county plans, programs, and projects and the State's long-range development objectives. The *Hawaii State Plan* is dependent upon implementing laws and regulations to achieve its goals.

1.3.2.2 Hawaii Revised Statutes, Chapter 195D

The purpose of Chapter 195D of Hawaii Revised Statutes (HRS) (Conservation of Aquatic Life, Wildlife, and Land Plants), is "to insure the continued perpetuation of indigenous aquatic life, wildlife, and land plants, and their habitats for human enjoyment, for scientific purposes, and as members of ecosystems …" (§195D-1). Section 195D-4 states that any endangered or threatened species of fish or wildlife recognized by the ESA shall be so deemed by State statute. Like the ESA, the unauthorized "take" of such endangered or threatened species is prohibited [§195D-4(e)]. Under Section 195D-4(g), the Board of Land and Natural Resources (BLNR), after consultation with the State's Endangered Species Recovery Committee (ESRC), may issue a temporary license (subsequently referred to as an "ITL") to allow a take otherwise prohibited if the take is incidental to the carrying out of an otherwise lawful activity. KWP II LLC is currently seeking an ITL.

1.3.2.3 Hawaii Revised Statutes, Chapter 343

HRS Chapter 343 (Environmental Impact Statements) was developed "to establish a system of environmental review which will ensure that environmental concerns are given appropriate consideration in decision making along with economic and technical considerations" (§343-1). This chapter requires the development of an EIS, which is an informational document that discloses the effects of a proposed action on the environment, economic welfare, social welfare, and cultural practices, as well as mitigation measures and alternatives to the action. The project area is located in a State Conservation District and on land that is owned by the State of Hawaii; both of these are triggers for Chapter 343 review.

1.3.2.4 Hawaii Revised Statutes, Chapter 205

Under The State Land Use Law (Act 187), HRS Chapter 205, all lands and waters in the State are classified into one of four districts: Agriculture, Rural, Conservation, or Urban. Conservation Districts, under the jurisdiction of DLNR, are further divided into five subzones: Protective, Limited, Resource, General, and Special. The use of Conservation District lands is regulated by HRS Chapter 183C and Hawaii Administration Rules (HAR) Chapter 13-5.

The KWP II project area is in the General subzone of a State Conservation District (Figure 3-2). Adjacent lands lie within the same Conservation District. Lands within a Conservation District are typically utilized for protecting watershed areas, preserving scenic and historic resources, and providing forest, park, and/or beach reserves [subsection 205-2(e) HRS]. As with other Conservation District lands, the project area is not subject to any County zoning or community plan designations or restrictions. However, KWP II LLC applied for and received a Conservation District Use Permit (CDUP) from the Office of Conservation and Coastal Lands (OCCL) to operate in the Conservation District.

1.3.2.5 Hawaii Revised Statutes, Chapter 198D

Established in 1988, the State Na Ala Hele Trails and Access Program (HRS 198D) is a statewide trail and access program administered by the Hawaii Division of Forestry and Wildlife (DOFAW). The primary purpose of this program is to ensure adequate public access to coastal and mountain trails and roads. DOFAW has the authority to regulate the use of trails and access for the following purposes: 1) to preserve the integrity, condition, naturalness, or beauty of the trails or accesses; 2) to

protect the public safety; or 3) to restrict public access to protected or endangered wildlife habitats, except for scientific or educational purposes. The Lahaina-Pali Trail, which transverses the upper portion of the project area, has been designated a demonstration trail in the Na Ala Hele Trails and Access Program.

1.3.2.6 Hawaii's Coastal Zone Management Program

Hawaii's Coastal Zone Management (CZM) Program (HRS 205A-2) is designed to protect valuable and vulnerable coastal resources by reducing coastal hazards and improving the review process for activities proposed within the coastal zone. The CZM Program focuses on ten objectives and policies related to the following: recreational resources; historic resources; scenic and open space resources; coastal ecosystems; economic uses; coastal hazards; managing development; public participation; beach protection; and marine resources. The CZM program also includes a permit system to control development within Special Management Areas (SMAs), which include lands within 300 ft (91 m) from the shoreline. The proposed project area is located more than 2,640 ft (805 m) from the coastline and therefore is not within a SMA.

1.3.2.7 Maui County General Plan

The *General Plan of the County of Maui* (1990) established a vision and a set of long-range guiding principles, goals, objectives, policies, and maps to guide growth and development on the island. The Plan was adopted by Ordinance No. 2039 on September 27, 1991 and was amended on April 23, 1993 by Ordinance No. 2234. An update of the *General Plan of the County of Maui* is underway, and the *Draft 2030 General Plan* outlining the County's development policies up to the year 2030 was circulated for comment in January 2008. Public review of the *Draft 2030 General Plan* is continuing.

The *Draft 2030 General Plan* consists of three tiers of planning documents: 1) Countywide Policy Plan, 2) Maui Island Plan, and 3) Community Plans. The Draft Countywide Policy Plan provides the policy framework for the development of the Maui Island Plan and nine community plans that will address the unique character of each of the four islands within the County.

1.3.2.8 Community Plans

Two Community Plans are applicable to the project area - the *West Maui Community Plan* (1996) and the *Kihei-Makena Community Plan* (1998). The proposed wind facility is located in the *West Maui Community Plan* area; the *Kihei-Makena Community Plan* area includes parts of the lower slopes and foothills of the West Maui Mountains, as well as the community of Maalaea. Each provides specific recommendations to address goals, objectives, and policies in the *General Plan of the County of Maui*, while recognizing the values and unique attributes of its region of coverage. Each community plan also identifies planning goals, objectives, policies and implementation considerations to guide decision-making in its region through the year 2010.

1.3.2.9 Maui County Zoning

The proposed KWP II project area lies within a State Conservation District; therefore, the project is exempt from the Maui County Code and County zoning regulations are not applicable to the proposed facility.

1.3.2.10 University of Hawaii's Land Study Bureau Detailed Land Classification

The University of Hawaii's Land Study Bureau developed a Detailed Land Classification that divides the island into a five-class agricultural productivity rating using the letters "A" through "E." "A" represents the class of highest productivity and "E" the lowest. The KWP II project area is primarily identified as "D" or "E" in this classification. Due to the low productivity classes and because the project area is not designated as an Agriculture District, this classification system is not applicable to the project and is not discussed further.

1.4 Public Involvement and Agency Coordination

Under the USFWS's NEPA implementing procedures, public scoping is not required to prepare an EA. However, during the public comment period for the EA and the HCP, 38 public comment letters were received in response to the notice for the proposed action. The comments were wide-ranging, but primarily were related to the Covered Species.

In addition, public scoping and public involvement for the project has occurred through the State of Hawaii's HCP, EIS, and CDUP processes (see Sections 1.3.2.2- 1.3.2.4, respectively).

Public involvement through the State's regulatory process began with the public review of the State EIS Preparation Notice (EISPN), which was released on February 8, 2008. Subsequently, a Draft EIS was released to the public on February 23, 2009 for a 45-day comment period. Due to a change in the project location (see Chapter 2), the EIS was revised and therefore re-released to the public for comment. The public comment period for the State *Revised Draft KWP II EIS* (Planning Solutions, Inc. 2009b) extended from December 8, 2009 to January 22, 2010. Feedback and comments on the proposed scope of the analysis and the completeness of the alternatives analyzed in the document were incorporated into the *Final KWP II EIS* (Planning Solutions, Inc. 2010). The Final EIS (FEIS) was accepted by the OCCL on May 19, 2010.

The State HCP process has also provided the opportunity for public involvement. A Draft HCP was published by the State Office of Environmental Quality Control (OEQC) on April 23, 2009. The public comment period extended until June 22, 2009, with a public meeting on May 12, 2009. No comments were received during the public meeting. Similar to the EIS, the State HCP was revised due to a change in the project location and re-released to the public on January 23, 2010. A public hearing for the State Revised HCP was held on March 17, 2010. Topics discussed during the meeting included: Hawaiian short-eared owl or pueo, native plants, revegetation, and molluscs. Testimony was largely in support of the Proposed Action and the existing KWP facility. The Final State HCP was reviewed by ESRC in October 2011 and approved by BLNR in November 2011. Issuance of ITL is expected in December 2011.

The public was able to provide feedback on the project through the CDUP process. Public review of the permit application began on February 8, 2010 and a public hearing for the CDUP was conducted by BLNR on March 9, 2010. Four comment letters were received from various agencies (Office of Hawaiian Affairs, USFWS, DBEDT, and Maui County Department of Planning). No comments were received during the public meeting for the CDUA and approval of the CDUP was granted in August 2010.

Furthermore, KWP II LLC also conducted community outreach to discuss increasing wind generating capacity at Kaheawa Pastures through meetings and site visits with members of the public, including representatives of the West Maui community. These meetings provided KWP II LCC with the opportunity to incorporate feedback into the project design and mitigation measures. Outreach efforts also included educational tours of the existing KWP facility with community organizations, elected officials, public agency representatives, and students (Planning Solutions, Inc. 2010).

KWP II LLC has also met with local, State, and Federal agencies and non-governmental field biologists during development of the proposed project. This includes coordination and consultation with the USFWS, DOFAW, ESRC, OCCL, and State Historic Preservation Division (SHPD). The ESRC met to discuss the proposed project in October 2008, January 2009, February 2009, November 2009, September 2011, and October 2011.

CHAPTER 2: ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter identifies and describes the Proposed Action (Alternative 1 or the Downroad Siting Area) and alternatives to the Proposed Action, as required by Section 102(2)(E) of NEPA. Alternatives to the Proposed Action include the No Action Alternative, Alternate Siting Areas at Kaheawa Pastures, Alternate Project Locations, Alternative WTG Models, Alternative Generating Capacities, and Temporary Shut-Down of Turbines. Only impacts anticipated as a result of the Proposed Action

(Alternative 1), Downwind/Downstring Siting Area (Alternative 2), and the No Action Alternative (Alternative 3) are evaluated in this EA. Reasons the other alternatives were rejected without further impact analysis are discussed in Section 2.4.

KWP II LLC initially considered three potential WTG siting areas (Upwind, Downwind/Downstring, and Downroad) at Kaheawa Pastures (Figure 2-1). Wind resource data collected at Kaheawa initially suggested that wind resources were strongest at the Downwind/Downstring area and KWP II LLC prepared a Draft EIS for the proposed project in February 2009. KWP II LLC continued to collect wind data from the meteorological monitoring towers at Kaheawa while the DEIS was being reviewed and public and agency comments were being received. As the data accumulated, it became apparent that the wind lower on the mountainside (Downroad area) was potentially superior to the wind resource in the Downwind/Downstring area. Based on the greater potential impacts of the Downwind/Downstring Siting Area to several Covered Species (particularly nene; see Section 2.2), as well as the new wind resource information for the Downroad area, KWP II LLC has determined that the Downroad Siting Area (Alternative 1) is preferable to the Downwind/Downstring Siting Area (Alternative 2).

2.1 Alternative 1 (Proposed Action) – Downroad Siting Area

The Proposed Action is the issuance of an ITP and approval of an HCP for the Downroad Siting Area to authorize the potential incidental take of four federally listed threatened and endangered species during the development, construction, and operation of KWP II, and to adequately avoid, minimize, and mitigate the anticipated incidental take.

The proposed project consists of constructing a 21-MW wind energy generating facility approximately 2,000 ft (610 m) southeast of the southern end of the existing KWP facility along the existing access road (Figure 1-3). Some components of the project will be constructed within the KWP I area. Once all required land use approvals and environmental permits are granted, KWP II LLC will:

- Obtain a lease for or easement right from the State DLNR for approximately 135 ac of land within parcel (2) 3-6-001:014 and roughly 8 ac of land within parcel (2) 4-8-001:001.

- Obtain easement rights for access to and use of the existing entrance and main access road (within parcels (2) 3-6-001:014 and (2) 4-8-001:001) from DLNR.

- Execute an agreement with KWP to use the existing road and to construct proposed KWP II facilities within the KWP lease area.

- Realign portions of the existing access road and construct short service roads that connect KWP II to the main access road. The cleared and graded area for the proposed new internal access roads will be approximately 36 ft (11 m) wide, of which 16-20 ft (5-6 m) will be graveled.

- Install 14 General Electric (GE) 1.5 MW WTGs and supporting equipment. Each WTG will be set in a concrete foundation approximately 46 ft^2 (4.3 m^2) in area. An additional 20-ft (6-m) wide cleared gravel perimeter will be provided around each foundation to facilitate access and maintenance. Table 2-1 lists other pertinent characteristics of the selected WTGs.

- Renovate the existing KWP Operations & Maintenance (O&M) building for shared KWP I and KWP II use, adding a bathroom, including expanding the office area and reducing the shop area.

- Construct a 5,000 ft^2 (465 m^2) maintenance building adjacent to the existing KWP I O&M building to be shared by both projects. Outdoor parking will be provided for 3-5 vehicles.

- Construct a new electrical substation near the existing KWP I WTG #12 and connect the new substation to the existing MECO power transmission lines that pass over the substation site using a short overhead cable.

- Construct a Battery Energy Storage System (BESS) and house it in an enclosure adjacent to the proposed substation to provide dispatchable energy under various operating conditions. This stored energy will be used to improve the ability of the MECO system to absorb additional as-available wind-generated resources. Outdoor parking will be provided for 3-5 vehicles.

- Construct one permanent unguyed met tower and one guyed temporary 65-meter test tower prior to construction of the WTGs. Remove the temporary test tower within 3 months of completing construction.

- Install an underground fiber optic network and electrical collection system connecting all of the KWP II WTGs, substation, BESS, met tower, KWP I communications tower, and O&M building. The electrical collection system will include an overhead collection line approximately 1,225 ft (374 m) in length mounted on poles approximately 60 - 90 ft (18 - 25 m) high that will cross Manawainui Gulch, adjacent and parallel to an existing MECO line. The underground collection cables will be buried in trenches approximately 2.0 ft (0.6 m) wide and 4.0 ft (1.2 m) deep (Figure 2-2). Trenches will be backfilled and returned to pre-construction elevations and disturbed areas will be revegetated.

- Install a 60,000-gallon tank adjacent to the existing KWP I O&M building, which could be filled with non-potable water periodically trucked into the site. This water will be used for non-potable plumbing, dust control, landscape irrigation, emergency fire-fighting, and other similar purposes. If a new tank does not prove feasible due to permitting or cost considerations, KWP II LLC will continue to use bottled water and portable pumped toilets.

Table 2-1. Characteristics of 1.5-MW wind turbine generators.

Power Generation	1.5 MW each
Tower Structure and Height	Tubular; 213 ft (65 m) tall
Rotor Diameter	231 ft (70 m)
Total Height (Tower + ½ Rotor)	328 ft (100 m)
Rotor Swept Area	50,130 ft^2 (4,657 m^2)
Rotor Speed	10-21 rpm (variable)
Wind Speed at Which Generator Starts	8 mph (13 kph)
Wind Speed at Which Generator Cuts Out	56 mph (90 kph)
Rated Wind Speed (unit reaches maximum output)	27 mph (43 kph)
Source: Planning Solutions, Inc. (2010).	

Construction of the proposed facilities will disturb approximately 43 ac (17 ha) of land or approximately 30% of the project area; the remainder will remain undisturbed. Table 2-2 summarizes the area that will be occupied by each of the major components of the proposed project. The total "developed" area of the site, or the total area that will contain structures or hardened surfaces, is anticipated to be roughly 23 ac (9 ha). This includes the 14 turbine foundations, one permanent met tower foundation, maintenance building, O&M building, substation, and BESS.

Figure 2-1. Siting Areas.

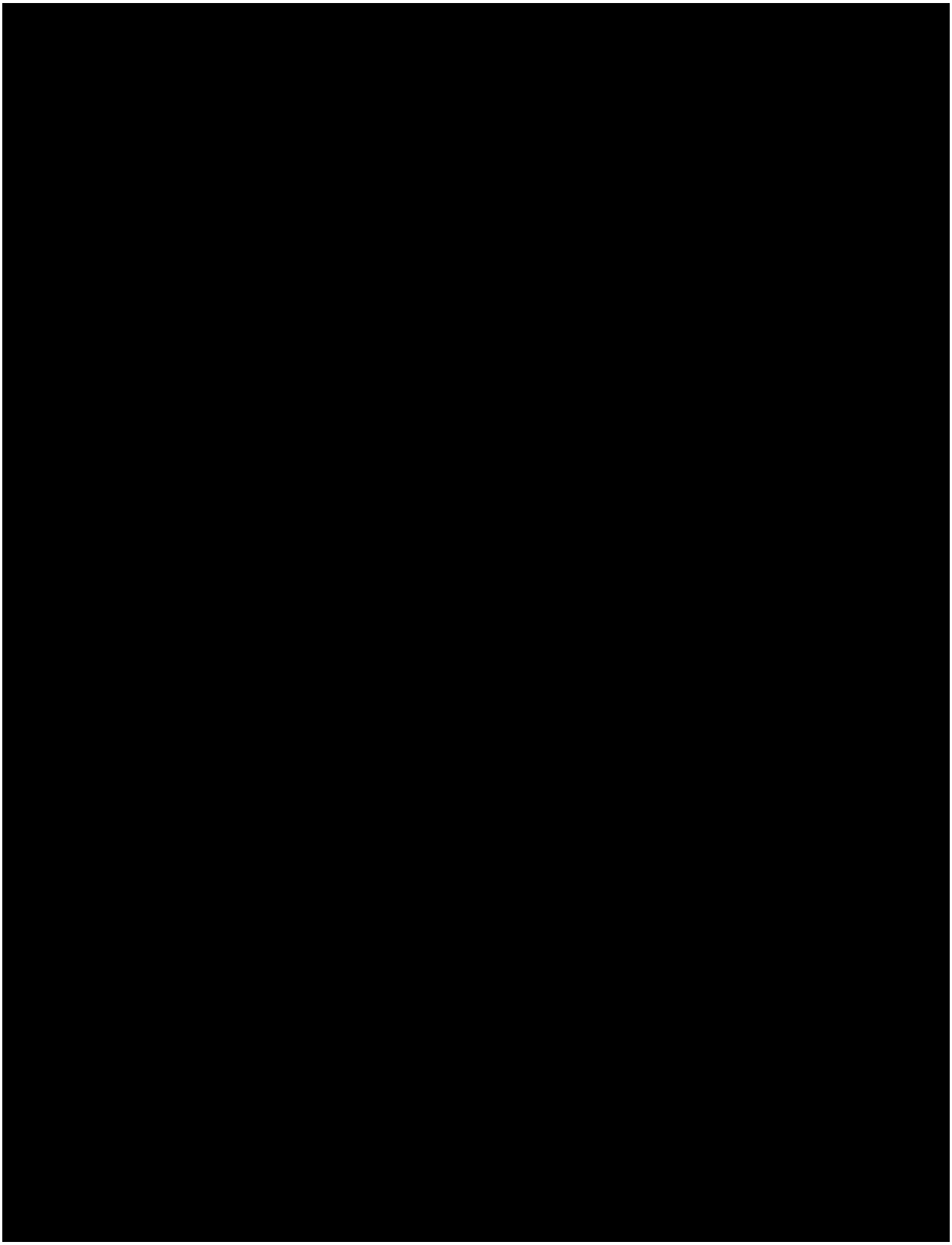


Figure 2-2. Underground Collection System.

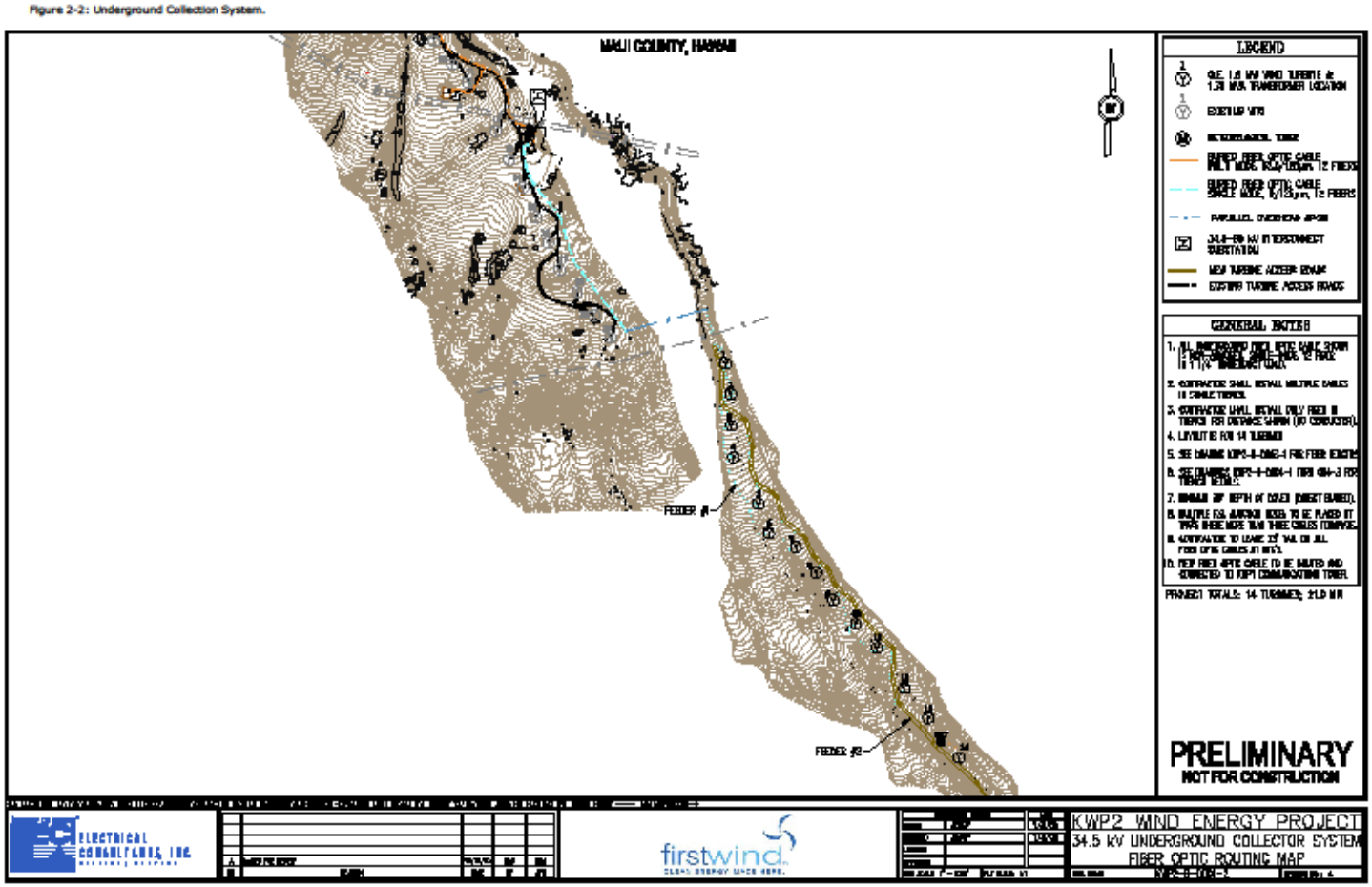


Table 2-2. Approximate area disturbed by construction of proposed facilities.

Project Component	Approximate Area Disturbed	
	Alternative 1	**Alternative 2**
14 WTG Foundations & Pads[1]	21 ac	21 ac
Trenching for Underground Electrical Cables[2]	2 ac	2 ac
Permanent Meteorological Tower[3]	0.2 ac	2 ac
Maintenance Building, Substation, BESS	2 ac	3 ac
Access Roads[4]	16 ac	30 ac
Temporary Lay-Down Area[5]	2 ac	2 ac
TOTAL	43 ac	60 ac

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

Source: Planning Solutions, Inc. (2010).

Construction of the project would likely occur as soon as practicable after all permits and authorizations have been obtained, and financing is completed. The WTGs will likely be erected in the second month by large cranes, which will be on-site for only three to four months. The turbines will become operational approximately six to nine months after the start of construction. Once operational, the estimated lifetime of the project is 20 years. Following this period, KWP II LLC will arrange either to extend the life of the project or remove the facilities.

2.1.1 Proposed Avoidance, Minimization, Mitigation, and Management Measures

As described in Section 1.2, construction and operation of the KWP II project under the Proposed Action would create the potential for the Covered Species to collide with the WTGs, temporary and permanent met towers, overhead collection lines, and cranes during the construction phase of the project. For each Covered Species, the potential of the species to collide with project components, possible rates of incidental take, and proposed mitigation measures associated with the proposed take authorizations for each Covered Species are discussed in the corresponding section for each Covered Species (Section 4.11.1.2). The proposed mitigation program for KWP II was influenced greatly by the approved mitigation program for KWP and the data that has been collected by KWP biologists since operations commenced. In coordination with biologists from DLNR and USFWS, the Applicant will build upon the existing KWP mitigation program, or perform other appropriate mitigation measures, to achieve the appropriate biological goals and objectives.

Efforts to minimize the potential impacts that the Proposed Action may have on the Covered Species have already been incorporated into the site design and configuration. Because complete avoidance of risk to the four Covered Species is impossible under the Proposed Action, KWP II LLC has sought to avoid and minimize the risk of collisions to the greatest extent practicable by making the turbines less attractive, more visible, and/or more likely to be avoided by birds and bats. These measures include:

- Employing relatively few turbines situated in two single rows, rather than a large number of staggered turbines or multiple rows;
- Using “monopole” steel tubular towers for turbines, rather than lattice towers, to virtually eliminate perching and nesting opportunities. The tubular towers may also reduce collision risk because they are considerably more visible;
- Utilizing a rotor with a rotational speed (11-20 revolutions per minute) that makes the rotor more visible to wildlife during operation;

- Choosing a site in proximity to existing electrical transmission lines to eliminate the need for a lengthy overhead transmission line from the project to the interconnect location;

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

- Placement of most new power collection lines underground to eliminate the risk of collision;

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

- Marking guy wires on the temporary met tower with 4-foot 1-inch poly tape, folded on itself and secured to the guy wires with ultra-violet resistant zip ties. The white tape acts as a streamer, making the met tower more visible to birds and bats and increasing likelihood of avoidance (Tetra Tech 2008). A total of at least 56 streamers will be attached to each met tower. In addition, high-visibility bird diverters, and other suitable marking devices will be placed between sections of the white tape;

- Restricting construction activity to daylight hours as much as possible to avoid the use of nighttime lighting that could be an attraction to seabirds;

- Requesting Federal Aviation Authority (FAA) endorsement of a minimal lighting plan to reduce the likelihood of attracting or disorienting seabirds;

- Having minimal on-site lighting at the O&M building and BESS, using fixtures that will be shielded and/or directed downward and only utilized on infrequent occasions when workers are at the site at night (these lighting measures will be used to minimize impacts to wildlife and also to greatly reduce the visual impact for the resident and visitor population of Maui). In addition, timers, motion sensors and similar devices should be employed where feasible to minimize the risk of unintended light emissions. These three lighting measures will be used not only to minimize impacts to wildlife, but also to reduce the visual impact as viewed from local communities at night.

- Conducting pre-construction surveys for nene and their nests prior to roadway and site clearing and construction to identify and avoid harming or harassing (as defined under the ESA) any active nests, eggs, young, or adults; the survey protocol that was developed and used for KWP will be used at KWP II for this measure;

- Implementation of a daily search protocol during construction to minimize the risk of direct impacts to nene and their nests;

- Immediate notification of designated environmental personnel should nene and/or a nest(s) be discovered after construction has began. Construction activities will be modified or curtailed until appropriate measures are implemented, in consultation with DLNR and USFWS to reduce or eliminate adverse risk to nene or their nests;

- Implementation of low wind speed curtailment at night by raising the cut-in speed of the project's wind turbines to 5m/s. Recent studies on the mainland indicate that most bat fatalities occur at relatively low wind speeds, and consequently the risk of fatalities may be significantly reduced by curtailing operations on nights when winds are light and variable (see HCP for detail). The times of the year when curtailment is implemented (i.e., year-round or seasonal) at KWP II will be decided based on bat detection data on site, seasonal distributions of observed fatalities on site, and best available science, with concurrence from USFWS and DLNR. The curtailment will initially occur during months of July to November, which is when bat activity has been consistently documented. Curtailment will be extended if fatalities are found outside the initial proposed curtailment period with concurrence from USFWS and DLNR.

Curtailment may also be reduced or shifted with the concurrence of DOFAW and USFWS if site-specific data demonstrate a lack of bat activity or during certain periods, or if experimental trials are conducted that demonstrate that curtailment is not reducing collision risk at the project during the entire curtailment period;

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

2.2 Alternative 2 – Downwind/Downstring Siting Area

Under Alternative 2, the 21-MW wind energy generating facility would be constructed and operated in the Downwind/Downstring Siting Area situated at a higher elevation than the Downroad area. The Downwind/Downstring Siting Area is located on a portion of parcel (2) 4-8-001:001 immediately to the southwest of the existing 30-MW KWP facility along the same ridgeline (Figure 2-1). The 333-acre (135-ha) parcel is State Conservation Land owned by the State of Hawaii. The site is accessible from Honoapiilani Highway (State Highway 30) via an existing State-owned road that was improved during construction of the KWP facility.

This alternative would include 14 WTGs, of which 11 would be in a line roughly parallel to the existing turbines (i.e., Downwind) and the remaining three WTGs would be constructed just south of the existing KWP WTGs (i.e., Downstring) (Figure 2-1). Alternative 2 would also include construction of an O&M building, a substation, a BESS, underground cables carrying electrical power from the individual WTGs to the new electrical substation, a short overhead transmission line to connect the substation to the MECO transmission system, met towers, and new internal service roads to connect the facility to the existing main access road serving KWP (Planning Solutions, Inc. 2010). Actions proposed under Alternative 2 are relatively similar to those proposed under Alternative 1, except for the following: more extensive road construction would be required (~14 acres more than Alternative 1); potentially more than one permanent unguyed met tower would be constructed; and there would be no overhead collections lines spanning Manawainui Gulch.

Compared to the Downroad Siting Area (Alternative 1), construction of the proposed project in the Downwind/ Downstring Siting Area (Alternative 2) will require roughly one-third more disturbance due to the more extensive road network required. This will result in greater ground disturbance, potential for erosion, and need for revegetation. Under this alternative, Covered Species are expected to be at a greater risk of collision with WTGs and the additional met towers. This alternative is also closer to native vegetation. However, Alternative 2 is less visible from most public vantage points in the vicinity. More details on the potential impacts of Alternative 2 compared to Alternative 1 are provided in Chapter 4.

2.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, the USFWS would not issue an ITP, as KWP II LLC would not construct the wind energy facility due to the risk of the facility causing unauthorized incidental take of listed species. Thus, the No Action Alternative represents a “no build scenario.” The no build scenario would not cause take of the Covered Species or any change in the status of the Covered Species, their recovery efforts and existing habitats, or the project area. None of the Covered Species mitigation measures contained in the HCP would be implemented.

The no build scenario does not support the State’s desire to develop viable renewable energy sources and reduce dependence on imported oil or support MECO’s obligation to meet these milestones. This scenario is also contrary to KWP II LLC’s fundamental purpose and objective as a business entity. Under the no build scenario, the project area may potentially be available for other uses.

2.4 Alternatives Considered But Not Analyzed

2.4.1 Alternate Project Locations

The proposed 143-ac project area was selected based on evaluation of wind resources on Maui, and a thorough consideration of alternate sites in the area. Kaheawa has a robust and reliable wind regime. In addition, the site's proximity to the existing KWP facility allows KWP II to share personnel and infrastructure with the existing wind facility such as the main access road and equipment storage and parts (subject to licensing agreements between the parties). Other wind-rich sites on Maui are located in areas that lack adequate transmission capability, are closer to/more visible from populated areas, or have other constraints. Constructing comparable infrastructure at another site is believed likely to result in greater costs and environmental impacts than would the proposed facility. Moreover, other sites suitable for wind development on Maui present comparable challenges in terms of topography, visibility, and natural resources without having comparable benefits.

Operation of the existing KWP facility has produced data pertaining to the Covered Species at the proposed location which has been used to more accurately estimate levels of take for each Covered Species at the proposed KWP II site. At an alternate location, the species vulnerable to take by a proposed wind facility may be different from the Covered Species in this HCP. The levels of take for those species also may change at an alternate project location, depending on movement rates and the potential level of interaction of each species with the wind facility. These take levels would have to be determined from wildlife surveys and other existing information, but would not have the benefit of long-term data that is available for the proposed location.

Based on the reasons mentioned above, it was concluded that the Downroad Siting Area is superior to the other siting areas and alternatives that are available for the KWP II project (Planning Solutions, Inc. 2010).

2.4.2 Alternate WTG Locations at Kaheawa Pastures

As mentioned above, KWP II LLC initially considered an Upwind Siting Area at Kaheawa Pastures. The Upwind Siting Area is located on the eastern side of the existing main access road roughly 2,000 ft to the east (i.e., on the Central Valley side) of the existing KWP facility. The Upwind area was eliminated because accessing this area would require construction of a new road across the intervening Manawainui Gulch, which is an ecologically sensitive area, and WTGs placed in this siting area would be more visible to surrounding communities than any of the other considered locations. Constructing in the Upwind area would also require KWP II LLC to lease up to an additional 250 ac (101 ha) of land.

Different configurations of individual WTGs within the preferred Downroad area were also considered. Factors that contributed to micro-siting of individual WTGs included viability of the wind resource, proximity and orientation to the existing KWP turbines (which can affect the efficiency and output of the facility), access to transmission, visibility to the Maui community, presence of sensitive resources (e.g., native flora and fauna, cultural features, etc.), and constructability (such as site topography, geological features, and extent of road-building required) (Planning Solutions, Inc. 2010).

2.4.3 Greater or Fewer Number of WTGs

The State *EIS Preparation Notice (EISPN)* for the project identified a range of possible generating capacities for KWP II, from 10.5 to 30 MW. Feedback on the *EISPN*, analyses of the wind and meteorological data that KWP II LLC has collected, and the fixed costs of the required battery storage facilities led KWP II LLC to conclude that 21 MW is the appropriate capacity for the facility (Planning Solutions, Inc. 2010).

KWP II LLC believes that reducing the size of the facility below 21 MW would decrease the benefits of further wind power development without significantly decreasing potential impacts of the facility. Lowering the number of WTGs would not produce a proportional reduction in the cost of the support facilities and permitting. This, combined with certain high-fixed costs (e.g., transportation, logistics, mobilization), mean that the cost per MW of capacity increases as the number of turbines decreases. Although a reduced scale project from 14 to 7 WTGs likely would reduce the risk of adverse impacts to

the Covered Species, the reduction in biological impacts is not sufficient to overcome the economic and logistical considerations. For these reasons, constructing and operating a facility with a lower generating capacity would be financially infeasible for KWP II LLC.

Constructing more than 14 1.5-MW WTGs was an option eliminated by KWP II LLC based on discussions with MECO about the amount of as-available wind energy that could be integrated into Maui's grid from this site. Furthermore, constructing more than 14 additional WTGs within the parcels would also be expected to increase visual impacts and would proportionately increase impacts to the Covered Species (Kingsley and Whittam 2007; Powlesland 2009).

2.4.4 Turbine Design and Size

KWP II LLC considered different alternatives with regard to the model of WTGs to be used in the project. KWP uses GE 1.5-MW wind turbines. These have been proven to be successful for the wind regime at the proposed site. The GE units are sufficiently large to take advantage of economies of scale and the higher wind speeds that are present at heights above those that can be reached by smaller/lower WTGs, yet they are considerably shorter and less massive than the larger WTGs that are now being put into service elsewhere.

KWP II LLC plans to use GE 1.5 MW turbines as well, which will be nearly identical in appearance, although about 30 ft (9 m) taller in overall height due to manufacturer's design changes. Using the same type of WTGs at KWP II as KWP will help ensure visual and logistical continuity for the facilities at Kaheawa Pastures. This decreases the overall visual impact of the WTGs and streamlines the delivery and exchange of parts. KWP II LLC's economic analyses indicate that the GE 1.5-MW turbines are likely to be the most cost-effective choice for this site. Finally, the GE 1.5-MW turbines can meet the requirements set by MECO (Planning Solutions, Inc. 2010).

CHAPTER 3: AFFECTED ENVIRONMENT

3.1 Climate

The climate of the Hawaiian Islands varies little throughout the year, with only minor periods of diurnal and seasonal variability. Generally, temperatures during the summer season (May through September) are warm, conditions are dry, and persistent trade winds originate from the northeast direction. The winter season (October through April) is characterized by cooler temperatures, higher precipitation, and less equable winds. Local climatic conditions and weather patterns on Maui vary as a result of several different factors in the physical environment. Among the most important of these are elevation, position on the windward or leeward side of the island (relative to the prevailing northeast trade winds and subsequent orographic rainfall), and local terrain features (Juvik and Juvik 1998; Planning Solutions, Inc. 2010).

Average monthly temperatures at the Kahului Airport range from 71.7°F (22.1°C) in January to 79.2°F in August (26.3°C). Annual precipitation in the Kaheawa area ranges from less than 15 inches (38 cm) per year at the Honoapiilani Highway/site access road intersection to slightly over 40 inches (102 cm) per year at the uppermost of the existing WTGs. Most of the rainfall occurs during winter months, with more the 80% occurring from November through April (Planning Solutions, Inc. 2010).

Prevailing surface winds in the project area are the northeasterly trade winds, which occur over 70% of the time; however, during "Kona" storm conditions, the prevailing winds change to a south/ southwesterly direction. Wind patterns vary through the day, with trade winds generally being stronger in the afternoon. When the trade winds are weak or absent, a land-sea breeze pattern sometimes develops. When this occurs during the day, winds blow on shore toward the warmer land mass. The reverse occurs in the evening as breezes blow toward the relatively warm ocean (Planning Solutions, Inc. 2010).

Episodic oceanic and atmosphere events, such as tropical storms, hurricanes, and El Niño Southern Oscillation (El Niño), can also influence climate in the islands during specific intervals. In Hawaii, hurricanes and El Niño are rare events; however, more frequent tropical storms can bring rain and generate winds below 74 miles per hour (mph). A tropical storm will pass sufficiently close to Hawaii

to affect the weather in some part of the state every year or two, typically between July through December (Planning Solutions, Inc. 2010).

3.2 Topography

The topography of Maui is characterized by two high elevation volcanoes (Haleakala to the east and West Maui to the west) separated by a central isthmus. The KWP II project area lies on the southern flank of the West Maui Mountains. Dominant topographic features in the area are Manawainui Gulch, Kealaloloa Ridge, Malalowaiaole Gulch, Papalaua Gulch, Puu Luau, and Puu Pohakuloa.

Topography is largely responsible for the heightened wind velocity and power at Kaheawa Pastures. The prevailing northeasterly trade winds tend to be split by Haleakala, and the northern stream whips over the southern flank of the West Maui Mountains while attempting to regain uniform flow, making that location the best wind resource on the island. The deep gulches and ravines present in the area can create additional acceleration of the wind speeds in the downslope direction, thereby increasing wind velocity on the ridges immediately above these gulches (Planning Solutions, Inc. 2010).

Under the Proposed Action (Alternative 1), the proposed KWP II facilities would be constructed on the lower portion of a broad interfluve between Manawainui Gulch on the west and Malalowaiaole Gulch on the east. Kealaloloa Ridge, situated immediately northeast of Malalowaiaole Gulch, separates the project area from the isthmus of Maui to the east. In Alterative 1, the WTGs would be located between 695 and 1,825 ft (211-556 m) elevation. Portions of the project (the proposed baseyard, maintenance building, and underground collection system) would be located at higher elevations adjacent to steep gulches in the KWP I area. Several small puu (hills, peaks) are present in the area, including Puu Luau located at an elevation of about 2,300 ft (700 m).

The ground slope along the mauka-makai (inland to seaward) axis of the area where the WTGs would be constructed varies, but averages about 14%. The cross-slopes within this area are also variable, but typically are no more than 2 to 3% (Planning Solutions, Inc. 2010).

Under Alternative 2, the proposed KWP II facilities would be located on a narrow band of land running mauka to makai between the Manawainui Gulch and the Papalaua Gulch, and on the ridge between Manawainui Gulch and Malalowaiaole Gulch where the current access road lies. Puu Luau and Puu Pohakuloa are located nearby at 2,300 ft and 1,600 ft elevation, respectively. In Alterative 2, the WTGs would be roughly located between 1,665 and 2,810 ft (507-856 m) elevation. The ground slopes in the Alternative 2 areas are similar to those in the Proposed Action area (Planning Solutions, Inc. 2010).

3.3 Geology, Soils, and Geologic Hazards

The Hawaiian Islands were and are being formed by a series of volcanic eruptions that have occurred at various hotspots beneath the Earth's crust. As the tectonic plate supporting the islands has slowly drifted northwestward, magma has welled up from fixed spots creating, in conjunction with subsidence and erosion, a linear chain of islands. Maui, the second largest island in the chain, was created by several geological processes. The present Island of Maui is part of "Maui Nui," a prehistoric landmass that consisted of six or seven coalesced volcanoes, including Haleakala, West Maui, Kahoolawe, Lanai, East Molokai, West Molokai, and Penguin Banks. About 300,000 to 400,000 years ago, subsidence resulted in the isolation of the combined Maui/Kahoolawe landmass from the remainder of Maui Nui. Continued subsidence separated Kahoolawe and Maui within the last 100,000 to 200,000 years (Juvik and Juvik 1998). With continued subsidence at the present-day rates, Haleakala and West Maui will become separate islands in about 15,000 years (Planning Solutions, Inc. 2010).

The project area is located on the lower flank of the extinct West Maui volcano, which evolved through shield (1.6 to 2.0 million years old), post-shield (1.5-1.2 million years old), and rejuvenated stages creating volcanic layers thousands of feet deep. Nearly a half-million years passed between the post-shield and rejuvenated phases with no evidence of volcanic activity. The rejuvenated stage is represented by only a handful of vents and flows. All the eruptions in the rejuvenated phase were from small cinder cones that grew briefly and then died. Lava flows were extruded from each, but the area covered by lava was generally only a few acres. There are no known unique or unusual geologic resources or conditions at the Downroad Siting Area (Alternative 1) or the Downwind/Downstring Siting Area (Alternative 2).

The primary soil types on Maui belong to the Lahaina Volcanic Series, the Honolua Volcanic Series, and the Wailuku Basaltic Series. Major soil types and characteristics found at Alternatives 1 and 2, as identified by the U.S. Department of Agriculture (USDA) Soil Conservation Service and Natural Resource Conservation Service (NRCS) (Foote et al. 1972), are summarized in Table 3-1.

Soil underlying the proposed WTGs in the Downroad Siting Area (Alternative 1) is characterized entirely as Rock land. This substrate consists of thin soils formed from gray trachyte lavas of the Honolua Series. Components of the proposed project located near the existing KWP I facility are underlain with Naiwa silty clay loam, Oli silt loam, and Rough broken and stony land. The Downwind/Downstring Siting Area (Alternative 2) is mostly underlain by Naiwa silty clay loam and Oli silt loam. These volcanic soils are deep, moderately acid, and well-drained.

Table 3-1. Soil types and characteristics found at KWP II based on classifications from Foote et al. (1972).

Soil Type	Key Characteristics				
	Slope	Permeability	Runoff	Erosion Hazard	Land Uses
Naiwa silty clay loam	3-20%	Moderately Rapid	Medium	Moderate to Severe	Pasture, woodland & wildlife habitat
Oli silt loam	3-10%	Rapid	Medium	Moderate	Pasture and wildlife habitat
Rough broken and stony land	4-70%	--	--	--	Pasture, wildlife habitat, & watershed
Rock land	0-70%	--	--	--	Pasture, wildlife habitat, water supply, urban development

3.4 Water Resources

The Clean Water Act (CWA), formerly known as the Federal Water Pollution Control Act, is the primary statute governing water pollution and water quality in waters subject to U.S. Army Corps of Engineers (USACE) jurisdiction. Section 404 of the CWA regulates the discharge of dredged or fill material into jurisdictional waters of the U.S. and USACE is authorized to issue permits for these activities.

3.4.1 Surface Water

No wetlands, perennial streams, or other aquatic habitats are present in the Downroad Siting Area (Alternative 1) or the Downwind/Downstring Siting Area (Alternative 2) (Hobdy 2004a, 2004b, 2006a). Storm runoff from the WTG sites in the Downroad area primarily flows in a southeasterly direction toward Malalowaiaole Gulch. Runoff from the facility components located near the existing KWP I turbines is expected to flow in a southwesterly direction toward Manawainui Gulch. The State of Hawaii Commission on Water Resource Management (CWRM) has determined that Manawainui Gulch does not have sufficient water to support instream uses and therefore is not subject to CWRM regulation (Izu 2004). The U.S. Army Corps of Engineers (USACE) has confirmed that the existing KWP facility is located entirely within an upland area and does not contain or convey waters of the United States subject to USACE jurisdiction (Young 2004).

3.4.2 Flooding

Executive Order 11988 requires Federal agencies to avoid adverse impacts to flood plains to the extent possible. The goal of this Executive Order is to minimize the impact of floods on public safety, health, conservation, and economics. Flood Insurance Rate Maps (FIRM) prepared by the Federal Emergency Management Agency (FEMA) National Flood Insurance Program depict flood hazard areas through the state. The maps classify land into four zones depending on the expected flood inundation. Both Alternatives lie entirely within Flood Zone X, an area defined as having less than 0.2% annual risk of flood inundation. FIRM maps do not identify any 100-year floodplains within or near the mouths of either of the gulches that border the alternatives.

3.4.3 Groundwater

Alternative 1 (Downroad Siting Area) and Alternative 2 (Downwind/Downstring Siting Area) are located over the Ukumehame Sector of the Lahaina Aquifer (Aquifer Code 60206 as designated by the State of Hawaii Water Use Commission). The estimated depth to the basal groundwater is believed to be approximately 1,550 to 2,950 ft (473 to 899 m) below the surface depending on the location on the project area (VEC 2005). Groundwater likely flows in a southerly direction. Perched areas of groundwater may also underlie the site (VEC 2005). Both sites are located mauka (inland) of the Underground Injection Control (UIC) line, which is the designated boundary that divides protected inland areas situated over drinking water sources from seaward areas located over non-potable water sources (Planning Solutions, Inc. 2010).

3.5 Air Quality

As required by the Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS). These standards cover seven major air pollutants: carbon monoxide (CO), nitrogen oxides (NO_X), ozone (O_3), particulate matter smaller than 10 microns (PM_{10}), particulate matter smaller than 2.5 microns ($PM_{2.5}$), sulfur oxides (SOX), and lead (CFR Title 40, Part 50).

In Hawaii, air quality is regulated and monitored by the State Department of Health (DOH), Clean Air Branch. The State of Hawaii has established ambient air quality standards for six of the pollutants mentioned above (all but $PM_{2.5}$), as well as hydrogen sulfide (H_2S) (HAR, Chapter 59). The only air quality monitoring station on the Island of Maui is located in Kihei, approximately 6.5 miles (10.5 km) southeast of the project area (DOH Clean Air Branch 2008). This station monitors $PM_{2.5}$ and PM_{10} only. Between 2004 and 2008, this station was generally in attainment for $PM_{2.5}$ and PM_{10}. The PM_{10} standard was exceeded once in 2005 due to a high wind/dust storm and once in 2007 due to a brush fire; DOH flagged both exceedances as exceptional events. In general, the State of Hawaii was in attainment for all NAAQS between 2004 and 2008 (DOH Clean Air Branch 2008, 2009).

Air quality in the Hawaii is consistently one of the best in the nation, and criteria pollutant levels remain well below state and federal ambient air quality standards (DOH Clean Air Branch 2009). There are few sources of air pollution near the project area. The most significant is the dust that naturally arises when strong winds sweep across the open fields or exposed slopes during dry weather. Other sources of airborne contaminants on or near the project area include vehicle exhaust, wildfires, and intermittent fugitive dust and ashes from agricultural cultivation and construction activities. Emissions from MECO's power plants also affect air quality, but they are sufficiently far away that they do not have a strong effect on ambient concentrations of the pollutants (Planning Solutions, Inc. 2010).

3.6 Noise

Noise is defined as any unwanted sound. Whether sound is perceived as a noise by a receiver depends on subjective factors, including the amplitude and duration of the sound (Rodgers and Manwell 2004). The frequency of a sound also greatly influences the ability of a receiver to hear a sound; people are generally more sensitive to certain higher frequency sounds than lower frequency sounds. The A-weighted sound level, or dBA, is the sound level measurement (in decibels) that accounts for this preferential response to frequency and provides some correlation with the sensitivity of the human ear to that sound.

The State of Hawaii regulates noise levels through the DOH regulations (HAR Title 11, Chapter 46, Community Noise Control). These regulations are also intended to protect public health and welfare, and to prevent significant degradation of the environment and quality of life. Maximum permissible sound levels are dependent on zoning designations and time of day (Table 3-2). The maximum permissible sound levels specified in the Community Noise Control Rule do not apply to any particular distance from a source (such as a WTG), but apply to sound levels at the property boundary (D.L. Adams Associates, Ltd. 2009b).

The proposed project would be subject to the Community Noise Control Rule. The project area is considered a Class A Zoning District; therefore, noises produced by the project cannot exceed 55 dBA[1] during the daytime or 45 dBA during the nighttime *at the project area property line*. Adjacent properties are also considered a Class A Zoning District; therefore, *at the property lines of these adjacent properties*, noise levels from the project cannot exceed 55 dBA during the daytime or 45 dBA during the nighttime (D.L. Adams Associates, Ltd. 2009b).

Table 3-2. Maximum permissible sound levels in dBA.

Zoning Districts	**Daytime** (7AM to 10PM)	**Nighttime** (10PM to 7AM)
Class A (residential, conservation, preservation, public space, open space)	55	45
Class B (multi-family dwellings, apartment, business, commercial, hotel, resort)	60	50
Class C (agriculture, country, industrial, similar)	70	70
Source: HAR Title 11, Chapter 46, Community Noise Control.		

Ambient sound levels must be identified in order to determine whether sounds produced by the WTGs would be audible over background levels. Ambient sound levels were measured at four locations in the vicinity of the Lahaina-Pali Trail near the proposed project (Figure 3-1). The results of the measurements are summarized in Table 3-3.

There are no residences or other noise sensitive buildings near the project area. Ambient sound levels along the Lahaina-Pali hiking trail are dynamic and depend significantly on environmental noises, primarily wind and rain. During periods of high winds, sound from the interactions between wind and vegetation dominates the ambient sound environment. During periods of low wind, noise levels drop off significantly. Secondary sources of noise include wind turbine sound from KWP, occasional aircraft flyovers, birds, crickets, hikers, and vehicles traveling along the facility access road (D. L. Adams Associates, Ltd. 2009b, 2009c).

[1] dBA is the sound level, in decibels, read from a standard sound-level meter using the “A-weighting network.”

Figure 3-1. Ambient Sound Measurement Locations.

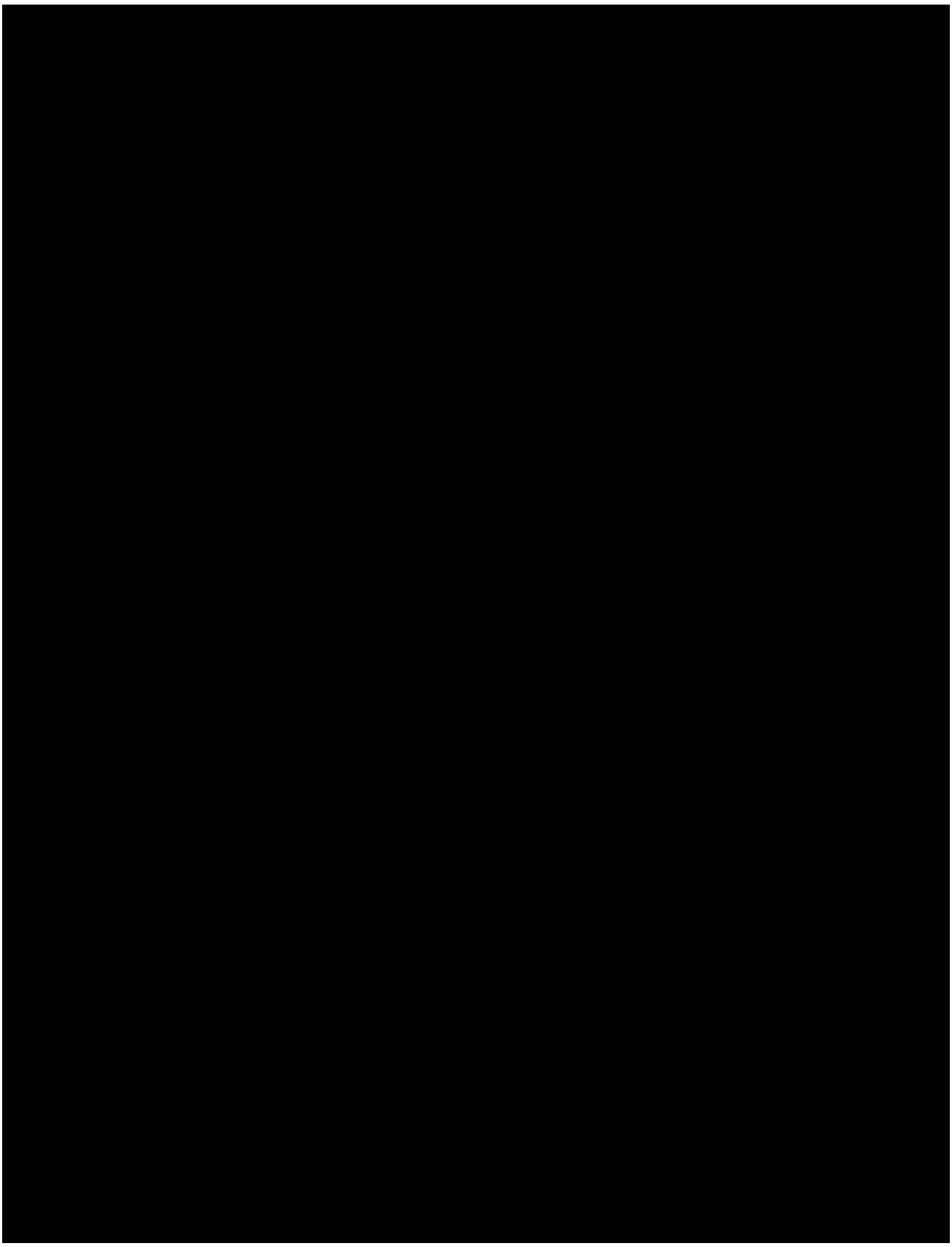


Table 3-3. Sound measurement results at the Lahaina-Pali Trail.

Measurement Location	Daily Avg. Sound Level L_{eq} (Day)[1]	Daily Avg. Sound Level L_{eq} (Night)[2]	Daily Avg. Day-Night Level L_{dn}[3]
N20 47.727 W156 32.397 (L1)	39 – 45 dBA	35 – 46 dBA	42 - 52 dBA
N20 47.783 W156 32.328 (L2)	37 – 42 dBA	34 – 46 dBA	41 – 53 dBA
N20 47.909 W156 32.348 (L3)	38 – 53 dBA	37 – 48 dBA	46 - 56 dBA
N20 48.050 W156 32.202 (L4)	40 – 51 dBA	36 – 43 dBA	45 - 52 dBA

[1)] Leq (day) is an average of the hourly equivalent sound levels during the daytime hours only (between 7:00AM and 10:00PM) within a 24-hour measurement period. The range represents the quietest and noisiest day measured within the 7-day measurement period.
[2)] Leq (night) is an average of the hourly equivalent sound levels during the nighttime hours only (between 10:00PM and 7:00AM) within a 24-hour measurement period. The range represents the quietest and noisiest night measured within the 7-day measurement period.
[3)] The Ldn represents the lowest and highest calculated average day-night level from the 7-day measurement period.

Source: D.L. Adams Associates, Ltd. (2009b).

3.7 Scenic Resources

A scenic vista or viewshed is broadly defined as a vista visible from a human observation point. No portion of Kaheawa Pastures is specifically identified as having an important scenic vista in county or state plans or studies (KWP LLC 2004).

Both of the areas that are being considered for the proposed project are uninhabited and situated near the existing KWP I facility. Hence, views of the two siting area from many public vantage points in the vicinity present a rural view of the hillside and the existing KWP turbines. Similar to the existing KWP facility, the Downroad and Downwind/Downstring Siting Areas are most visible from aircraft on approach to Kahului airport. The existing WTGs are also visible from segments of the Lahaina-Pali Trail, a public hiking trail that passes approximately 3,000 ft (914 m) below (south of) the lowest KWP I turbine (Planning Solutions, Inc. 2010). Both potential siting areas for KWP II are visible from portions of the Lahaina-Pali Trail. In general, intervening terrain and vegetation blocks views of much of the land on which Alternative 2 would be built from Honoapiilani Highway and other public views of the area (Planning Solutions, Inc. 2010).

3.8 Hazardous Substances and Materials

A Phase I Environmental Site Assessment (Phase I) was conducted at the existing KWP I project area by Vuich Environmental Consultants, Inc (VEC 2005). This assessment found that the few “products of concern” (e.g., silt, paints, oils, antifreezes) that were present on-site occurred in small quantities and did not constrain use of the area. The report concluded that no “recognized environmental conditions” are present on the site or in the surrounding area, as defined by American Society of Testing and Materials Standard E1527-00 (VEC 2005). The proximity of the proposed KWP II project area and the similarity of past uses suggest similar conditions at the KWP II site; however, a Phase I will be conducted prior to construction of the proposed KWP II project.

A follow-up Phase I of the KWP I facility was conducted by Malama Environmental in August 2007, after the facility commenced operation. The report concluded that regulated wastes and petroleum products are effectively managed on-site, and that secondary containment of petroleum-based wastes and effective spill management has been implemented in the daily operations of the facility. Furthermore, petroleum-based wastes and all other regulated wastes generated on-site are being properly managed and disposed of by certified waste contractors (Malama Environmental 2007).

3.9 Land Use

The Downroad Siting Area (Alternative 1) is located within two parcels that are designated as State Conservation land (Figure 3-2), both of which are entirely owned by the State of Hawaii; approximately 135 ac (55 ha) of land are located within parcel (2) 3-6-001:014 and 8 ac (3 ha) of land are located within parcel (2) 4-8-001:001. Alternative 2 would be situated within a portion of parcel (2) 4-8-001:001, which is entirely owned by the State of Hawaii.

In addition to the KWP facility, the following land uses occur within the vicinity:

- Public hiking occurs along the 4.5 mi (7.2 km) Lahaina-Pali Trail, which traverses the hillside at an elevation of approximately 1,500 ft (457 m) near the Downstring sites;
- One MECO transmission line easement crosses the uppermost portion of the project area at an elevation of approximately 1,900 ft (579 m) and an additional transmission line crosses Kaheawa Pastures in a southwesterly direction from Maalaea at an elevation of approximately 2,300 ft (701 m);
- Nene are released as part of an ongoing wildlife preservation program on State-owned land mauka and west of the project area;
- Manawainui Plant Sanctuary, located mauka of the KWP facility, is used for education, management, and restoration of native plant habitat; and
- West Maui Forest Reserve is managed by DOFAW for a variety of public uses and benefits.

Past land uses, including cattle ranching and the installation of the two MECO transmission lines, have impacted the Kaheawa area by increasing the abundance of invasive plant species, bare soil areas, and fire hazards. There are no planned land uses identified in any state or local plans for the project area (Planning Solutions, Inc. 2010).

Applicable regulations, plans, and policies related to land use are discussed in Section 1.3.

3.10 Flora

Prior to European contact, the Kaheawa area is believed to have been entirely covered with low-stature native vegetation. Much of the native vegetation was converted to non-native grasslands as a result of grazing and wildfires (Hobdy 2009a, 2009b). Cattle ranching began in the area in the late 1800s and continued for over 100 years. During this time, grazing animals consumed most of the native vegetation, which was gradually replaced by hardy non-native weed species. Fires further eliminated remnant native vegetation (Hobdy 2006a). Large fires swept across the West Maui Mountains in 1999 and 2006, affecting portions of the KWP II project area.

A botanical survey of the Downroad Siting Area (Alternative 1) was conducted by Robert Hobdy in August 2009. A supplemental survey was conducted by Hobdy in January 2010 in two small areas of the existing KWP I area where new buildings are planned and within the proposed trenching corridor for the collection system (Hobdy 2010). No state or federally listed threatened, endangered, or candidate plant species were found during any of the surveys (Hobdy 2009a, 2010). Copies of Hobdy's surveys for Alternative 1 are provided in Appendix 1.

In 2009, Hobdy (2009a) identified 62 plant species, 15 of which are native to the Hawaiian Islands. During the supplemental 2010 survey, a total of 57 species were identified. This survey documented 16 native species, nine of which were not recorded during the 2009 survey. Thus, the entire area proposed under Alternative 1 contains 24 plants native to the Hawaiian Islands; fifteen of these are endemic and nine are indigenous (Table 3-4).

The vegetation in the Downroad Siting Area (Alternative 1) is mostly grasses and low-growing shrubs, with occasional small trees in the wetter gullies. The most abundant species in the project area is buffelgrass (*Cenchrus ciliaris*), which proliferated after the fires in 1999. Other common species in the vicinity of the proposed WTGs are natal redtop (*Melinis repens*), ilima (*Sida fallax*), uhaloa (*Waltheria indica*), lesser snapdragon (*Antirrhinum orontium*), and Jamaican vervain (*Stachytarpheta jamaicensis*) (Hobdy 2009a).

Figure 3-2. State Land Use Map.

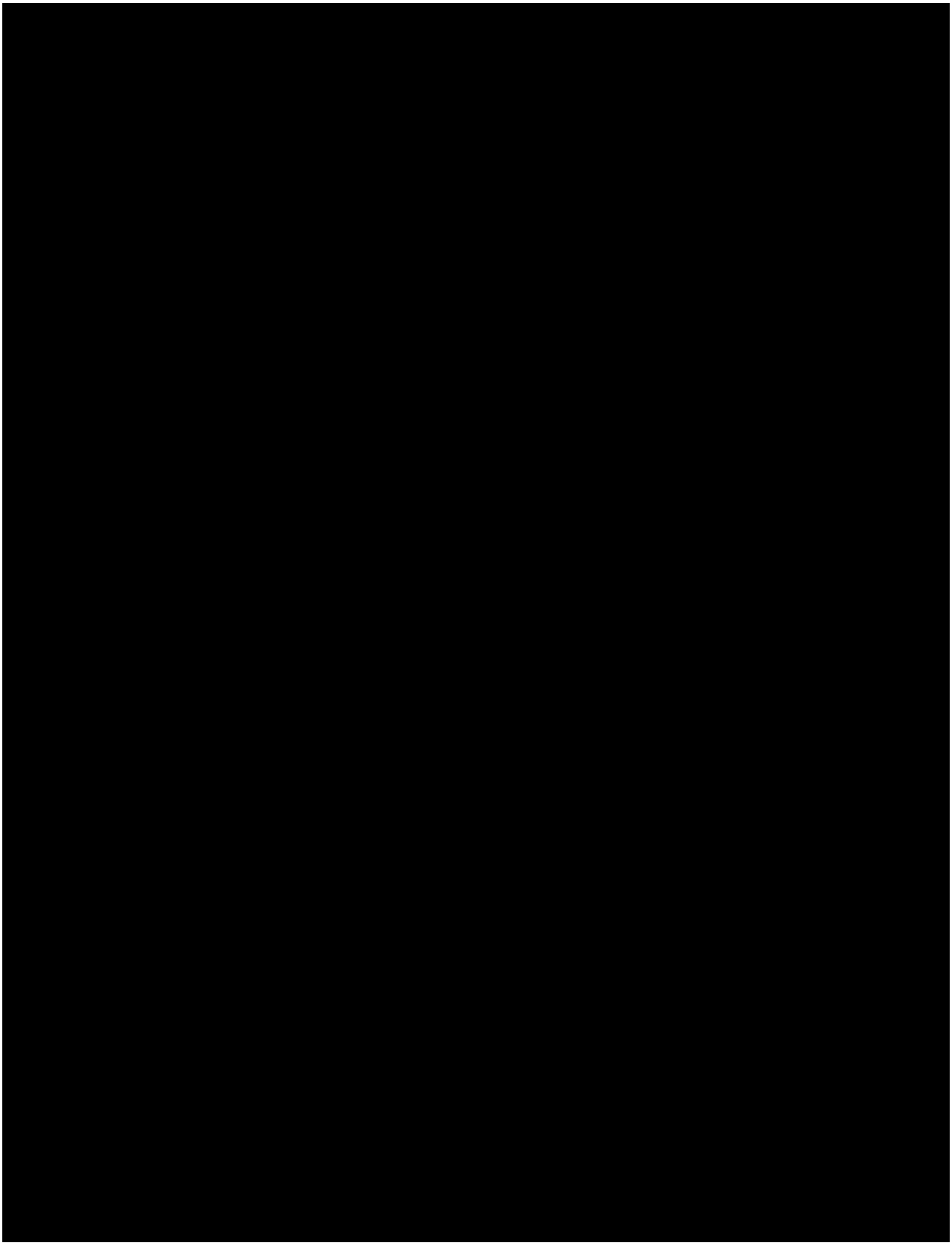


Table 3-4. Native Hawaiian plants observed in the KWP II project area.

Scientific Name	Hawaiian & Common Names	Status[1]	Abundance (at site)[2]	
			Alternative 1	Alternative 2
FERNS				
DENNSTAEDTIACEAE (Bracken Family)				
Pteridium aquilinum (L.) Kuhn var. *decompositum* (Gaud.) R.M. Tryon	kilau	E	rare	common
PTERIDACEAE (Brake Fern Family)				
Doryopteris decipiens (Hook.) J.Sm.	kumuniu	E	rare	--
MONOCOTS				
CYPERACEAE (Sedge Family)				
Carex wahuensis C.A. Meyen subsp. *wahuensis*	----------	E	uncommon	uncommon
Cyperus phleoides Nees ex Kunth subsp. *phleoides*	----------	E	rare	--
POACEAE (Grass Family)				
Eragrostis deflexa Hitchc.	kalamalo	E	rare	--
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	pili	I	uncommon	rare
Trisetum inaequale Whitney	Whitney's false oat	E	--	rare
DICOTS				
AMARANTHACEAE (Amaranth Family)				
Chenopodium oahuense (Meyen) Aellen	aheahea	E	rare	--
ASTERACEAE (Sun Flower Family)				
Bidens mauiensis (A.Gray) Sherff	kookoolau	E	--	rare
Bidens micrantha subsp. *micrantha* Gaud.	kookoolau	E	uncommon	rare
Lipochaeta lobata (Gaud.) DC. var. *lobata*	nehe	E	rare	--
Melanthera lavarum (Gaud.) Wagner & Rob.	nehe	E	uncommon	rare
CONVOLVULACEAE (Morning Glory Family)				
Ipomoea indica (J. Burm.) Merr.	koali awahia	I	rare	uncommon
Ipomoea tuboides Degener & Ooststr.	Hawaiian moon flower	E	--	rare
ERICACEAE (Heath Family)				
Leptecophylla tameiameiae (Cham. & Schlect.) C.M. Weiller	pukiawe	I	uncommon	uncommon
EUPHORBIACEAE (Spurge Family)				
Chamaesyce celastroides (Boiss.) Croizat & Degener var. *amplectens* (Sherff) Degner & I. Degener	akoko	E	uncommon	rare
GOODENIACEAE (Goodenia Family)				
Scaevola gaudichaudii Hooker & Arnott	naupaka kuahiwi	E	rare	--
MALVACEAE (Mallow Family)				
Sida fallax Walp.	ilima	I	common	common
MENISPERMACEAE (Moonseed Family)				
Cocculus orbiculatus (L.) DC.	huehue	I	rare	uncommon
MYOPORACEAE (Myoporum Family)				
Myoporum sandwicense A. Gray	naio	I	rare	rare

Scientific Name	Hawaiian & Common Names	Status[1]	Abundance (at site)[2]	
			Alternative 1	Alternative 2
MYRTACEAE (Myrtle Family)				
Metrosideros polymorpha Gaud. var. *glaberrima* (H.Lev.) St. John	ohia	E	uncommon	--
Metrosideros polymorpha Gaud. var. *incana* (H. Lev.) St. John	ohia	E	rare	rare
PAPAVERACEAE (Poppy Family)				
Argemone glauca (Nutt. ex Prain) Pope	puakala	E	rare	--
ROSACEAE (Rose Family)				
Osteomeles anthyllidifolia (Sm.) Lindl.	ulei	I	uncommon	common
SANTALACEAE (Sandalwood Family)				
Santalum ellipticum Gaud.	iliahialoe	E	rare	uncommon
SAPINDACEAE (Soapberry Family)				
Dodonaea viscosa Jacq.	aalii	I	uncommon	uncommon
STERCULIACEAE (Cacao Family)				
Waltheria indica L.	uhaloa	I	common	common
THYMELAEACEAE (Akia Family)				
Wikstroemia oahuensis (A.Gray) Rock.	akia	E	rare	uncommon

(1) E= endemic (native only to Hawaii); I= indigenous (native to Hawaii and elsewhere).
(2) Common= widely scatted throughout or locally abundant; uncommon= scattered sparsely throughout or occurring in a few small patches; rare= only a few isolated individuals.

Source: Hobdy 2006a, 2006b, 2009a, 2009b, 2010.

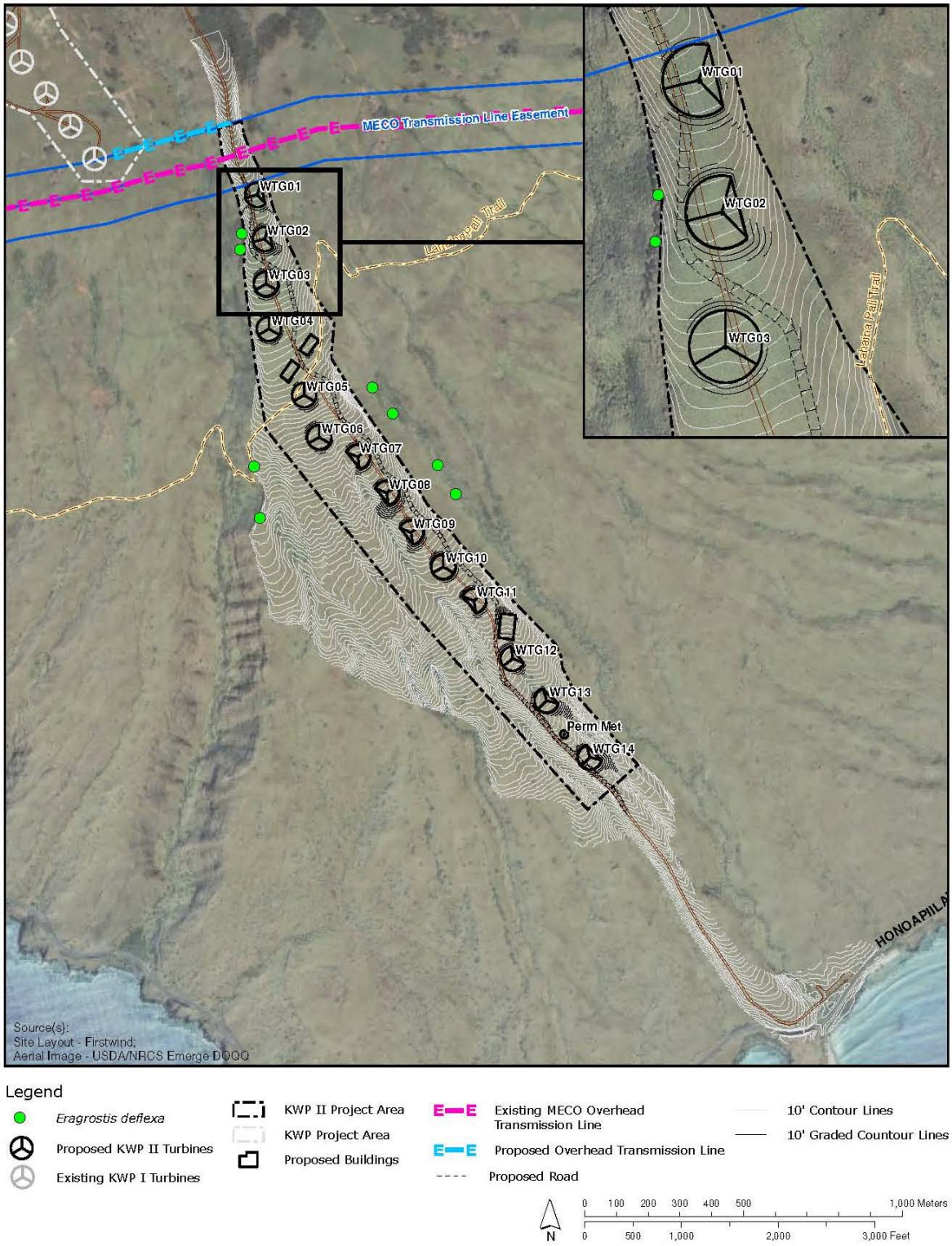
In the two small areas near the existing KWP facility proposed to be developed under Alternative 1 and within the proposed trenching corridor, the most common species include molasses grass (*Melinis minutiflora*), ulei (*Osteomeles anthyllidifolia*), lantana (*Lantana camara*), natal redtop, and aalii (*Dodonaea viscosa*) (Hobdy 2010).

Native plant species within the Downroad Siting Area are most prevalent in the rocky habitat bordering Manawainui and Malalowaiaole Gulches (Hobdy 2009a), as well as in the vicinity of the proposed underground cable (Hobdy 2010). These habitats are the most protected from grazing and fire. The three hardiest species - ilima, uhaloa, and aalii - are also present on the flatter grassy ridge tops. Native vegetation is less prevalent at the lower, drier parts of the area where fires have more recently occurred (Hobdy 2009b). Most of these native plants are common at Kaheawa and throughout the main Hawaiian Islands. Only one species found within Alternative 1, *Bidens micrantha*, is found only on Maui and Lanai, but is common in West Maui (Hobdy 2010).

Kalamalo (*Eragrostis deflexa*), which was recorded as rare throughout the project area by Hobdy in August 2009, was presumed extinct in the early 1990s, but has since be documented on West Maui, Lanai, Molokai, and Kahoolawe (Hobdy 2009a).

Six occurrences of kalamalo were recorded within the project area along the rocky edges of Manawainui and Malalowaiaole gulches in August 2009 (Hobdy 2009a). These occurrences were affected during the fire that swept through the area in June 2010. The current known distribution of kalamalo in the vicinity of the project area is shown in Figure 3-3. Two clumps of kalamalo are known in the northern portion of the project area near WTG 2 along the steep edges of Manawainui Gulch and two additional discrete clumps occur further makai in the rocky crevices and outcroppings along Manawainui Gulch. All individuals were observed just outside of the project area on the steep outer portions of the gulch, making them inaccessible to foot and vehicular traffic. Each cluster ranges between 6 and10 ft (2-3 m) in size.

Figure 3-3. *Eragrostis deflexa* Distribution in the Vicinity.



Botanical surveys of the Alternative 2 area (Downwind/Downstring Siting Area) were conducted by Hobdy in October 2006 and again in January 2009. The second survey was conducted to document and assess changes in the vegetation following a wildfire that occurred in September 2006, which burned about 80% of the 333-acre area (Hobdy 2006a, 2009b).

Hobdy (2009b) identified 86 plant species in the Alternative 2 area, 20 of which are endemic or indigenous to the Hawaiian Islands. Of the 20 native plant species documented, 11 are endemic and nine are indigenous to the Hawaiian Islands (Table 3-4). The surveys indicate that native plants are spread among the grasses throughout the Alternative 2 area, but are less prevalent at the lower, drier parts of the area where fires have more recently occurred (Hobdy 2009b). One pocket of predominantly native shrubland occurs on the western edge of the Alternative 2 area on an eroded rocky ridge between 2,000 and 2,400 ft (610 and 732 m) elevation. Only one of the native species occurring in Alternative 2, (*Trisetum inaequale*), is somewhat rare in the Hawaiian Islands, having a limited distribution on West Maui and Lanai (Hobdy 2009b). The endemic naupaka kuahiwi (*Scaevola gaudichaudii*), which was detected in low numbers in 2006, was not found in the 2009 survey. Much of the native vegetation believed to have entirely covered the area in Pre-Contact times was converted to non-native grasslands as a result of grazing and wildfires (Hobdy 2009b).

Although no federally listed plant species and/ or rare Hawaiian plants have been recorded on the KWP II project area, several have been documented in the vicinity, specifically within Manawainui Gulch, Papalaua Gulch, and Kealaloloa ridge (including the Manawainui Plant Sanctuary). Hobdy (2006) noted several threatened and endangered plant species within a mile of KWP I including: iliahi (*Santalum freycinetianum* var. *lanaiense*), pauoa (*Ctenitis squamigera*), haiwale (*Cyrtandra oxybapha*), kookoolau (*Bidens campylotheca* subsp. *pentamera*), kokio ulaula (*Hibiscus kokio*), *Remya mauiensis*, *Diellia erecta*, *Cystopteris douglasii*, *Cyanea obtuse*, and *Schiedea pubescens*. The dwarf form of mamane (*Sophora chrysophylla*), which is considered rare on West Maui, occurs at the puu (peak or outcrop) adjacent to the main access road leading to the KWP site.

3.11 Wildlife

3.11.1 Non-Federally Listed Species

Wildlife occurring in the Kaheawa Pastures area has been investigated through a combination of general biological, point count, and radar surveys. The mixed grassland/ shrubland vegetation in the project area provides habitat for various non-federally listed mammals, molluscs, and bird species.

Birds: General avian surveys were conducted during the development of the KWP project to identify bird species present in that project area. Several ornithological surveys were conducted at Kaheawa when development of a wind facility at Kaheawa Pastures was first being considered (Nishibayashi 1997, 1998). The purpose of those surveys was to identify the avian species present and to assess the potential impact of six meteorological towers that were installed prior to the construction of the KWP project. Radar studies and night-visual observations were performed by ABR, Inc. in an effort to determine the type and number of seabirds that traverse the project area (Cooper and Day 2009).

Fourteen bird species have been observed by KWP biologists for the KWP II area since 2006 (Table 3-5). The endemic Hawaiian short-eared owl, or pueo, is listed as endangered by the State of Hawaii on the Island of Oahu. Cooper and Day (2009) reported nine observations of Hawaiian short-eared owls during five nights of surveys in July 2009. Hawaiian short-eared owls are also commonly observed by KWP staff and reported along with other wildlife observations. Most owl activity is concentrated in the nearby gulches, although individuals occasionally are observed foraging over the open, flatter parts of the KWP II area.

The indigenous white-tailed tropicbird (*Phaethon lepturus*) has been observed flying overhead of the project area by KWP staff, but usually remain associated with the deep gulches adjacent to the site. White-tailed tropicbirds are known to nest in steep valley faces and canyon walls which are common features in nearby Ukumehame, Manawainui, and Malalowaiaole Gulches. The other native bird species documented near the project area, the Pacific golden plover (*Pluvialis fulva*), is present on-site during the migratory season (late August to May).

Table 3-5. Avian species identified in the project area by KWP biologists (2006 to present).

Scientific Name	Common Name	Biogeographical Status[1]	Protection[2]
Branta sandvicensis	Hawaiian goose, nene	E	MBTA, End.
Phaethon lepturus dorotheae	White-tailed tropicbird	I	MBTA
Francolinus pondicerianus	Gray francolin	NN	
Francolinus francolinus	Black francolin	NN	
Phasianus colchicus	Ring-necked pheasant	NN	
Pluvialis fulva	Pacific golden plover	W	MBTA
Streptopelia chinensis	Spotted dove	NN	
Geopelia striata	Zebra dove	NN	
Asio flammeus sandwichensis	Hawaiian short-eared owl, pueo	E	MBTA
Tyto alba	Barn owl	NN	MBTA
Alauda arvensis	Eurasian skylark	NN	MBTA
Acridotheres tristis	Common myna	NN	
Lonchura punctulata	Nutmeg mankikn	NN	
Fregata minor	Great frigatebird, iwa	I	MBTA

(1) E = endemic permanent resident; I = indigenous breeding season transient; NN = non-native permanent resident; W = winter visitor.
(2) End = Federally endangered; T = Federally threatened; MBTA = protected by the MBTA.

In addition to the nine introduced bird species documented by KWP biologists, two other introduced species documented by Nishibayashi (1997 and 1998) could also occur at the KWP II project area. The two species are the northern cardinal (*Cardiinalis cardinalis*) and the house finch (*Carpodacus mexicanus*).

Mammals: Based on information provided by Maui DLNR staff and KWP biologists, mammals occurring in the vicinity of the project area likely include the house mouse (*Mus musculus*), rats (*Rattus* spp.), axis deer (*Cervus axis*), small Indian mongoose (*Herpestes auropunctatus*), feral cat (*Felis silvestris*), and feral dog (*Canis lupus*). No evidence of dogs has been documented in the project area since KWP began operations in June 2006 and only a few reports of deer have been received during the same period. None of these species are native to Hawaii.

Molluscs: No federally listed species of snails were found during the molluscan surveys conducted at the KWP II project area (Severns 2009a, 2009b, 2010; Appendix 2). Only one native snail species was found within the Alternative 1 area – *Succinea mauiensis* (Family: Succinidae). *Succinea mauiensis* is found in dry habitats and has a wide range on East and West Maui. Within the KWP II project area, specimens were found only on the underside of undisturbed rock outcroppings or in the root mat of grasses beneath rocks. The species was uncommon in the pasture and more common at the upper edges of the gulches. The species is also likely to be present in similar habitats within Kaheawa Pastures (Severns 2009b). No living snails, shells, or fossils were found during the supplemental survey of the underground collection system, BESS and substation enclosures, expanded O & M building, and water storage tank facilities (Severns 2010).

Severns (2009a) found no evidence of snails (fossil or extant) during his survey of the Alternative 2 area. This area is considered to have unsuitable habitat for native snails (Severns 2009a).

3.11.2 Federally Listed Species (Covered Species)

Four Federally listed species – three birds and one bat – have the potential to occur in, or fly over, the KWP II project area. Two of the birds, the Hawaiian petrel and Newell's shearwater, are seabirds that are only expected to fly over the project area and only during their breeding seasons. The other bird, nene, is known to occur in or in the immediate vicinity of the project area year-round. These four species (referred to as Covered Species) and their listing status are identified in Table 3-6. Natural

history information for each species and a summary of investigation into status of each species in the KWP II project area is provided below.

Table 3-6. Federally listed species (Covered Species) with potential to be impacted by the KWP II project.

Scientific Name	Common, Hawaiian Name(s)	Date Listed	Status[1]
Birds			
Puffinus auricularis newelli	Newell's shearwater, ao	10/28/1975	T
Pterodroma sandwichensis	Hawaiian petrel, uau	3/11/1967	E
Branta sandvicensis	Hawaiian goose, nene	3/11/1967	E
Mammals			
Lasiurus cinereus semotus	Hawaiian hoary bat, opeapea	10/13/1970	E
(1) E = Federally endangered; T = Federally threatened.			

3.11.2 (a) Hawaiian Petrel

Population, Biology, and Distribution

Hawaiian petrel was historically abundant on all the main Hawaiian Islands except Niihau. The population was most recently estimated to be approximately 20,000 individuals, with 4,000 to 5,000 breeding pairs (Mitchell et al. 2005). Today, Hawaiian petrels breed in high-elevation colonies on Maui, Hawaii, Kauai, and Lanai (Richardson and Woodside 1954; Simons and Hodges 1998; Telfer et al. 1987; DOFAW unpublished data 2006, 2007). Radar studies conducted in 2002 also suggest that breeding may occur on Molokai (Day and Cooper 2002). Breeding is no longer thought to occur on Oahu (Harrison 1990).

Survey work at a Hawaiian petrel colony on Lanai indicates that thousands of birds are present, rather than hundreds of birds as first surmised, and that the size of the breeding colony approaches that at Haleakala, Maui, where as many as 1,000 pairs have been thought to nest annually (Mitchell et al. 2005; Tetra Tech EC, Inc. 2008a, 2008b). Radar counts of Hawaiian petrels on the perimeter of Maui and recent colony detections by KWP researchers suggest that the Maui population may be much higher than the 1,000 pairs previously estimated to nest at Haleakala (Cooper and Day 2003). Hawaiian petrels are nocturnal and subsist primarily on squid, fish, and crustaceans caught near the sea surface. Unlike shearwaters, Hawaiian petrels are not known to dive or swim below the surface (Pitman 1986). Foraging may take place many hundreds of miles from their home islands during both breeding and non-breeding seasons (Spear et al. 1995). Recent studies conducted using satellites and transmitters attached to actively breeding Hawaiian petrels have shown that they can range across more than 6,200 mi (10,000 km) during two-week foraging expeditions (Adams 2008).

Hawaiian petrels are active in their nesting colonies for about eight months each year. The birds are long-lived (ca. 30 years) and return to the same nesting burrows each year between March and April. Present-day Hawaiian petrel colonies are typically located at high elevations above 8,200 ft (2,500 m). The types of habitats used for nesting are very diverse and range from xeric habitats with little or no vegetation, such as at Haleakala National Park on Maui, to wet forests dominated by ohia (*Metrosideros polymorpha*) with uluhe (*Dicranopteris*) understory as those found on Kauai (Mitchell et al. 2005). Females lay only one egg per year, which is incubated alternately by both parents for approximately 55 days. Most eggs hatch in late June or the first half of July (Simons 1985). After hatching, both adults fly to and from sea to feed the nestling and themselves. The fledged young depart for sea in October and November. Adult birds do not breed until age six and may not breed every year, but pre-breeding and non-breeding birds nevertheless return to the colony each year to socialize.

Current Threats

The most serious land-based threat to the species is predation of eggs and young in the breeding colonies by introduced mammalian predators such as small Indian mongoose, feral cats, pigs, dogs and rats. Owls have also been identified as potential predators. Population modeling by Simons (1984) suggested that this species could face extinction in a few decades if predation was not controlled. Intensive trapping and habitat protection has helped to improve nesting and fledging success (Harrison 1983; Ainley et al. 1997). Hodges and Nagata (2001) found that nesting activity (signs of burrow activity) in sites protected from predators on Haleakala ranged from 37.25 to 78.13% while nesting activity in unprotected sites ranged from 23.08 to 88.17%. Nesting success (proportion of active burrows that showed signs of fledging chicks) in protected sites ranged from 16.97 to 50.00%, while nesting success in unprotected sites ranges from 0.00 to 44.00%, averaging 42.4% and 27.1%, respectively (Hodges and Nagata 2001).

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

Three observed direct take of adult Hawaiian petrels have been recorded at KWP since the beginning of operations in January 2006 (First Wind and KWP LLC 2011). The average annual adjusted take at KWP is approximately 0.93 birds (4.96/5.33 years= 0.93 birds/year) for the entire project site or 0.047 petrels/turbine/year.

Occurrence on Maui

Observations by Simons and Hodges (1998), as well as recent observations of birds calling and performing aerial displays consistent with breeding behavior, indicate the presence of Hawaiian petrel nesting colonies in West Maui (KWP LLC 2007, 2008b). Cooper and Day (2003) also observed Hawaiian petrels flying inland over the northern coast toward the mountainous interior of West Maui.

Research and field investigations in support of the KWP HCP confirmed the presence of at least one nesting colony of Hawaiian petrels in West Maui in the lower portion of Kahakuloa Valley and evidence of possibly other small colonies in the West Maui Mountains in the upper portions of Kahakuloa and Honokohau Valleys (Spencer 2009a; Figure 3-4). The colony near lower Kahakuloa Valley was found by DLNR/DOFAW wildlife biologists from Maui, seabird researchers from the U.S. Geological Survey (USGS), and H.T. Harvey and Associates in early July 2007.

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

Occurrence in the Project Area

ABR Inc. conducted radar and night-visual observations in July and October 2009 to document passage rates of seabirds over KWP II during the nesting season (Cooper and Day 2009; Appendix 3). The estimated number of Hawaiian petrel passing through the airspace of KWP II is 6.3 birds/night for the entire spring/summer season and 4.12 birds/night during the fall fledging season. Passage rates in the fall are lower because the visitation rates by adults to feed their chicks decline as much as 80% in the last quarter of the nestling period (Simons 1985).

Spring/summer and fall passage rates of Hawaiian petrels and Newell's shearwaters combined at KWP II are within the range of variability of passage rates observed upslope at KWP over the last 10 years.

However, when comparing passage rates over other areas and islands of Hawaii, passage rates over the KWP and KWP II project areas are lower than the mean rate measured for West Maui (8.7 ± 3.9 targets/hr), East Maui (52.8 ±16.6 targets/hr, Cooper and Day 2003) and are less than 2.5% of the mean passage rates measured on Kauai (131 ± 35 targets/hr, Day and Cooper 2001).

3.11.2 (b) Newell's Shearwater

Population, Biology, and Distribution

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

The most recent population estimate of Newell's shearwater was approximately 84,000 birds, with a possible range of 57,000 to 115,000 birds (Ainley et al. 1997). The largest breeding population of Newell's shearwater occurs on Kauai (Telfer et al. 1987; Day and Cooper 1995; Ainley et al. 1995, 1997; Day et al. 2003b). However, radar studies on Kauai showed a 63% decrease in detections of shearwaters between 1993 and 2001 (Day et al. 2003a). Breeding also occurs on Hawaii Island (Reynolds and Richotte 1997; Reynolds et al. 1997; Day et al. 2003a) and almost certainly occurs on Molokai (Pratt 1988; Day and Cooper 2002). Recent radar studies suggest the species may also nest on Oahu (Day and Cooper 2008). On Maui, radar studies and visual and auditory surveys conducted over the past decade and more recently suggest that one or more small breeding colonies are present in the West Maui Mountains in the upper portions of Kahakuloa Valley (Spencer 2010).

Newell's shearwaters typically nest on steep slopes vegetated by uluhe fern (*Dicranopteris linearis*) undergrowth and scattered ohia trees (*Metrosideros polymorpha*). Currently, most Newell's shearwater colonies are found from 525 to 3,900 ft (160 to 1,200 m) above mean sea level, often in isolated locations and/or on slopes greater than 65 degrees (Ainley et al. 1997).

The birds nest in short burrows excavated into crumbly volcanic rock and ground, usually under dense vegetation and at the base of trees. A single egg is laid in the burrow and one adult bird incubates the egg while the second adult goes to sea to feed.

Once the chick has hatched and is large enough to withstand the cool temperatures of the mountains, both parents go to sea and return daily to feed the chick. Newell's shearwaters arrive at and leave their burrows during darkness and birds are seldom seen near land during daylight hours. During the day, adults remain either in their burrows or at sea some distance from land (Ainley et al. 1997).

First breeding occurs at roughly six years of age, after which breeding pairs produce one egg per year. A high rate of non-breeding is found among experienced adults that occupy breeding colonies during the summer breeding season, similar to some other seabird species (Ainley et al. 2001). No specific data exist on longevity for this species, but other shearwaters may reach 30 years of age or more (Bradley et al. 1989; del Hoyo et al. 1992). The Newell's shearwater breeding season begins in April, when birds return to prospect for nest sites. A pre-laying exodus follows in late April and possibly May; egg-laying begins in the first two weeks of June and likely continues through the early part of July. Pairs produce one egg, and the average incubation period is thought to be approximately 51 days (Telfer 1986). The fledging period is approximately 90 days, and most fledging takes place in October and November, with a few birds still fledging into December (Ainley et al. 1997).

Current Threats

Declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997; Mitchell et al. 2005; Hays and Conant 2007). No Newell's shearwater fatalities have been recorded at KWP in the time since the ITP and ITL were issued in January 2006 (First Wind and KWP LLC 2011).

Figure 3-4. Seabird Colonies in West Maui.

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

Occurrence in the Project Area
ABR Inc. conducted radar and night-visual observations over the KWP II project area in July and October 2009 (Cooper and Day 2009; Appendix 3). The estimated number of Newell's shearwaters passing through the airspace of KWP II is 4.2 birds/night for the spring/summer season and 2.75 birds/night for the fall. Visitation rates by adults to feed their chicks are expected to decline in the last quarter of the nestling period much like Hawaiian petrels.

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

3.11.2 (c) Nene

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

After nearly becoming extinct in the 1940s and 1950s, the nene population has been slowly rebuilt through captive-breeding programs. Wild populations of nene occur on Hawaii, Maui, and Kauai. The USFWS (2004) estimated that in the early part of this decade, the nene population numbered 1,300 individuals (USFWS 2004). The primary release site on Maui is located at Haleakala National Park on East Maui where 511 nene were released between 1962 and 2003. Since 1995, the majority of Maui releases have been from a release pen in the Hanaula in the region of West Maui in an effort to establish a second population on Maui on this part of the island (KWP 2006). This pen is located near the upper end of the Kaheawa Pastures project area. Since 1994, approximately 104 nene have been released at Hanaula, compared with 18 at Haleakala (USFWS 2004). Additional nene releases have also occurred on Molokai.

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

Nene occupy various habitat types ranging from beach strand, shrubland, and grassland to lava rock, at elevations ranging from coastal lowlands to alpine areas (Banko 1988; Banko et al. 1999). The geese eat plant material, and the composition of their diet depends largely on the vegetative composition of their surrounding habitats. They appear to be opportunistic in their choice of food

plants as long as the plants meet their nutritional demands (Banko et al. 1999; Woog and Black 2001).

Current Threats

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

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

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

To date there have been nine documented nene fatalities associated with WTGs at the KWP project. After adjusting the observed direct take at KWP for the effects of searcher efficiency and carcass removal by scavengers, the estimated total direct take at this facility after five years of operation has been 12.8 birds.

Occurrence on West Maui and the Project Area

The Hanaula release pen is located near the upper end of the existing KWP project area, roughly 1,800 ft (550 m) from the nearest KWP wind turbine. Little is known about the exact distribution and movements of the birds released at the Hanaula release pen, although they have been recorded as far west as Lahaina (approximately 7.7 miles or 12.3 km from the project area) and as far east as Haleakala National Park, indicating that at least some birds from this release site move extensively around the island (KWP 2006). The nene population in this region is monitored under the KWP HCP and survey effort is now well coordinated between DOFAW and KWP biologists.

In 1998, four goslings were successfully fledged from the first nest reported in the area since reintroduction began (DOFAW 2000). Monitoring studies to date at KWP have resulted in discovery of a few nene nests in the vicinity. One successful nest was discovered in 2007 about 330 ft (100 m) to the west of turbine WTG-15. Most nesting activity is observed well to the west and southwest of the KWP area but seldom, if ever, within the KWP II area (Spencer 2008).

Nene presence and nesting behavior has been regularly monitored in the KWP project area prior to and after commencing operation of KWP. Data collected from the incidental surveys and the WEOP program (December 2006 – June 2009), have provided information about nene distribution and behavior at KWP and KWP II. Monitoring of nene during the construction period at KWP (January to June 2006) also documented nene use of the KWP II project area. Both these data sets combined provide over 800 observations (n = 820 individuals) on nene distribution and span over three and a half years[2]. Results show that nene are seen almost twice as frequently (n = 532 individuals) at the KWP area than at the lower elevation KWP II project area (n = 288). Most of the observations were in the upper elevations of the KWP II project area, near the Lahaina-Pali Trail Junction (Mile Marker

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

1.75) and in the vicinity of MECO's 64kV overhead transmission route crossing (Mile Marker 2.25). The birds periodically use the area for browsing and socializing (Spencer 2009b). No nesting is expected to occur within the KWP II project area. In addition to the WEOP observations, systematic surveys were also conducted at KWP and consisted of 116.8 hours of observation time from June 2006 to June 2007. The primary purpose of the systematic surveys was to record nene flight behavior around the existing KWP wind facility. Surveys were conducted in the mornings (6AM – 10AM), afternoons (10AM – 2PM) and evenings (2PM – 6PM). Systematic surveys show that flight activity did not vary with time of day.

Data from the WEOP surveys and systematic surveys combined document that nene frequently fly within the rotor-swept zone (RSZ) of the turbines at KWP (66.1% of all flights observed, n=97) with 16.9% occurring below the RSZ and also 16.9% above. The low mortality of nene observed at KWP is attributable to their diurnal flight behavior, detection capacity, and maneuverability which, under most conditions enable them to successfully avoid the turbines and met towers (Spencer 2008). Two of the documented nene fatalities at KWP were closely correlated with abrupt and severe shifts in environmental conditions that may have reduced their visual acuity and compromised their maneuvering abilities. Weather conditions at the higher elevations of KWP can change rapidly affecting the visibility of the WTGs. As turbine towers at KWP II will be 33 ft taller, the RSZ height is also raised by 33 ft (the area remains the same). Assuming that flight characteristics of nene at KWP II are similar to those observed at KWP, slightly fewer nene (61.3%) are expected to be flying at RSZ height at the KWP II project area, further reducing collision risk. Flock sizes in flight averaged 2.7 birds.

In summary, fewer nene are seen in the KWP II project area compared to KWP. Applying nene behavioral observation at KWP to KWP II, nene may transit through the KWP II project area at any time during daylight hours. As KWP II turbine towers are 33 ft taller than the KWP turbines, fewer nene flocks will fly within the RSZ of the KWP II turbines (61% vs. 66%) and the flight avoidance behavior observed at KWP is expected to further lower the risk of take at KWP II. The greater visibility on-site due to the lower elevation of KWP II (and resulting decrease in the frequency and extent of cloud cover), could also potentially decrease the risk of turbine collision for nene.

3.11.2 (d) Hawaiian Hoary Bat

The Hawaiian hoary bat is the only extant native terrestrial mammal from the Hawaiian archipelago (USFWS 1998). The species has been recorded on Kauai, Oahu, Molokai, Maui and Hawaii, but no historical population estimates or information exist for this subspecies. Population estimates for all islands in the state in the recent past have ranged from hundreds to a few thousand bats (Menard 2001). The Hawaiian hoary bat is believed to occur primarily below an elevation of 4,000 ft (1,220 m), although bats have been recorded between sea level and approximately 9,050 ft (2,760 m) in elevation on Maui, with most records occurring at or below roughly 2,060 ft (628 m) (USFWS 1998).

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

A preliminary study of a small sample of Hawaiian hoary bats (n=18) on the Island of Hawaii found that they have estimated short-term (1-2 weeks) home range sizes of 104.8 ± 94.9 (SD) ac (42.4 ± 38.4 ha) with core areas of approximately 13.3 ± 13.6 (SD) ac (5.4 ± 5.5 ha, USGS, unpublished data). The size of home ranges and core areas varied widely among individuals. Core areas included feeding ranges that were actively defended, especially by males, against conspecifics. For some individuals, core areas included night roosts, but typically did not include day roosts. Roosting and feeding areas may be disjunct as the average long-axis (maximum length of home range) was 2.7 ± 2.9 (SD) mi (4.4 ± 4.6 km), with a maximum length of 11.1 mi (17.8 km), indicating that some individuals travelled long distances between roosting and feeding areas.

It is thought that breeding occurs primarily between April and August. Breeding has only been documented on the Islands of Hawaii and Kauai (Baldwin 1950; Kepler and Scott 1990; Menard 2001). It is not known whether bats observed on other islands breed locally or only visit these islands during non-breeding periods. Seasonal changes in the abundance of Hawaiian hoary bats at different elevations indicate that altitudinal migrations occur on the Island of Hawaii. During the breeding period, Hawaiian hoary bat occurrences increase in the lowlands and decrease at high elevation habitats. Hawaiian hoary bat occurrences are especially low from June until August in high elevation areas. In the winter, especially during the post-lactation period in October, bat occurrences increase in high elevation areas and in the central highlands, possibly receiving bats from the lowlands (Menard 2001).

Hawaiian hoary bats feed on a variety of native and non-native night-flying insects, including moths, beetles, crickets, mosquitoes and termites (Whitaker and Tomich 1983). They appear to prefer moths ranging between 0.60 and 0.89 inches (16 to 20 mm) in size (Bellwood and Fullard 1984; Fullard 2001). Prey is located using echolocation. Water courses and edges (e.g. coastlines and forest/pasture boundaries) appear to be important foraging areas. In addition, the species is attracted to insects that congregate near lights (USFWS 1998; Mitchell et al. 2005). They begin foraging either just before or after sunset depending on the time of year (USFWS 1998; Mitchell et al. 2005).

Current Threats

The availability of roosting sites is believed to be a major limitation in many bat species. Possible threats to the Hawaiian hoary bat include pesticides (either directly or by impacting prey species), predation, alteration of prey availability due to the introduction of non-native insects, and roost disturbance (USFWS 1998). Management of the Hawaiian hoary bat is also limited by a lack of information on key roosting and foraging areas, food habits, seasonal movements and reliable population estimates (USFWS 1998).

In their North American range, hoary bats are known to be more susceptible to collision with wind turbines than most other bat species (Johnson et al. 2000; Erickson 2003; Johnson 2005). Most mortality has been detected during the fall migration period. Hoary bats in Hawaii do not migrate in the traditional sense, although as indicated, some seasonal altitudinal movements occur. Currently, it is not known if Hawaiian hoary bats are equally susceptible to turbine collisions during their altitudinal migrations as hoary bats are during their migrations in the continental U.S.

To date there has been two documented Hawaiian hoary bat fatalities at KWP. When adjusted for unobserved take, this equates to a total direct take of 6 bats since project operation or an average of 1.2 bats/year (First Wind and KWP LLC 2011).

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

On Maui, this bat is believed to occur primarily in moist, forested areas, although little is known about its exact distribution and habitat use on the island, especially in the West Maui Mountains. No Hawaiian hoary bats were recorded in the area of the proposed WTGs during nighttime visual studies using night vision equipment conducted in summer 1999 (Day and Cooper 1999) or fall 2004 (Cooper and Day 2004a). Hawaiian hoary bats are not expected to breed or roost in the project area because the mixed grassland/ shrubland vegetation does not provide appropriate habitat for such behaviors. Some potential exists for bats to roost in woody vegetation in the gulches on either side of the project area. Bats are likely to use the KWP II area for foraging only.

Since the HCP for KWP was approved and the existing facilities began operation in the summer of 2006, KWP has carried out regular bat monitoring in accordance with the provisions of its HCP. The results of these observations as summarized below have greatly increased the information that is available on the presence of the Hawaiian hoary bat at Kaheawa Pastures and confirm that the species is present, at least seasonally, in low numbers in the KWP II project area. Due to their proximity to each other and some similarities in habitat structure at KWP and KWP II, it is expected that bat activity at KWP II will likely be comparable.

Visual Surveys for Flying Bats. In accordance with the provisions of the KWP HCP, KWP biologists carried out regular crepuscular and nocturnal surveys aimed at recording bat activity at Kaheawa

Pastures from June 2006 through June 2007. During this period, KWP biologists performed 32 surveys totaling nearly 116 hours of observation effort in and around the KWP site and adjacent countryside. Initially, surveys were conducted in the vicinity of each of the wind turbines on the site; however, the survey area was extended to include some of the adjacent gulches (KWP LLC 2007). The sites were surveyed during winter and spring seasons and under a range of weather and survey conditions. Though there often appeared to be abundant aerial insect prey and favorable wind conditions for flight in the sheltered gulch areas (and occasionally on the plateaus), no positive observations of Hawaiian hoary bats were made during either survey period (KWP LLC 2007, 2008a). Between July 2007 and June 2008, visual surveys for bats continued at KWP. Two separate bat sightings were reported by contractors between July 2007 and June 2008. One observation occurred on the access road before the Lahaina-Pali Trail on February 20, 2008 and the other at the O&M building on April 5, 2008 (KWP LLC 2008a). KWP biologists conducted interviews and in both cases identification of these individuals could not be confirmed, but these sightings are consistent with other confirmed records of occurrence in the project area.

Visual Surveys for Downed Bats. KWP biologists also looked for bats as part of their year-round monitoring aimed at documenting all downed (i.e., injured or dead) Covered Species in the project area. On September 26, 2008, one dead bat was found near WTG 8. Injuries to the bat suggested it had died of physical trauma, presumably having collided with a turbine rotor or the tower. This remains the only observed bat fatality apparently associated with the KWP project since issuance of the ITP and ITL in January 2006.

On-Site Acoustic Monitoring of Bat Activity. Since August 2008, four to eight Anabat detectors (Titley Electronics, NSW, Australia) have been deployed at various locations in Kaheawa Pastures (KWP LLC 2008a, 2009). These detectors record ultrasonic sounds, which are then analyzed using *Analook®* computer software to determine if bat calls were recorded. Thirty-nine confirmed bat passes were recorded by the detectors over the sampling period (Table 3-7). This equates to a detection rate of 0.011 passes/detector/night (39 bat passes in 3,436 detector-nights). This is less than 2% of the detection rates measured during a study being conducted by USGS at Hakalau National Wildlife Refuge on the Island of Hawaii (0.66 passes/detector/night) (Bonaccorso, unpubl. 2008). At KWP and KWP II, bat call sequences were mostly detected between the months of May and November.

3.12 Socioeconomic Characteristics

The proposed KWP II facility is located in Maalaea, within the District of Lahaina, on the Island of Maui. The total resident population of the Island of Maui is 129,471 (DBEDT 2008a). The majority of the resident population lives in the District of Wailuku. The County of Maui Planning Department *Socio-Economic Forecast: The Economic Projections for the Maui County General Plan 2030* (2006) projects Maui Island's de facto population (i.e., the average number of residents and visitor present) will increase from 175,147 in 2005 to 254,448 in 2030, a gain of about 45%.

The nearest community to the proposed KWP II project area is Maalaea, which is approximately two miles (3.2 km) to the east. The most recent estimate of the population of the Maalaea Census Designated Place (CDP), as defined at the U.S. Census Bureau, was approximately 450 individuals. The small town of Olowalu, which is over three miles (4.8 km) to the southwest, has far fewer people. Local development proposals in the *Socio-Economic Forecast: The Economic Projections for the Maui County General Plan 2030* (2006) include the development of sizeable new residential communities at Olowalu and Maalaea (Planning Solutions, Inc. 2010). Resident population figures for selected areas are shown in Table 3-8.

Table 3-7. Summary of bat detector survey data at KWP.

Detector ID #	Location	Survey dates	Operation Days	Total Passes	Total Detection Rate
1	KWP I	08/08/08 - 11/11/08	86	2	***0.02***
2	KWP I	08/08/08 - 11/05/08	86	3	***0.03***
3	KWP I	08/07/08 - 11/05/08	82	2	***0.02***
4	KWP I	08/07/08 - 11/12/08	89	0	0.00
5	KWP I	11/12/08 - 04/07/09	138	0	0.00
6	KWP I	11/12/08 - 04/15/09	138	0	0.00
7	KWP I	11/14/08 - 04/16/09	159	0	0.00
8	KWP I	11/14/08 - 04/04/09	72	0	0.00
9	KWP I	04/28/09 - 05/27/10	343	1	0.00
10	KWP I	05/17/09 - 06/30/10	394	12	***0.03***
11	KWP I	05/07/09 - 05/27/10	307	0	0.00
12	KWP I	04/28/09 - 05/27/10	366	4	***0.01***
13	KWP I	06/02/09 - 05/27/10	324	1	0.00
14	KWP II	06/03/09 - 06/30/10	375	12	***0.03***
15	KWP II	06/03/09 - 05/27/10	314	2	***0.01***
16	KWP I	06/03/09 - 10/23/09	66	0	0.00
17	KWP I	06/24/10 - 06/30/10	7	0	0.00
18	KWP II	05/27/10 - 06/30/10	35	0	0.00
19	KWP I	06/27/10 - 06/30/10	5	0	0.00
20	KWP II	05/27/10 - 06/30/10	16	0	0.00
21	KWP II	05/28/10 - 06/30/10	34	0	0.00
		Total detector nights	**3436**		
		Total passes	**39**		
		Overall detection rate	**0.011**		

Table 3-8. Resident population figures for selected areas.

Area	1980	% change	1990	% change	2000	% change	2005
State of Hawaii	964,691	14.9	1,108,229	9.3	1,211,537	5.1	1,273,278
Maui Island	62,823	45.4	91,361	28.8	117,644	10	129,471
Lahaina District	10,284	41.7	14,574	23.3	17,967	10.5	19,852
Maalaea CDP	--	--	443	2.5	454	--	--
Source: DBEDT (2008a); U.S. Census Bureau (2003).							

West Maui is considered one of Maui's major centers for the visitor industry. In 2007, the total visitor expenditures for the Island of Maui were $3,468 million, or approximately 27% of the total statewide visitor expenditures during that year (DBEDT 2008b).

While Maui is very dependent on the visitor industry, the economy has diversified, as shown by the growth of the resident population, housing, and jobs (County of Maui 2006). The island's agricultural industry, principally sugar and pineapple, provides a vital contribution to the economy. In 2004, Maui County had 34,800 ac (14,083 ha) of cane fields and generated a $46.2 million sugar crop. Pineapples were grown on 5,500 ac (2,226 ha) and produced a $28.4 million crop. Other crops were valued at $54.6 million in 2004 (DBEDT 2008a).

In 1999, the median household income in the Maalaea CDP was $53,750 and the median per capita income was $43,571. In 2000, approximately 3.3% of families and 3.7% of individuals in the Maalaea CDP had an income below poverty level. In comparison, throughout the State of Hawaii, approximately 7.6% of families and 10.7% of individuals were considered to be living below poverty level in 2000 (U.S. Census Bureau 2003).

Demographic information indicates that the population of the Maalaea CDP in 2000 was primarily composed of Caucasians (85.9% alone, 3.3% in combination[3]). Asians were the second largest group (6.6% alone, 3.5% in combination). In comparison, the largest group in the State of Hawaii is Asian (41.6% alone, 16.5% in combination) (U.S. Census Bureau 2000).

3.13 Historical, Archaeological, and Cultural Resources

3.13.1 Pre-Historic and Historic Land Uses in the Area

The proposed project is located in the Ukumehame ahupuaa, which is the easternmost ahupuaa in the District of Lahaina. Distinctive features of this ahupuaa are Ukumehame Valley and several inter-valley tablelands. Archaeological evidence suggests that taro was formerly cultivated in irrigated fields on the lowland plains and gulch bottom (Rechtman et al. 2009). The upland tablelands were relatively inhospitable for intensive settlement or agriculture because of their steep and rugged terrain, lack of water sources, and limited access to the ocean. However, the tablelands may have been a resource area for the collection of native birds, used as an access route to the higher elevations of the West Maui Mountains (Tomonari-Tuggle 1998), or used to collected pili grass (*Heteropogon contortus*) as material for house thatching (Planning Solutions, Inc. 2010). By the 1850s, the Ukumehame ahupuaa was primarily used for cattle ranching and sugar cane cultivation (Clark and Rechtman 2006).

Kaheawa Pastures extends from above the proposed KWP II project area to the coast. Clark and Rechtman (2006) concluded that Pre-Contact use of the project area centered on coastal habitation and the exploitation of marine resources. Devereux et al. (1999) described a network of trails that may once have connected the coastal habitation area with inland resource areas. If a Pre-Contact mauka/makai (inland/seaward) trail route traversed Kaheawa Pastures, then it likely accessed inland resource areas, and may have connected to trails leading to other areas of West Maui. Athens (2002) reported that trails likely ran to Site 5232, an inland heiau located on Puu Luau in late Pre-Contact times. Isolated marine shell fragments and an adze fragment observed in the area may have been dropped along such a trail route leading to or from the heiau (Planning Solutions, Inc. 2010).

A greater number of Historic-period sites occur in the vicinity of Kaheawa Pastures. All Historic-period sites may relate to cattle ranching, which was ongoing in the area from the late 1850s to the early 1990s (Tomonari-Tuggle 1998; Planning Solutions, Inc. 2010). The only Historic-period site recorded close to the existing wind energy facilities is a concrete watering trough constructed in 1943 (Site 5402). Other features in the vicinity include a terraced roadbed, a possible privy, and a hoist loche (Planning Solutions, Inc. 2010). In addition, the historic Lahaina-Pali Trail crosses the Kaheawa Pastures area. This trail was constructed around 1841 for horse travel between Wailuku and Lahaina. The trail fell into disuse approximately 50 years later with the construction of a carriage road (Site

[3] In combination with one or more of the other races listed. The numbers and percentages for race "alone or in combination" may add to more than the total population because individuals may report more than one race.

4696) along the coast (Tomonari-Tuggle and Tuggle 1991). The Lahaina-Pali Trail brought numerous historic travelers across the lower slopes of the West Maui Mountains, and it continues to bring modern day visitors to the area as part of the Na Ala Hele Statewide Trail and Access System (Planning Solutions, Inc. 2010).

3.13.2 Archaeological and Historical Features at the Proposed KWP II Project Area

Rechtman et al. (2009) conducted an archaeological inventory survey of approximately 175-ac (71 ha) of land on and around the proposed Alternative 1 area (Appendix 4). The objective of the survey was to create a complete inventory of all archaeological sites and features within the proposed project area and to provide preliminary evaluations of significance for any recorded sites. Previous archaeological surveys conducted in the same general area were also used to supplement the recent survey. These included an archaeological survey report (Tomonari-Tuggle and Tuggle 1991) and a cultural resource management plan (Tomonari-Tuggle 1995), which were prepared for the Lahaina-Pali Trail, a portion of which crosses through the project area. In addition, an inventory survey was conducted for the MECO transmission lines located along the mauka boundary of the Alternative 1 area (Hammatt et al. 1996; Robins et al. 1994).

The survey by Rechtman et al. (2009) identified the following features in the Alternative 1 area:

Lahaina-Pali Trail (and a possible remnant section of its Maalaea branch trail): The Lahaina–Pali Trail is a 4.5-mi long section of a Historic-period trail that once connected the towns of Lahaina and Wailuku. The Trail and the Maalaea branch of the Trail were constructed in 1841 for horse traffic and remained in use until 1891. It is reasonable to assume that during earlier times other trails accessed this area; however the physical evidence of such trails is no longer observable on the surface (Rechtman et al. 2009).

Site 5648: The site was first reported by Rasmussen (2005a, 2005b) and included ten rock formations. Twenty new features were documented during the recent survey, bringing the total number of features at this site to 30. The features are indicative of temporary habitation and may represent recurrent use shelters associated with trail routes. The use of these features probably dates to both Pre-Contact and Historic-period times. The most intensive habitation may have been from 1841 to 1891 when the Lahaina-Pali Trail and its Maalaea branch were in use (Rechtman et al. 2009).

Site 6665: This site is a concrete water trough that was built on December 14, 1943. This water trough is part of a water system developed by Honoula Ranch in Ukumehame in the 1940s. This system provided water for cattle in the once extensive, but arid pastures of this upland area (Rechtman et al. 2009).

3.13.3 Cultural Uses and Resources at the KWP II Project Area

Wilson and Rechtman (2009) prepared a Cultural Impact Assessment (CIA) for KWP II in accordance with the provisions Chapter 343 HRS and the Office of Environmental Quality Control Guidelines for Assessing Cultural Impact. The CIA considered resources in the entire ahupuaa (including its coastal and off-shore resources) and the site's relationship to neighboring lands within the larger region through archival-historical research and oral-historical interviews.

No on-going cultural practices have been identified for the project area. However, the above mentioned archaeological sites may have possible cultural properties that merit preservation. In addition, archival research and oral-historical information indicate that there are two potential traditional cultural properties associated with the KWP II project area and the vicinity. The exposed red dirt Honuaula Ridge is considered to have functioned as a visual marker, or koa, associated with local navigational practices. The second potential traditional cultural property is kulamanu, a place where birds (namely nene, pueo, and uau) historically gathered (and continue to gather) before moving in flocks to other parts of Maui and to Kahoolawe (Planning Solutions, Inc. 2010). The Alternative 1 area is located further from these two potential cultural properties than the Alternative 2 area.

3.14 Utilities and Public Services

3.14.1 Energy

The State of Hawaii uses a higher percentage of petroleum to generate electricity than any other state in the U.S. In 2005, oil was used to produce 80% of electricity sold by the State's utilities (Planning Solutions, Inc. 2010). The remaining electricity generation during that year was supplied by coal (13.9%), municipal solid waste (2.6%), geothermal (2%), hydroelectricity (0.7%), bagasse or sugarcane waste (0.6%), wind (0.1%), and a very small amount from solar photovoltaics. Imported oil costs Hawaii between $2 and $4 billion annually (DBEDT 2008c). As a result, Hawaii pays among the highest electricity costs in the country and faces a high level of energy insecurity due to volatile oil prices and potential for disruptions in petroleum supply and shipping.

Fortunately, Hawaii has abundant renewable resources, including a robust wind resource on several islands. Significant potential for small or distributed wind energy projects is believed to exist throughout the Hawaiian Islands (Global Energy Concepts LLC 2006). It has been estimated that the state has a combined wind energy potential of 1,000,000 kWh (State of Hawaii and Hawaiian Electric Companies 2008). Due to increasing fossil fuel costs, energy security issues, and concerns over climate change, the State of Hawaii is striving to utilize its own renewable energy (M & E Pacific, Inc. 2008). State and Federal government agencies are taking important steps to reduce Hawaii's dependence on fossil fuel. Hawaii's Renewable Portfolio Standards (HRS Chapters 269-91 to 269-95) present a timeline to increase the amount of electricity generated using renewable resources.

According to these standards, each electric utility company that sells electricity for consumption in the State shall establish a renewable portfolio standard of 15% of its net electricity sales by December 31, 2015 and 20% of its net electricity sales by December 31, 2020. A proposal to increase the standard to 40% by 2020 is under consideration by the Hawaii State Legislature.

In January 2008, the State of Hawaii and the U.S. Department of Energy (DOE) signed an agreement to establish the Hawaii Clean Energy Initiative (HCEI). The goal of this agreement is to have 70% or more of the State's energy derived from clean, renewable energy for electricity and transportation by 2030. This goal has the potential of reducing Hawaii's current crude oil consumption by 72% (State of Hawaii and USDOE 2008). Hawaii also passed various House bills (HB2848 CD1, HB 2175 CD1, and SB 988 CD1, HB 2505 CD1, HB 2863 CD1) to promote energy efficiency and renewable energy sources. In October 2008, the State of Hawaii signed an Energy Agreement with the Hawaiian Electric Companies (which includes MECO) to help reach the State's energy objectives by facilitating the production of renewable energy sources on the islands, such as wind resources (State of Hawaii and Hawaiian Electric Companies 2008). The agreement includes a commitment by Hawaiian Electric Industries to encourage and explore the development of known project proposals, including KWP II.

MECO's most recent Renewable Portfolio Standard Status Report to the State of Hawaii PUC states that in 2007 the utility achieved a Renewable Portfolio Standard of 24.7%. In that year, slightly under two-thirds of the electrical energy that was generated in MECO's system using renewable resources came from KWP, with the bulk of the remainder coming from Hawaiian Commercial & Sugar Company (HC&S). The remaining third of the renewable portfolio standard credits that MECO reported to the PUC came from programs that displaced electricity from fossil fuel-fired sources (e.g., solar water heating) and from electrical savings achieved by switching to more energy-efficient technologies such as fluorescent lighting (Planning Solutions, Inc. 2010).

In order to meet the 70% clean energy goal, local renewable energy alternatives need to be developed in Hawaii; a collaborative approach to explore these opportunities between private industry and policymakers is ongoing. Several wind energy facilities are already operating in the islands and others are being proposed (Table 3-9). In 2007, KWP provided two-thirds of the renewable electrical energy generated in MECO's system. KWP II could provide at least 70,000 megawatt-hours of electricity per year (MWh/year) to MECO's system. This is equivalent to well over 5% of the electricity produced on the island in 2007 or enough electricity to power about 7,700 average Maui homes (at 750 kilowatt-hours per month).

MECO provides electrical service to the entire Island of Maui. Two MECO transmission line easements containing three transmission circuits cross the Kaheawa area. The existing KWP facility uses power from the uppermost of the three lines via step-down transformers located at the existing KWP substation. Likewise, power generated by the KWP facility is fed into the MECO grid via those transmission lines. At MECO's request, the proposed KWP II facility would utilize the middle line (the lowermost line in the upper transmission corridor) for extracting the small amount of power it needs and for distributing the power generated by the proposed turbines. MECO requested that KWP II connect to a different transmission line than KWP so as to provide greater redundancy and security to its system (Planning Solutions, Inc. 2010).

Table 3-9. Existing and potential wind energy facilities throughout the State.

Facility Name	Operator	Energy Generated	Island
Lalamilo Wind Farm	Hawaii Electric Light Company	1.2 MW	Hawaii
Pakini Nui	Tawhiri Power, LLC	20.5 MW	Hawaii
Upolu Point	Hawi Renewable Development	10.5 MW	Hawaii
Kaheawa Wind Power (KWP)	First Wind	30 MW	Maui
Auwahi Wind Project (P)	Auwahi Wind Energy LLC	22 MW	Maui
Kaheawa Wind Power (KWP) II (P)	First Wind	21 MW	Maui
Kahuku Wind Power	First Wind	30 MW	Oahu
Kawailoa Wind Power (P)	First Wind	50 – 70 MW	Oahu
Na Pua Makani (P)	Oahu Wind Partners LLC	25 MW	Oahu
Ikaika Wind Power I (P)	First Wind	50 MW	Molokai
Ikaika Wind Power II (P)	First Wind	200 MW	Molokai
Unknown (P)	Castle & Cooke	200 MW	Lanai
Kauai Wind Power (P)	First Wind	10.5 – 15 MW	Kauai
(P) = Potential wind facility			

3.14.2 Hospitals

The nearest hospital to the proposed KWP II project area is the Maui Memorial Hospital in Wailuku. In case of emergencies, paramedic/ambulance services are available from the Wailuku and Kihei areas.

3.14.3 Police and Fire Protection Services

The Maui Police Headquarters is located on Mahalani Street in Wailuku. The KWP II project area is approximately 10 mi (16 km) from the Wailuku Fire Station and approximately 12 mi (19 km) from the Kihei Station. Additional fire stations are located in Kahului and Lahaina.

3.14.4 Water Supply

Water on Maui is supplied by the County of Maui Department of Water Supply. A connection to the County water facilities is not anticipated to be needed for the proposed project.

3.14.5 Wastewater and Solid Waste

Solid waste generated by the residents of West Maui is collected by the County of Maui and disposed of at the County's Central Maui Landfill facility, located approximately 4.0 mi (6.4 km) southeast of

the Kahului Airport. This landfill also accepts commercial waste from private collection companies. The Central Maui Landfill handles roughly 500 tons of waste per day and is the largest disposal facility in the County. The privately-owned DeCoite Landfill located near Maalaea is permitted to receive construction and demolition waste (GBB, Inc. 2008).

Three wastewater treatment facilities occur on the Island of Maui that are owned and operated by the County of Maui, Department of Environmental Management, Wastewater Division (WWD). These are located in Kihei, Lahaina, and Kahului. Several privately operated wastewater treatment facilities also occur on the island (Rollins 2010).

3.14.6 Roadways

Access to KWP II would be provided by an existing State-owned access road from Honoapiilani Highway (State Highway 30), one of Maui's major coastal roadways. Honoapiilani Highway is heavily traveled by tourists and commuters, especially during daylight hours. It connects with other major highways and provides ready access to the harbor facilities at Kahului where the equipment and other construction materials needed for the proposed project would be landed (Planning Solutions, Inc. 2010).

The State Department of Transportation conducts regular traffic counts on Honoapiilani Highway near McGregor's Point (Site ID B740030000611) just a short distance to the west of its intersection with the Kaheawa Pastures access road. The 24-hour volume on August 24th and 25th, 2007 was 24,973 and 25,559, respectively. With one exception, the volume exceeded 1,500 vehicles per hour every hour between 7:00AM and 6:00PM on these two days. The highest volume occurred between 4:00PM and 5:00PM, when on average over 2,100 vehicles were recorded (Planning Solutions, Inc. 2010).

CHAPTER 4: POTENTIAL IMPACTS AND MITIGATION MEASURES

Potential impacts to the affected environment as a result of the Proposed Action/Alternative 1 (issuance of an ITP and approval of an HCP for the proposed KWP II project in the Downroad Siting area), Alternative 2 (issuance of an ITP and approval of an HCP for the proposed KWP II project in the Downwind/Downstring Alternative), and Alternative 3 (non-issuance of an ITP) are discussed in this section. The potential impacts of constructing and operating the KWP II facility are evaluated and discussed in relation to the existing conditions in the proposed project area and on the Island of Maui. In addition to the potential direct and indirect environmental affects, cumulative impacts of the alternatives are addressed.

When applicable, avoidance, minimization, and mitigation measures for activities expected to, or with potential to, adversely impact environmental resources are also discussed. KWP II LLC has coordinated with biologists from USFWS, DLNR-DOFAW, USGS, First Wind, SWCA, and members of the ESRC to identify and select appropriate mitigation measures. The criteria used to determine the most appropriate mitigation measures for the Covered Species are discussed in detail in the *KWP II HCP* (SWCA 2011). Potential impacts of the mitigation measures are also discussed.

4.1 Climate

4.1.1 Alternative 1 (Proposed Action) – Downroad Siting Area

The proposed KWP II project is expected to have a beneficial impact on the climate by decreasing fossil fuel consumption and decreasing greenhouse gas emissions. Burning fossil fuels is known to emit several GHGs which contribute to climate change, mainly carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (ICF International 2008). Of these gases, CO_2 is considered the most important. Present concentrations of CO_2 are believed to be higher than at any time in at least the last 650,000 years, primarily as a result of combustion of fossil fuels (IPCC 2007a, 2007b). It is also very likely that observed increases in CH_4 are also partially due to fossil fuel use (IPCC 2007a, 2007b).

KWP II LLC estimates that the proposed project could provide MECO with at least 70,000 megawatt hours (MWh) of renewable electricity annually, thereby allowing for reduction in oil consumption by an

estimated 138,000 barrels per year (Planning Solutions, Inc. 2010). Eliminating the consumption of this amount of oil would reduce emissions of CO_2, sulfur dioxide (SO_2), and nitrogen oxides (NO_X) by approximately 107 million pounds (48.5 million kg), 0.75 million pounds (0.34 million kg), and 195,000 pounds (88,450 kg) per year, respectively (Planning Solutions, Inc. 2010). Although construction and operation of the facility will result in some emissions of CO_2 (e.g. employee trips, transporting materials, etc.), reductions that would result from replacing fossil fuel-generated power with wind-generated power produced by the proposed project would more than offset these emissions.

WTGs of the type and number that are proposed do not have the potential to affect temperature, rainfall, humidity, or most other meteorological parameters. By altering the atmospheric mixing that occurs as wind passes over a site, the WTGs do have the potential to affect slightly certain aspects of the wind regime; however, KWP II would extract only a small percentage of the wind energy at elevations above ground level and no existing or proposed uses in the area would be affected by minor changes in wind speed and/or velocity.

4.1.2 Alternative 2 – Downwind/Downstring Siting Area

Overall, impacts to climate would be expected to be generally similar to those described for the Proposed Action (Alternative 1).

4.1.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, no adverse impacts to the existing climate would be expected because the facility would not be constructed and operated. This alternative also would not result in the beneficial impacts to climate expected from the Proposed Action and beneficial measures proposed in the HCP would not be implemented.

4.2 Topography

4.2.1 Alternative 1 (Proposed Action) – Downroad Siting Area

Grading would be required for the turbine pads, internal access roads, substation, and control building associated with the proposed KWP II facility. This grading would cause minor alterations of local topography, but no alteration of major topographic features. KWP II LLC will seek permission from DLNR to take advantage of the existing KWP access road from Honoapiilani Highway. Use of this road will assist in reducing the level of topographic disturbance required for the project.

4.2.2 Alternative 2 – Downwind/Downstring Siting Area

Overall, impacts to topography would be expected to be generally similar to those described for the Proposed Action (Alternative 1).

4.2.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, no adverse impacts to the existing topography of the project area would be expected because the wind facility would not be constructed or operated in the project area.

4.3 Geology, Soils, and Geologic Hazards

4.3.1 Alternative 1 (Proposed Action) – Downroad Siting Area

No significant impacts to geological resources or conditions are expected to occur under the Proposed Action. Grading for new roads, WTG pads, and other project components would cause shallow alteration of bedrock in some areas. No significant geologic resources are known or expected to occur in the project area, so geologic alterations are expected to be minor.

Total ground disturbance expected from construction of the proposed project is 43 acres as outlined in Table 2-2 (Planning Solutions, Inc. 2010). Temporary construction activities will include establishment of an on-site construction lay-down area for equipment staging roughly 150 ft x 250 ft (46 x 76 m),

which will be surfaced with gravel to minimize erosion. Grading/scraping will impact soils in the disturbed areas and expose the areas to increased erosion hazard.

The types of soil present in the project area are generally not suited to mechanized production of common field crops without special management. Therefore, potential for agricultural uses of the land is limited and the project is not expected to reduce potential for agricultural productivity in the Kaheawa Pastures area (Planning Solutions, Inc. 2010).

Minimization and/or Mitigation Measures:

All surface alterations associated with the proposed project will comply with applicable construction codes for erosion and sedimentation control during construction. Best Management Practices (BMPs) will be employed to prevent and minimize soil erosion during construction and operation of KWP II, as outlined in Table 4-1. Temporary soil stabilization measures (i.e. silt fences and geotextile mats) will provide immediate protection to reduce erosion potential by retaining sediments within an area. Permanent soil stabilization (i.e. graveling and re-vegetation) will occur in temporarily disturbed areas as soon as practical after final grading. These measures are expected to reduce erosion by holding soil in place and protecting soil from the direct impacts of rainfall, wind, or other soil removing processes. Impacts to soils are expected to be minor because of the use of the BMPs and revegetation of temporarily disturbed areas.

4.3.2 Alternative 2 – Downwind/Downstring Siting Area

Compared to the Proposed Action (Alternative 1), construction of the proposed project in the Downwind/Downstring area would require more earthwork to put in the required road network. The preliminary engineering estimates indicate that Alternative 2 would disturb approximately 60 acres of land due to the extension of the access road. Compared to the Proposed Action, this would result in greater soil disturbance and loss of existing vegetation that holds soil in place, thereby increasing the potential for soil erosion. BMPs outlined in Table 4-1 would also be employed in under this alternative.

Table 4-1. Potential pollutants from construction activities and Best Management Practices.

Pollutant	Source / Activity	BMP
Vegetation/ Rock	Excavation, grubbing, grading, stockpiles	Silt fences, temporary soil stabilization
Soil/ Sediment	Excavation, grading, stockpiles, watering for dust control	Silt fences, protection of stockpiles, natural vegetation, sand bags, construction entrance stabilization, temporary soil stabilization, geotextile mats (internal access road slopes), avoid excess dust control watering
Oil and Gas	Construction equipment, vehicles	Regular vehicle and equipment inspection, prohibition of on-site fuel storage, drip pan for on-site tanker fueling, spill kits
Construction Waste	Construction debris, select fill, paint, chemicals, etc.	Protection of stockpiles, dumpsters, periodic waste removal & disposal, compaction & swales, containment pallets
Concrete Wash Water	Pouring of WTG foundations	Containment in wash water pits, silt fences
Equipment and Vehicle Wash Water	Construction equipment	Containment berms around equipment washing area, off-site vehicle washing
Sanitary Waste	Portable toilets or septic tank	Sanitary/septic waste management
Source: Department of Environmental Services, City and County of Honolulu (1999).		

4.3.3 Alternative 3 – No Action Alternative

Under the no build scenario, no impacts to geologic features or soils would be expected because the wind facility would not be constructed or operated in the project area.

4.4 Water Resources

4.4.1 Alternative 1 (Proposed Action) – Downroad Siting Area

Surface Water
No streams, ponds, wetlands, or other water features occur in areas proposed for construction of the WTGs or associated facilities. The proposed project will result in only slight increases in impervious surfaces; thus, the project will not significantly increase the volume of stormwater runoff leaving the project area. Localized topographic alterations resulting from site grading and the construction of building pads and roads will alter local drainage patterns and stormwater runoff pathways.
During construction, ground disturbance has the potential to increase the level of sediment and other pollutants in stormwater runoff, which could change the water quality of receiving waters. The area most likely to receive stormwater runoff during construction is Malalowaiaole Gulch, which is a dry gulch. Runoff from project components located near the existing KWP facility will likely flow into Manawainui Gulch. Both of these gulches lead to the Pacific Ocean. However, BMPs and general construction management techniques will be implemented (see Table 4-1) to ensure no significant impacts to these areas result from the Proposed Action.

Flooding
Proposed locations for the WTGs and associated facilities lie outside of 100-year floodplains as mapped by FEMA. Minor grading or alterations that will be conducted on-site are not anticipated to affect the natural topography and drainage beyond the local level. Thus, flood hazard will not be increased as a result of the proposed project.

Groundwater
As stated previously, the proposed project will result in only slight increases in impervious surfaces. Because precipitation falling on these impervious surfaces will likely run off to adjacent open lands where aquifer recharge will occur, the slight increase in impervious surfaces is not expected to measurably reduce potential for groundwater recharge. Therefore, no components of the project will adversely affect the quantity of water available in basal groundwater, which is believed to be approximately 1,550 to 2,950 ft below the surface (VEC 2005).

Minimization and/or Mitigation Measures:

Because the area to be disturbed is over an acre, KWP II LLC will be required to prepare a Notice of Intent for construction-related stormwater runoff pursuant to National Pollutant Discharge Elimination System (NPDES) regulations. The NPDES application will identify potential receiving waters for runoff, quantify the anticipated volume of runoff, and identify BMPs that will be used to prevent pollutants from leaving the site. BMPs anticipated to be used for the project are identified in Table 4-1. These practices are designed to prevent toxic substances and other pollutants from reaching receiving waters. The use of silt fences, construction entrance stabilization, geotextile mats, earthen berms, and watering for dust control will retain or contain soil/sediment within the site, thereby reducing the amount of sediment discharged into water bodies. Regular inspection and maintenance of vehicles and equipment, as well as proper containment and storage of potential pollutants, will also minimize or prevent the pollution of storm water runoff.

In addition to these BMPs, the following general construction management techniques will be incorporated to reduce impacts to hydrology, drainage, and water features under the Proposed Action:

- Clearing and grubbing will be held to the minimum necessary for grading, access and equipment operation.
- Erosion and sediment control measures will be in place prior to initiating earth moving activities. Functionality will be maintained throughout the construction period.
- Construction will be sequenced to minimize the exposure time of the cleared surface area.

- Areas that are disturbed during the course of construction will be protected and stabilized according to BMPs approved by DOH following its review of the Construction Stormwater Permit application for the project.
- Control measures (i.e., silt fences, sand bag barriers, sediment traps, geotextile mats, and other measures intended for soil/sediment trapping) will be inspected once weekly during dry periods and repaired as necessary.
- Control measures (i.e., silt fences, sand bag barriers, sediment traps, geotextile mats, and other measures intended for soil/sediment trapping) will be inspected and repaired as needed within 24 hours after a rainfall event of 0.5 inches or greater over a 24-hour period. During periods of prolonged rainfall, daily inspection will occur, unless extended heavy rainfall makes access impossible or hazardous.
- Records for all inspections and repairs will be maintained on site.
- Permanent soil stabilization (i.e., graveling or re-planting of vegetation) will be applied as soon as practical after final grading, as discussed in the KWP II Post-Construction Revegetation and Restoration Plan (Appendix 5). KWP II LLC will coordinate with DLNR and other specialists regarding selection of appropriate species for revegetation.

4.4.2 Alternative 2 – Downwind/Downstring Siting Area

Compared to the Proposed Action (Alternative 1), construction of the proposed project in the Downwind/Downstring Siting Area would require more earthwork (43 vs. 60 total acres disturbed). Greater ground disturbance has the potential to increase the level of sediment and other pollutants in stormwater runoff, which could change the water quality of receiving waters. Areas most likely to receive stormwater runoff are the dry gulches of Manawainui Gulch, Manawaipueo Gulch, Papalaua Gulch, Mokumana Gulch, and Kaalaina Gulch, all of which lead to the Pacific Ocean (Planning Solutions, Inc. 2010). Similar to Alternative 1, BMPs and general construction management techniques would be employed under this alternative.

4.4.3 Alternative 3 – No Action Alternative

Water resources in the area would not be impacted under the No Action Alternative because the wind facility would not be constructed or operated.

4.5 Air Quality

4.5.1 Alternative 1 (Proposed Action) – Downroad Siting Area

The construction, operation, and monitoring phases of the proposed project will result in emission of low levels of air pollutants. These emissions will be temporary or infrequent, and will be generated primarily through combustion of gasoline and diesel fuel for vehicles.

Potential air pollutants that may be emitted (depending on the equipment used) during the construction phase include hydrocarbons (HC), fugitive dust (PM_{10}), CO, NOx, SO_2, and CO_2. These pollutants will be released by equipment during earthmoving operations, by vehicles traveling project roadways, and by vehicles traveling to and from the project area. Emissions will primarily occur locally, intermittently, and at low levels (Planning Solutions, Inc. 2010).

Construction-related emissions will comply with HAR Title 11 Chapter 60.1 regarding air pollution control, specifically Section 11-60.1-33, regarding fugitive dust and the prohibition of visible dust emissions at property boundaries. To minimize any adverse effect on air quality, KWP II LLC will require construction contractors to adhere to specific minimization measures (see below).

Because emissions during the construction phase will be temporary and of relatively low level, and will be minimized by the measures stated above, no significant adverse short-term impacts to air quality are anticipated to result from construction of the proposed project. Therefore, construction of the project is not expected to result in appreciable degradation of air quality.

During operation, including environmental monitoring, there will be minor exhaust emissions from staff and vendor vehicles. The average number of daily vehicle trips during the operation phase of the

project is expected to be roughly 20 (Planning Solutions, Inc. 2010). There will also be minor emissions from periodic use of cranes used for maintenance of the facility components. In addition to the maintenance equipment and vehicle emissions, operation of the electrical substation and BESS equipment will result in minor indirect emissions of greenhouse gases as a result of fossil fuel energy use for electricity. Because vehicle usage in the area will be very low and emissions from operation of the facility will be minor, no significant adverse long-term impacts to air quality are anticipated to result from construction or operation of the proposed project.

The proposed project is expected to result in positive impacts on long-term regional air quality. The 21-MW of power potentially generated by the proposed facility will be able to eliminate the use of approximately 138,000 barrels of oil annually that will otherwise be used to produce conventional power. This will reduce air pollutant emissions associated with the combustion of fossil fuel by the following amounts:

- approximately 107 million pounds (48.5 million kg) of CO_2 annually emitted into the atmosphere;
- approximately 0.75 million pounds (0.34 million kg) of SO_2 annually emitted into the atmosphere; and
- approximately 195,000 pounds (88,450 kg) of NO_X annually emitted into the atmosphere.

Thus, the Proposed Action has the potential to cause a reduction in the emission of major air pollutants that are products of generating electricity through combustion of fossil fuel.
Minimization and/or Mitigation Measures:

Construction BMPs detailed in KWP II LLC's NPDES General Permit Notice of Intent will include measures relative to dust control, including ESC10 (Seeding and Planting), ESC11 (Mulching), ESC21 (Dust Controls), ESC23 (Construction Road Stabilization), and ESC24 (Stabilized Construction Entrances). KWP II LLC will use only water with no chemical additives for dust control.

In order to minimize any adverse effect on air quality, KWP II will require construction contractors to adhere to the following measures:

- Maintain all construction equipment in proper tune according to manufacturer's specifications.
- Fuel all off-road and portable diesel powered equipment, including but not limited to bulldozers, graders, cranes, loaders, scrapers, backhoes, generator sets, compressors, auxiliary power units, with motor vehicle diesel fuel.
- Maximize to the extent feasible, the use of diesel construction equipment meeting the latest certification standard for off-road heavy-duty diesel engines.
- Minimize the extent of disturbed area where possible.
- Use water trucks or sprinkler systems in sufficient quantities to minimize the amount of airborne dust leaving the site.
- Cover or continuously wet dirt stockpile areas containing more than 100 cubic yards of material.
- Implement permanent dust control measures identified in the project landscape plans as soon as possible following completion of any soil disturbing activities.
- Stabilize all disturbed soil areas not subject to revegetation, paving, or development using approved chemical soil binders, jute netting, or other methods.
- Lay building pads and foundations as soon as possible after grading unless seeding or soil binders are used.
- Limit vehicle speed for all construction vehicles moving on any unpaved surface at the construction site to 15 mph (24 kph) or less.
- Cover all trucks hauling dirt, sand, soil, or other loose materials.

4.5.2 Alternative 2 – Downwind/Downstring Siting Area

Compared to the Proposed Action (Alternative 1), construction of the proposed project in the Downwind/Downstring Siting Area will require almost 17 more acres of disturbance due to the more extensive road network. Thus, this alternative would result in greater emissions during the construction and operation periods.

4.5.3 Alternative 3 – No Action Alternative

No change in existing air quality is expected under the No Action Alternative because the wind facility would not be constructed or operated in the project area.

4.6 Noise

4.6.1 Alternative 1 (Proposed Action) – Downroad Siting Area

Construction of the proposed project will produce short-term construction-related noise. Site grading, vegetative clearing, and construction of the various facility related structures will involve the short-term use of graders, excavators, bulldozers, cranes, cement trucks, haul trucks, and other heavy equipment. If construction noise is expected to exceed DOH's "maximum permissible" property line noise levels, KWP II LLC will obtain a permit from the State DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit sound levels in excess of the "maximum permissible" levels. The DOH noise permit does not limit the sound level generated at the construction site, but rather the times at which noisy construction can take place. Development of a few areas of the Downroad area (e.g., the uppermost WTGs) may involve work so close to the property line that a contractor may wish to obtain a State DOH construction noise permit.

Preliminary geotechnical information indicates that the area that will be used for the WTGs at KWP II has numerous areas of rock where mechanical equipment alone may be unable to excavate effectively to achieve the desired civil design. In these locations, the contractor will use small explosive charges (i.e., "drill-and-shoot") to fracture the rock in place. The fractured rock would then be removed and processed into a well-graded mixture in accordance with the geotechnical engineer's specifications and used on-site for surface gravel for access roads, pad construction, and potentially for deeper fills (Planning Solutions 2010).

Because of the substantial area that is involved, it is not practical to determine the precise volume of rock that will require this treatment. The way in which explosives are used is very site-specific, with the magnitude and approximate number of charges tailored to the minimum number required to break up the material sufficiently for it to be removed by heavy equipment. In this type of application, holes are drilled in the unyielding rock, the drill holes are then packed with the explosive material and filled with sand or dirt to contain the fracturing effect of the blast, and then the charges are detonated. Blast mats will be used to prevent material from being inadvertently tossed into the air. Tests will be conducted on the type of explosive material to be utilized and the drill/borehole patterns including depth will be performed for each case to insure sufficient fracturing for the mechanical machine excavation.[4] The impulsive sound levels produced by such operations are not expected to exceed the limit in HAR Chapter 11-46 (Planning Solutions 2010). See Final EIS for more detail.

No occupied homes, businesses, or noise sensitive buildings occur close to project area boundaries. However, as stated in Section 3.13.2, a heiau is located nearby. Construction related impacts to the heiau (including noise impacts) will be monitored by an archaeological monitor that will be present during any development activities (e.g. grading) that occur within 500 ft of the heiau, as required by the *Heiau Preservation Plan* (Tomonari-Tuggle and Rasmussen 2005).

Following construction, the only project components expected to create sound on a regular basis will be the WTGs. Wind turbines produce four types of sound: broadband, tonal, low frequency, and impulsive. Sound emission from modern wind turbines is dominated by the aerodynamic broadband type. Broadband noise occurs as the revolving rotor blades encounter atmospheric turbulence, creating a rhythmical "swishing" sound. Tonal sound occurs at discrete frequencies, such as turbine meshing gears. Low frequency sound is the portion of broadband sound at the low end of the

[4] Blasting will be done in conformance with the "Blasting Guidance Manual", Office of Surface Mining, Reclamation, and Enforcement, U.S. Department of Interior (OSMRE). Blasting will also be conducted in accordance with United Stated Department of Labor departments of Mine Safety and Health Administration (MSHA) and Occupational Safety and Health Administration (OSHA). The contractor will prepare a blasting plan prior to commencing project blasting. This will include sketches of each blast location, drill pattern, delay period and use of a blasting matte. It will also indicate the type and amount of explosive to be used and establishment of a safety perimeter.

frequency spectrum, near the lower limit of human hearing. Low frequency sound can also include infrasound, which is defined as sound below the limit of human hearing (i.e., vibration). Impulsive sound (short acoustic impulses) can be caused by the interaction of WTG blades with disturbed air flowing around the tower of a downwind machine (Rogers and Manwell 2004; Pedersen and Waye 2007). As wind speed varies throughout the day, lower or higher rotational speed of the turbines will result in lower or higher sound levels (van den Berg 2004).

The noise impact of the wind turbines is partially dependent on the ambient sound level. Assessments of the existing background sound levels help to determine whether wind turbine sound will be audible over background sound levels. If ambient sound is high, turbine sound gets lost in the background. Although ambient sound levels can be measured and increases can be estimated, the public's perception of the sound impact of WTGs is in part a subjective determination. Due to the variation in the levels of individual tolerance for sound, there is no completely satisfactory way to measure the subjective impacts of sound from the proposed project (Rogers and Manwell 2004).

D. L. Adams Associates, Ltd. (2009a) used the CadnaA software program to model expected sound propagation from the WTGs. The model assumes a worst case scenario (i.e. meteorological conditions and ground attenuation are favorable to sound propagation). Figure 4-1 shows the predicted sound level contours and sound levels for 45 dBA and higher at locations along the KWP II property lines. Based on the predicted sound levels shown in Figure 4-1, the KWP II project would be in general compliance with the 55 dBA daytime limit. However, the project may exceed the Community Noise Control Rule, Class A nighttime property line sound level limit of 45 dBA. If KWP II LLC wished to be in full compliance with the standard, it could request a variance from the State DOH as provided for in HAR's Community Noise Control Rule (Planning Solutions, Inc. 2010).

The Lahaina-Pali hiking trail, which lies approximately 3,000 ft down slope of the southernmost existing KWP turbine, is the closest noise sensitive area to the Downroad Siting Area. Other than individuals related to the project and users of the Lahaina-Pali Trail, people that would be capable of hearing project-related sound are expected to only be briefly transiting the area. Model results by D.L. Adams Associates, Ltd. (2009a, 2009b) compared the results of the sound propagation model to the existing ambient noise measured near the trail (Table 4-2). The model indicates that sound from the WTGs may be audible along parts of the Lahaina-Pali Trail.

During periods of low wind speeds, the ambient sound environment is not expected to change. During periods of moderate to high wind speeds, KWP II is expected to increase sound levels along the Lahaina-Pali Trail by as much as 13 dB for trail locations that are close to the WTGs (Figure 4-2).

Table 4-2. Predicted WTG and existing ambient sound levels near the Lahaina-Pali Trail.

Measurement Location	Predicted Sound Level[1]	Measured L_{eq} During Moderate Winds[2]	Combined Sound Level[3]	Δ due to New WTGs[4]
L1	47 dBA	42 dBA	48 dBA	+ 6 dB
L2	55 dBA	44 dBA	55 dBA	+ 11 dB
L3	55 dBA	42 dBA	55 dBA	+ 13 dB
L4	49 dBA	43 dBA	50 dBA	+ 7 dB

[1)] Sound levels were predicted from the sound propagation model and do not include ambient sound.
[2)] Approximated sound levels based on the sound measurement results collected during moderate wind speeds.
[3)] Combined sound level is the logarithmic addition of the predicted sound level plus the measured ambient sound level.
[4)] The predicted change (in dB) due to wind turbines is the amount by which the ambient sound environment is expected to increase with the expansion of the KWP II project.

Source: D. L. Adams Associates, Ltd. (2009b).

Figure 4-1. Predicted Sound Levels at Project Site Boundaries from *Final KWP II EIS* (2010).

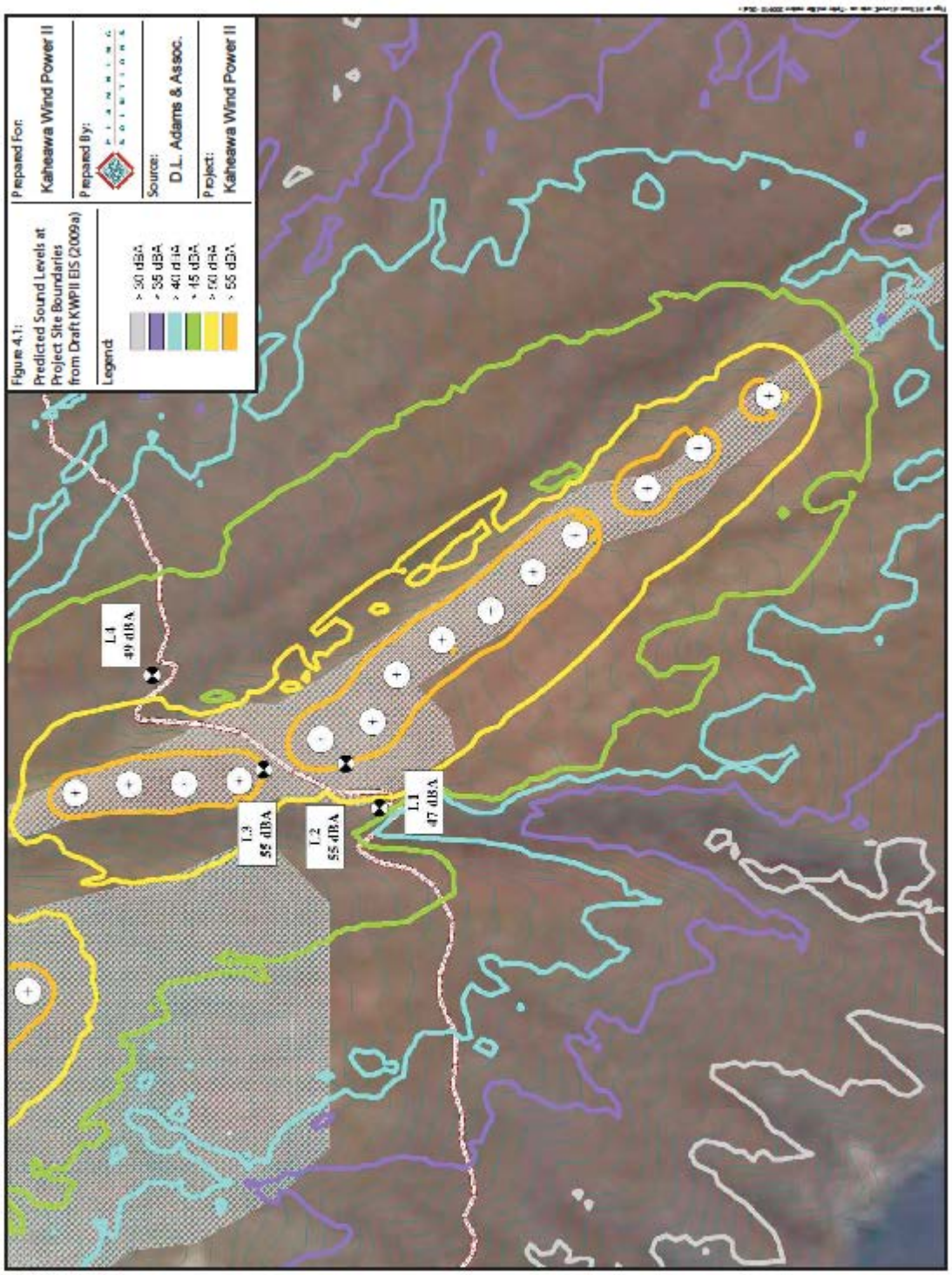
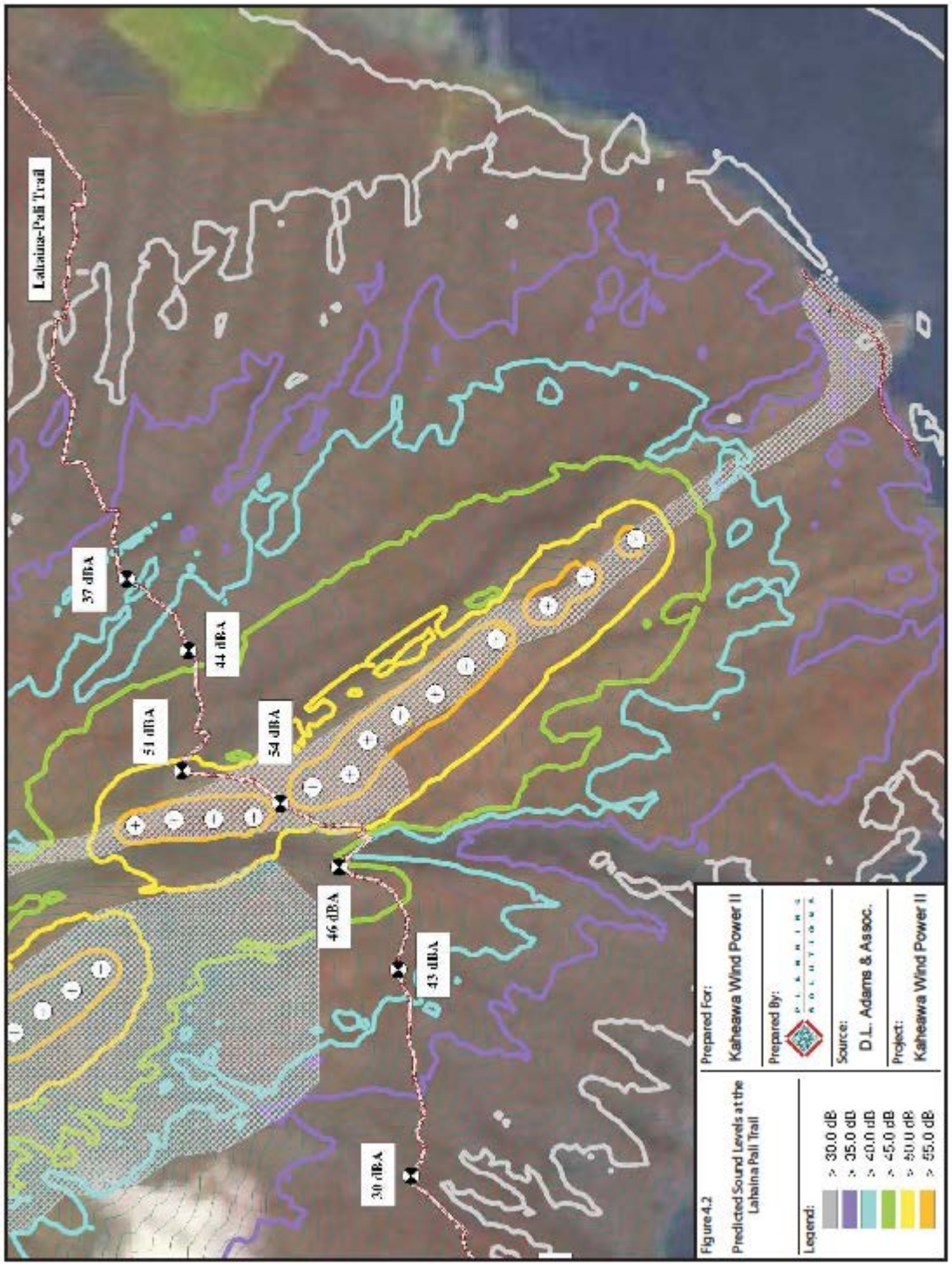


Figure 4-2. Predicted Sound Levels at the Lahaina-Pali Trail.



While this increase may be noticeable at some locations (particularly where the trail intersects between WTG #4 and WTG #5), turbine sound may still be masked by environmental noises. The predicted wind turbine sound levels from the KWP II project are not expected to exceed the DOH daytime maximum permissible noise limit of 55 dBA near the hiking trail (D.L. Adams Associates, Ltd. 2009b), which is when nearly all trail use takes place. Therefore, project-related impacts on trail users would be low and are not anticipated to interfere substantially with enjoyment of the trail (Planning Solutions, Inc. 2010).

Minimization and/or Mitigation Measures:

- The State DOH may require KWP II LLC to incorporate noise mitigation into the construction plan and/or it may require KWP II LLC to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. However, because of the isolated location of the proposed work, the State DOH may deem this unnecessary. If a construction noise permit is granted, KWP II LLC will be required to use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. If construction noise in excess of the standards is allowed, it will be limited to between 7:00 a.m. and 6:00 p.m., Monday through Friday and to between 9:00 a.m. and 6:00 p.m. on Saturday (Planning Solutions, Inc. 2010).
- For noise related impacts during operation of the proposed project under the Proposed Action, it is unlikely that a noise abatement package for the WTGs would reduce the sound levels sufficiently to meet the property line limit fully (D. L. Adams Associates, Ltd. 2009b).

4.6.2 Alternative 2 – Downwind/Downstring Siting Area

Compared to the Proposed Action (Alternative 1), construction of the proposed project in the Downwind/Downstring area would disturb approximately 14 more acres due to the earthwork required to put in the road network. Thus, this alternative would result in greater construction related noise.

During operation, impacts are expected to be roughly the same as the Proposed Action. Modeling indicates that Alternative 2 would be in general compliance with the 55 dBA daytime limit, but may exceed the Community Noise Rule, Class A nighttime property line sound level limit of 45 dBA. Because the area proposed under Alternative 1 is smaller, the WTGs would be closer to the site boundaries and sound produced by WTGs in Alternative 1 may exceed the nighttime property line limit more than Alternative 2.

4.6.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, no change in existing noise conditions would occur in the project area because the wind facility would not be constructed and WTGs would not operate.

4.7 Scenic Resources

4.7.1 Alternative 1 (Proposed Action) – Downroad Siting Area

Impacts to scenic resources were evaluated by determining which facilities would be the most visible and then producing photo-rendering to illustrate the proposed project from selected vantage points. These vantage points include: (1) North Kihei/Maalaea, (2) Wailea, (3) Kapoli Street near Maalaea Harbor, (4) Central Maui, (5) Olowalu, and (6) Lahaina-Pali Trail.[5] Photo rendering of the project as seen from these points are provided in the *Final KWP II EIS*. The proposed WTGs are much taller and bulkier than the other structures associated with the project (e.g., maintenance building, substation, etc.), which are relatively low and resemble existing structures in the area. KWP II LLC also plans to paint these structures earth tone colors that will help blend into their surroundings. The permanent met tower will also be visible, but it is much less bulky than the WTGs. For these reasons, the WTGs

[5] This photo-simulation was done for Alternative 2 only because the trail passes at such a close distance as to make simulations ineffective at representing the appearance of the facilities.

have a much greater potential to affect views and other aspects of the visual environment than other components of the project and so these components were not included in the photo-rendering (Planning Solutions, Inc. 2010).

The WTGs proposed for KWP II are the same shape and color as the immediately adjacent KWP I WTGs, although they are slightly taller (~33 ft). In general, the proposed new WTGs would be more visible from the most populous areas of the island than the existing WTGs. Because the WTGs that will be constructed under this alternative are lower on the hillside and slightly to the east of the existing ones, they will not only be visible from more places, they will appear slightly larger from the closest viewpoints than do the existing WTGs (Planning Solutions, Inc. 2010).

Based on photo-renderings, turbine towers that will be constructed as part of Alternative 1 will not be seen from Honoapiilani Highway due to intervening terrain, but the tips of some blades will be visible to persons looking closely from southbound vehicles once they pass the intersection with Highway 380. Ten or more the proposed WTGs will be visible from all points to the east of Honoapiilani Highway. From Maalaea Harbor, one of the closest vantage points, the nearest WTG will be a little more than a mile away; the distance from the Maalaea Harbor to the uppermost of the WTGs in this alternative is approximately 1.75 miles. Brief descriptions of the photo-renderings from selected vantage points are provided below.

North Kihei/Maalaea: WTGs that will be constructed under this alternative represent an extension of the existing line of WTGs on the hillside in this area. The proposed WTGs appear slightly more distinct and marginally larger, although they do not introduce an entirely new visual element. The distance from this viewpoint to the nearest of the new WTGs is over five miles (8 km).

Wailea: WTGs become indistinct farther from the West Maui Mountains. Because of this, there is no potential for the proposed project to have a significant impact on views from Wailea, which is a little less than 10 miles (16 km) from Kaheawa Pastures (Planning Solutions, Inc. 2010).

Kapoli Street near Maalaea Harbor: The terrain blocks views of the lower part of the WTGs, but the upper portions of most of the towers and virtually all of the blades will be visible (Planning Solutions, Inc. 2010).

Central Maui: The upper portions of the 14 proposed WTGs will be visible along the ridge line. Their appearance is softened both by the distance between the viewpoint (over 5 miles) and by the fact that no more than half the height of any tower is visible. The WTGs are not visually dominant, but they do represent a manmade element that is not now present.

Olowalu: None of the facilities that will be constructed under this alternative will be visible from the developed areas of Olowalu, although some are visible along the shoreline in the Olowalu area. In the photo renderings for KWP II, none of the facilities will be within eyesight of people along the shoreline (Planning Solutions, Inc. 2010).

Lahaina-Pali Trail: Many of the KWP WTGs are visible from the Lahaina-Pali Trail. The additional proposed WTGs will both increase the number of WTGs that can be seen from the trail and decrease the distance between the trail and nearest WTGs, with little natural vegetation to screen them from their presence. The turbine nearest the trail will be 340 ft (104 m) away. The fundamental nature of the views will not significantly change because the additional WTGs are nearly identical in appearance to the existing WTGs (Planning Solutions, Inc. 2010).

Because the proposed WTGs will be built next to existing ones, the KWP II WTGs will not create an entirely new feature on the mountainside, but will add to the cluster that is already visible. For viewers who have grown accustomed to the existing wind farm and have positive attitudes toward renewable energy, the addition is expected to be minimal. On the other hand, many observers consider WTGs an intrusion on views of an otherwise natural landscape (Planning Solutions, Inc. 2010).

Although the proposed permanent met tower is roughly the same height as the proposed WTGs, the met tower is anticipated to only become visible to users of the Lahaina-Pali Trail. This structure will be indiscernible from other vantage points in the area.

4.7.2 Alternative 2 – Downwind/Downstring Siting Area

In general, construction of the proposed project in the Downwind/Downstring Siting Area is expected to have a smaller visual impact on the residents of Maui than Alternative 1. In addition, this alternative would be substantially less visible from the most populous areas of the island than are the existing WTGs. People in most of the areas from which the new WTGs would be visible can already see the existing turbines, and in general the existing turbines are more visible than would be the new array as laid out in this alternative. The area that would experience the greatest visual change as a result of the additional WTGs is Olowalu and the shoreline immediately to the east. However, because of the distance between Olowalu and the closest turbine (approximately 4.3 miles), the proposed new WTGs and other facilities would not significantly alter views even from the few locations where they would be visible.

4.7.3 Alternative 3 – No Action Alternative

No impacts to existing scenic resources would occur under the No Action Alternative because the wind facility would not be constructed or operated in the project area.

4.8 Hazardous Substances and Materials

4.8.1 Alternative 1 (Proposed Action) – Downroad Siting Area

No hazardous substances, materials, or hazardous conditions will be generated or created by the construction of the wind facility. During the construction phase, small amounts of several hazardous materials that require special handling and storage will be transported, used, and stored on-site. These may include such materials as waste aerosols, gel-cell batteries, fuel, combustible liquid materials, chemicals, and paint. Risks of harm will be minimized by requiring the contractor to follow BMPs, including proper containment of staging and stockpiling areas, provision of spill kits, regular waste collection and disposal, frequent equipment inspection, and off-site refueling and vehicle washing at an approved location.

Routine operation and maintenance of the proposed wind facility will involve the use of several materials that require special handling including common lubricants, petroleum products, or other chemical products. The batteries that are part of the BESS system do not contain hazardous materials and are fully contained. Storage of containerized chemical products used for maintenance of the WTGs and substation will be limited, incidental, and contained to the on-site O&M building. Bulk quantities of petroleum products, pesticides, herbicides, fertilizer, or other products will not be stored on-site. Operational releases of hazardous materials will most likely emanate from one of the following areas: the maintenance building, the WTG sites, or the substation and BESS enclosure.

The maintenance building will contain products/materials needed for routine operations and maintenance, including mineral oil (~55 gallons), hydraulic oil (~5 gallons), grease tubes (5 to 6 cases), a waste oil container (~55 gallons), and cleaner/degreaser (~20 gallons). These items will be stored on a spill retentive skid or absorbent sheets. Diesel fuel will be stored in small containers (i.e. 5 gallon capacity) outside the maintenance building (Planning Solutions, Inc. 2010).

Each WTG site will include a gear box, which stores 64 gallons of hydraulic and lubricating oils, and a step-up transformer, which contains approximately 522 gallons of mineral oil. The gear box is contained within the nacelle, which have catch basins capable of containing small oil spills and larger spills would be contained at the tower's base. Each transformer will be built on a foundation which includes appropriate containment capacity and/ or will be surrounded by washed gravel (Planning Solutions, Inc. 2010).

The new electrical substation will store approximately 4,000 gallons of mineral oil. The main transformer will be surrounded by a containment dike. The distribution transformer will be pad-

mounted and surrounded by six inches of ¾-inch washed gravel, and the grounding transformer will be mounted on an aerial platform and also surrounded by 6 inches of ¾-inch washed gravel. As noted previously, the batteries that are part of the BESS system do not contain hazardous materials (Planning Solutions, Inc. 2009a).

Procedures for handling and storing these substances, as well as preventing spills, will be addressed prior to beginning construction and operation in a Spill Prevention, Countermeasure, and Control (SPCC) Plan for the KWP II facility. The SPCC Plan that KWP II LLC will prepare will include emergency contacts, an emergency action plan, organizational roles and responsibilities, site-specific contingency plans, information on hazards analysis, response functions, public information and community relations, as well as information on spill containment and cleanup (Planning Solutions, Inc. 2009a). The SPCC will include the following types of prevention and control measures:

- *Personnel Training:* As required by 40 CFR 112.7(f)(1) and (3), oil handling personnel will be trained to prevent discharges. KWP II personnel will participate in periodic training for oil spill prevention and cleanup. This training will include familiarization with oil pollution prevention measures at the site, the SPCC, and available spill cleanup supplies. Contractors and other transient personnel will be advised of applicable spill prevention measures upon entering the site (Planning Solutions, Inc. 2009a).
- *Security:* Because the project is located in a remote area on State Conservation lands, access to the area is controlled by a locked gate and signage warning that the road is closed to the public. The Lahaina-Pali Trail runs across the access road between WTGs #4 and #5. Signage is in place to warn hikers that the access road is closed to the public and to stay on the trail. The gear boxes are located within the nacelle and require no additional security. The step-up transformers at the individual WTGs sites are located on access roads that are closed to the public. These transformers have pad-locked and wrenched locked cabinets which prevent access to the level gauges and valves that could result in oil discharge. Security fencing and gates are installed around the substation where the largest oil containing transformers are located. These factors ensure that vandalism is a low risk. The existing O&M building is kept locked. The 5 gallon diesel containers are stored outside and in an area that is not easily seen while approaching the building (Planning Solutions, Inc. 2010).
- *Inspection Protocols and Recording:* Facility inspections will be conducted monthly for WTG sites, the substation, all containment structures, and all storage containers. The results will be documented and the records retained in accordance with 40 CFR 112.7(e) (Planning Solutions, Inc. 2009a).
- *Spill Response, Reporting and Cleanup:* KWP II LLC will develop "Spill Response and Reporting Procedures" for the proposed facility. The procedures will specify the clean-up and reporting requirements for small spills (less than 5 gallons) and larger spills (equal to or greater than 5 gallons). If the spill or release cannot be contained, the Maui Fire Department will be contacted. Spill reporting may include notifications to the National Response Center (NRC), U.S. EPA, the State Department of Health Office of Hazard Evaluation and Emergency Response, and the State Department of Land and Natural Resources (Planning Solutions, Inc. 2009a).
- *Transformer Inspections.* The large transformer in the substation will be inspected for rainwater monthly. If there is no sheen present, the rainwater will be pumped out of the concrete pit. If sheen is present, a spill response contractor or facility personnel will provide clean-up (Planning Solutions, Inc. 2009a).
- *Containment Measures:* The SPCC regulations in 40 CFR 112.8(b) require facilities to prevent potential discharges from un-diked areas (such as the land containing the step-up transformers located at the base of each wind turbine) by designing facility drainage systems to flow into catchment basins or lagoons. These areas at Kaheawa Pastures are located such that a spill would not reach navigable waters or cause a violation of water quality standards due to the existing topography and/or the distance to wetlands or surface water (Planning Solutions, Inc. 2010).
- *Spill Prevention Procedures:* No fuel will be transported to or stored at the KWP II facility with the exception of a very small quantity of diesel fuel (~5 gallons). When transferring hazardous products to or from a storage container, personnel will be instructed to load or unload in approved locations only, verify the remaining volume of the receiving container, allow sufficient volume (approximately 10% of the total capacity) in the container for thermal

expansion, and visually inspect all valves for leakage when transfer is complete (Planning Solutions, Inc. 2009a).

Vegetation in the project area is likely to be controlled using mechanical methods; however, in the event that herbicides are used on-site, only herbicides that are registered with the USEPA for the proposed use will be used. All herbicide applications will be carried out by licensed applicators in accordance with approved procedures and product labels.

As stated in Section 4.6, small explosive charges may be used during construction. General safety zones will be established before any explosives are used; all personnel not involved in the actual detonation will stand back at least 1,000 ft (305 m) and workers involved will stand back at least 650 ft from the time the "blast imminent" signal is given until the "all clear" has been sounded. Before any use of explosives, the main access road will be blocked off and flagmen will be posted at the main access roads, the approaches of the Lahaina-Pali Trail, and all other access points so that no one is able to approach closer than 1,000 ft to the work site. The contractor will use an air horn or siren to give the proper "warnings" and "all clear" signals, in addition to radio communication to all perimeter flagmen (Planning Solutions 2010).

4.8.2 Alternative 2 – Downwind/Downstring Siting Area

Overall, impacts to human safety due to hazardous substances and materials would be expected to be generally similar to those described for the Proposed Action (Alternative 1).

4.8.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, there would be no change from existing conditions because the wind facility would not be constructed or operated in the project area.

4. 9 Land Use

4.9.1 Alternative 1 (Proposed Action) – Downroad Siting Area

4.9.1.1 Existing Land Use

The proposed facility will be located in open meadows and adjacent to existing roadways and the existing KWP wind energy generation facility on a remote ridge. Discussions with DLNR staff have indicated that the proposed KWP II project will not interfere with other existing or potential uses of the State land that the proposed facilities will encumber via a proposed lease. The presence of the WTGs, site access roads, substation, and related facilities will not limit access to other land served by the existing access road. The presence of the proposed facilities will not interfere with continuing use of the Lahaina-Pali Trail (Planning Solutions 2010), although the trail will pass through the northern portion of the project area (see Section 3.6.1). The proposed KWP II facilities would be visible from other areas, however, none of these areas are proposed for land uses that might be particularly sensitive to the presence of the WTGs and/or related facilities. Therefore, the Proposed Action is not expected to result in significant impacts to any existing or likely future land uses.

4.9.1.2 Existing Policies and Land Use Plans

The proposed KWP II facility is compatible and comparable to existing land uses in the vicinity and is consistent with all Federal, State, and local land use plans and controls described in Section 1.3.

National Environmental Policy Act
The proposed project is compatible with this Act. See Sections 1.2 and 1.3.1.1.

Federal Endangered Species Act
The proposed project is compatible with this Act. See Sections 1.2, 1.3.1.2, and 4.11.

Federal Migratory Bird Treaty Act
The proposed project is compatible with this Act. See Sections 1.3.1.3 and 4.11.

Federal National Historic Preservation Act
The proposed project is compatible with this Act. See Sections 1.3.1.4 and 4.13.

Executive Order 12898 - Environmental Justice
The proposed project is compatible with this Executive Order. See Sections 1.3.1.5 and 4.12.1.1.

Hawaii State Plan
The sections of the Hawaii State Plan that are most relevant to the proposed KWP II project are Sections 226-18(a) and (b), which establish objectives and policies for energy facility systems. These sections are reproduced and discussed below.

§226-18 *(a) Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:*

(1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;

The proposed project is cost-competitive with traditional fossil-fueled electrical generation and has the associated environmental and economic benefits of reduced air pollutant emissions and enhanced energy independence. The proposed battery storage will significantly enhance the facility's reliability as well. Consequently, it is consistent with this objective (Planning Solutions, Inc. 2009a).

(2) Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;

KWP II will help to increase the ratio of indigenous to imported energy on Maui by harnessing the naturally high winds in the West Maui Mountains (Planning Solutions, Inc. 2009a).

(3) Greater energy security in the face of threats to Hawaii's energy supplies and systems.

The proposed facility will reduce Maui's dependence on imported fossil fuels significantly. The fixed cost of the project will also help buffer the local economy from the fluctuating costs of energy during the KWP II lifespan (Planning Solutions, Inc. 2010).

(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.

As discussed in Section 4.1.1, the proposed project would reduced the emission of several GHGs, mainly CO_2, CH_4, and N_2O. Because wind energy generates little to no emissions, these reductions are significant and in accordance with this objective (Planning Solutions, Inc. 2009a).

§226-18 *(b) To achieve the energy objectives, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable energy services to accommodate demand.*

As previously discussed, the proposed facility will provide clean, cost-competitive electricity to MECO, and its reliability will be bolstered by the battery storage technology KWP II LLC is proposing. Consequently, the project is consistent with this objective (Planning Solutions, Inc. 2010).

Hawaii Revised Statutes, Chapter 195D
KWP II LLC is currently seeking an ITL. A final HCP was approved by ESRC and BLNR and acquisition of an ITL is expected. Therefore, the project is compliant with this statute.

Hawaii Revised Statutes, Chapter 343
As stated in Section 1.3.2.3, the project is subject to HRS Chapter 343 because the project area is located in a State Conservation District and on land that is owned by the State of Hawaii. The public comment period for the State *Revised Draft KWP II EIS* (Planning Solutions, Inc. 2010) ended on January 22, 2010. Feedback and comments on the document were incorporated into the Final EIS,

which was accepted by the Office of Coastal and Conservation Lands (OCCL) on May 19, 2010 completing the State 343 environmental review process. In addition to the FEIS, Kaheawa Wind Power II LLC will also comply with Chapter 343 for any actions conducted under the Habitat Conservation Plan, as required by law.

Hawaii Revised Statutes, Chapter 205

Hawaii Administrative Rules Chapter 13-5-22(P-6) identifies "energy generation facilities utilizing the renewable resources of the area (e.g., hydroelectric or wind farms)" as a "Public Purpose Use." This type of land use is permitted in the General Subzone with the issuance of a Conservation District Use Permit (CDUP) approved by BLNR (Planning Solutions, Inc. 2010). The criteria that DLNR and BLNR will use in evaluating the project are outlined in HAR Chapter 13-5-30(c) and discussed in detail in the State Final EIS (Planning Solutions, Inc. 2010).

KWP II LLC previously obtained a CDUP for the subject parcel in order to conduct meteorological monitoring. The application to obtain a CDUP for the proposed project was submitted to DLNR in December 2009. Public review of the permit application began on February 8, 2010 and a public hearing for the CDUP was conducted by BLNR on March 9, 2010. The CDUP was approved in August 2010.

Hawaii Revised Statutes, Chapter 198D

KWP LLC consulted with the Na Ala Hele Trails and Access Program during development of the existing KWP facility and inputs were used to guide the placement of several WTGs so as to reduce the visual impact of the facility to trail users. The proposed KWP II facility will increase the visual impacts to users of the trail, as stated in Section 4.7. However, due to the anticipated environmental and economic benefits of the proposed facility, KWP II LLC believes that the proposed facility will not compromise the ability of the trail to meet the objectives of the Na Ala Hele Trails and Access program (Planning Solutions, Inc. 2010).

Hawaii's Coastal Zone Management Program

The project area is located more than a mile from the coastline and is not located within a SMA. It does not involve the placement, erection, or removal of materials near the coastline. The project does not require a CZM Federal consistency determination because the type and scale of the action does not have the potential to affect coastal resources significantly (Planning Solutions, Inc. 2009a).

Maui County General Plan

The following section lists the topics outlined in the Draft Countywide Policy Plan that are most relevant to the proposed project and discusses the proposed project's consistency with these topics.

A. Protect the Natural Environment: Development of the proposed facilities would occur in areas dominated by non-native species. In selecting the proposed layout, KWP II LLC specifically ruled out areas to the north with higher concentrations of native plants. KWP II LLC is also proposing to prevent the introduction and spread of invasive species at the project site. Important scenic vistas, and view planes were also considered in selecting the proposed layout (Planning Solutions, Inc. 2009a). Visual impacts are discussed further in Section 4.7.

B. Preserve Local Culture and Traditions: Archaeological inventory and cultural resource surveys were conducted for the entire KWP II project area (Section 4.13). None of the features identified were recommended for further preservation by the archaeologists, and SHPD concurred with this recommendation. Although it is not on the proposed project site, KWP II LLC will comply with the preservation plan that is in place for the heiau on the KWP I site and will notify contractors of its presence (Planning Solutions, Inc. 2009a).

F. Strengthen the Local Economy: Maui County has identified renewable energy as an important emerging industry. As described throughout this document, the project is expected to result in environmental, economic, and community benefits by providing a clean renewable energy source, generating tax and lease revenue, and contributing to Maui's energy independence (Planning Solutions, Inc. 2009a).

I. Improve Physical Infrastructure: The goals and objectives outlined in the Countywide Policy Plan confirm that renewable energy will remain a priority for the County well into the future. KWP II is an example of the type of public-private partnership that Maui County seeks to encourage in expanding its renewable energy portfolio (Planning Solutions, Inc. 2009a).

Community Plans

Several of the opportunities, objectives, and policies identified in the *West Maui Community Plan* are relevant to the proposed KWP II project. The following objectives and policies in the plan are compatible with the proposed project:

- encouraging "alternate energy production (i.e., solar, wind and biomass)" (Section 4.14.1.1);
- preserving and enhancing the "mountain and coastal scenic vistas and the open space areas of the region" (Section 4.7.1);
- preserving the "current State Conservation District and the current State Agriculture District boundaries" (Section 4.9.1);
- ensuring that "new projects or developments address potential impacts on archaeological, historical, and cultural resources and identify all cultural resources located within the project area" and requiring "that all proposed activity adequately mitigate potential adverse impacts on cultural resources" (Section 4.13.1); and
- promoting the "environmentally sensitive use of renewable energy resources, such as biomass, wind, and solar (Sections 4.14.1.1).

The portions of the *Kihei-Makena Community Plan* relevant to the proposed project closely parallel those in the *West Maui Community Plan* discussed above. Consequently, the *Kihei-Makena Community Plan* is not discussed separately. The proposed KWP II project does not conflict with existing or planned land uses outlined in the *Kihei-Makena Community Plan* (Planning Solutions, Inc. 2009a).

4.9.2 Alternative 2 – Downwind/Downstring Siting Area

Alternative 2 is compatible and comparable to existing land uses in the vicinity and is consistent with Federal, State, and local land use plans and controls.

4.9.3 Alternative 3 – No Action Alternative

No change in existing land use would occur under the No Action Alternative because the project would not be constructed or operated. It is possible that land in the project area could ultimately be used for some other purpose if the KWP II facility is not constructed; however, there are no planned land uses identified in any state or local plans for the project area and uses would be limited to those permitted in a Conservation District.

4.10 Flora

4.10.1 Alternative 1 (Proposed Action) – Downroad Siting Area

Construction of the facility will have a minor impact on existing flora at the project area due to ground clearing. The proposed roads, construction activities, and regular operation of the proposed project will result in disturbance of approximately 43 ac of the 143-ac project site. Non-native vegetation may also be removed from search plots if such vegetation creates unsearchable conditions within the required search areas. Vegetation in areas that will be disturbed consists of grassland composed primarily of non-native grasses and forbs, especially molasses grass, mixed with very low densities of shrubs and sub-shrubs.

As stated in Section 3.10, all individuals of *Eragrostis deflexa* were recorded outside of the project area on the steep slopes of Manawainui Gulch. However, to avoid impacts to this native grass during construction, known populations will be resurveyed prior to construction and orange fencing and/or signage will be placed around accessible populations to avoid direct or indirect impacts. Additionally, all construction contractors and personnel will be briefed on the presence of the species during the environmental training program.

Excavation of the trench will result in the loss of some native vegetation between proposed WTGs 12 through 20, and existing KWP WTGs 13 through 20. The exact trenching route will be microsited to avoid remnant native plant communities when feasible. Much less native vegetation will be impacted by the proposed substation and BESS (near WTG 12) and the extension of the O&M building, as these two sites are nearly entirely covered with non-native grasses (Hobdy 2010).

No state or federally listed threatened, endangered, or candidate plant species have been documented on-site (Hobdy 2006a, 2009, 2010). Due to the general condition of the habitat and the specific lack of any environmentally sensitive native plant species on the project site, the proposed KWP II project is not expected to result in any significant adverse impact on botanical resources in this part of Maui. The proposed project will have provide a net benefit to potential habitat for future recruitment of rare and/or listed plant species.

Invasive Species

Executive Order 13112 was signed to prevent the introduction of invasive species and provide for their control. According to this Executive Order, an invasive species is defined as "an alien species (a species that is not native to the region or area) whose introduction does or is likely to cause economic or environmental harm or harm to human health." HRS Chapter 152 (Noxious Weed Control) also prohibits the introduction or transport of "specific noxious weeds or their seeds or vegetative reproductive parts into any area designated pursuant to section 152-5 as free or reasonably free of those noxious weeds" (§152-3). A list of plant species designated as noxious weeds by the Hawaii Department of Agriculture (DOA) for eradication or control purposes is provided in HAR, Title 4, Chapter 68.

The Kaheawa Pastures region is particularly prone to the ingress of invasive flora in part due to its propensity for periodic wildfires and the widespread occurrence of aggressive pasture weeds. The area receives a significant amount of wind-borne seeds from adjacent lands that harbor invasive species capable of quickly becoming established in burned landscapes.

Fire Hazard

Flora in the area will continue to be at risk from naturally occurring wildfires because of invasive, fire-prone grasses on-site. The Proposed Action will not enhance the existing fire hazard; however, construction and operation of the project will involve materials/equipment and activities (e.g., petroleum-fueled equipment, petroleum-based lubricants, sparks from vehicles) that will slightly increase the potential for fire. Measures to control fire hazard are discussed below.

Minimization and/or Mitigation Measures:

- Revegetation: The KWP II Post-Construction Revegetation/Restoration Plan (Appendix 5) is intended to meet the dual goals of 1) stabilizing disturbed areas immediately following construction, and 2) re-introducing and establishing several native plant species throughout the site as a longer-term effort. KWP II LLC proposes to accomplish phase one by hydroseeding with annual rye (*Lolium multiflorum*) to establish an initial cover of vegetation along the edges of turbine pads, road cuts, and fill slopes. Annual rye grass is expected to provide rapid cover that will gradually die back and allow recruitment of neighboring species. All hydroseeded areas will be monitored and irrigated for a 90-day period following hydroseeding. A final inspection of hydroseeded areas will occur six months post-application for the presence of problematic and/or invasive species. Certain sections of the site, notably the turbine pads and road cuts, will be stabilized with hard materials (e.g. rip-rap and compacted gravel) or matting rather than vegetation in order to ensure stability or increase searchability of turbine plots for downed wildlife. All gravel or rock brought to the project area will be purchased from a local supplier on Maui to avoid introducing non-native species not present on the island. All gravel and rock will be freshly crushed and loaded from above the ground level of the crushed pile so as not to include any of the substrate that the crush pile is sitting on. Vertical sections of rock/gravel will be sliced off from well below the soil line rather than the surface to reduce the possibility of non-native seeds or invertebrates being present in the material (Penniman 2010). To accomplish the long-term goal, KWP II biologists propose to re-introduce native plants in discrete locations over several years. The specific species,

sizes, densities, and location of native outplantings will be determined in collaboration with DOFAW, USFWS, and other specialists based on site-specific factors such as slope, erosion potential, and substrate. The long-term phase will be considered to be successful if a minimum of 5,000 individual plants are installed during the first three years following construction, with an average survival rate of greater than 75% (i.e. a minimum of 3,750 surviving plants), for all plants one year after installation, as determined by representative sampling of planted areas.

Concerns that revegetation may present foraging opportunities for nene, thereby attracting nene to the vicinity of the WTGs, have arisen during discussions with DLNR and KWP II. Observations by KWP biologists suggest that nene are attracted to grasses only during the emergent phase and hence revegetation will attract nene for only a short period of time. Nene in flight have also been documented to exhibit avoidance behavior of the WTGs (KWP LLC 2008b, 2008c); hence, the attraction risk to nene due to revegetation with grasses is considered minimal. KWP II will work alongside specialists from DOFAW to ensure that revegetation initiatives consider and incorporate all wildlife, forestry, fire and rangeland concerns and are in alignment with the management provisions of the Conservation District.

- Invasive Species Control: KWP biologists co-established the Fireweed Working Group (FWG), a coalition of conservationists on Maui, to address the appearance of fireweed (*Senecio madagascariensis*) in West Maui along with other invasive and incipient vegetation issues and their effect on the landscape of the region, including Kaheawa Pastures. KWP II LLC will support and collaborate with the FWG on existing efforts to control and manage fireweed. Additionally, KWP II LLC will work actively to implement effective measures to minimize and avoid the introduction of invasive species to the Kaheawa Pastures region during development of the proposed project by following the recommendations of invasive species specialists and using appropriate BMPs in accordance with the CDUP. These measures would include a requirement that contractor vehicles transporting materials and equipment from off-site sources must perform a complete vehicle wash-down prior to delivery of materials, and allow inspection of all equipment, materials, and vehicles for invasive or harmful non-native species prior to entering the project area. KWP II will ensure that off-site sources of raw materials will be identified, inspected, and documented in accordance with recommendations for managing materials prior to transport and use. An inspection station at the staging area near the main highway will be established and each vehicle will be inspected upon entry. Each vehicle will be inspected to screen for collections of excessive debris or plant materials prior to authorizing traveling up to the site. At the end of the construction period, all earthmoving equipment leaving the project area will be washed down prior to leaving the project area. KWP II LLC will consult with the Hawaii DOA and Maui Invasive Species Commission (MISC) to establish protocols and training orientation methods for screening, determine the best means of preventing invasive species introductions, and identifying control strategies for undesirable species, should they emerge.

  For the first two years after construction, areas impacted by construction of the project will be monitored every six months by a qualified botanist for the presence of problematic and/or invasive species. This monitoring will be designed to enable early detection/rapid response of any new problematic and/or invasive species accidentally brought into the project area during construction. Problematic and/or invasive species include MISC's priority target species, species listed as noxious by the State of Hawaii DOA, and other species considered to be potentially problematic by the qualified project botanist. If a problematic and/or invasive species is detected during this monitoring, KWP II LLC will immediately notify DLNR and USFWS. Following consultation with DLNR and USFWS, appropriate remedial actions will be undertaken to contain or eradicate the target species, as soon as reasonably possible. Additional invasive species control protocols associated with post-construction revegetation/restoration are described in the previous section.

- Fire Prevention: Fire prevention measures for KWP II were adopted from the detailed Fire Contingency Plan for KWP I (dated June 17, 2005). The plan outlines three primary means of preventing fires in the project area and the vicinity: vegetation maintenance; availability of firefighting equipment; and education and implementation of fire prevention policies. KWP II

LLC will coordinate closely with DOFAW to ensure that appropriate vegetation control is implemented to control fire hazards. Vegetation in the immediate vicinity of project components will be appropriately maintained or cleared to provide fuel breaks around project components. Earthmoving equipment present on-site during construction will also be able to assist in creating fire breaks (Planning Solutions, Inc. 2010). Fire-fighting equipment will be readily available on-site. All project vehicles will be equipped with portable fire extinguishers as a first response option. Portable fire extinguishers, as well as shovels and backpack pumps, will also be available in the existing KWP O&M building and substation. Finally, the existing water tank at KWP and the proposed water tank for KWP II will be available for fire-fighting if necessary (Planning Solutions, Inc. 2010). All on-site contractors and personnel will be educated on fire prevention policies including: methods to contact the Department of Fire Control and 911; prohibiting open fires in the project area; and refraining from driving and parking over dry vegetation. Routine checks of electrical connections and proper maintenance of all vehicles, equipment, and tools by personnel will further reduce the risk of fires in the project area (Planning Solutions, Inc. 2010).

- Enhancement of mid-elevation native plant habitat: The area to be disturbed during construction of the KWP II facility is former pasture that was converted from native plant communities well over 100 years ago, and is currently dominated by a mixture of native and non-native grasses and low shrubs with scattered small trees. The area is prone to periodic wildfires, which suppress native plants and favor the spread of non-native, fire-tolerant grasses. Several native plant species are spread throughout the project area, mixed among the grasses, but are less prevalent at the lower, drier parts of the project area where fires have occurred more recently (Hobdy 2009b, June 2010). At KWP II, native plants are more prevalent in the rocky habitat bordering Manawainui and Malalowaiaole Gulches (Hobdy 2009a, 2009b). As stated above, construction of the proposed KWP II facility will disturb approximately 43 ac (17 ha) of land and approximately one third of the disturbed area will be revegetated upon completion of earthwork. Turbine pads, as well as some portion of the road cuts, will be stabilized with hard materials (e.g., rip-rap and compacted gravel) rather than vegetation in order to ensure stability or increase searchability of turbine plots for downed wildlife.

  KWP biologists have had considerable success reintroducing nursery grown native plants at various locations throughout KWP I, including along cut and fill slopes and other open earth portions of the roadsides and turbine pads. These outplantings and their propagules have become the dominant botanical cover in the areas treated and after 5 years time have enabled other recruits of native species to take hold in these areas. KWP II biologists propose to re-introduce native plants at the project site in discrete locations over several years, with the intent of eventually re-establishing some key species of plants that existed historically and/or at the time of project construction. This may involve collecting native seeds and cuttings in the area, propagating these at local nurseries, and subsequently outplanting these species at the site. If native species are selected that did not occur before construction, but are believed to be good candidates for reintroduction, these will be reviewed in advance to be sure they will thrive and not represent a nuisance by creating an attractive habitat feature that could increase the risk of take for the Covered Species.

  Native species that may potentially be used in the reintroductions at KWP II include species identified in the botanical assessments of the area such as aalii (*Dodonaea viscosa*), pili grass (*Heteropogon contortus*), ulei (*Osteomeles anthyllidifolia*), and ilima (*Sida fallax*). These relatively fast-growing and easily propagated species provide excellent root structure for maintaining surface substrate retention, as well as provide a native seed source for the project area. Pili grass and aalii are particularly appropriate for the conditions at Kaheawa Pastures because these species are among the few native Hawaiian plants shown to be fire tolerant (Tunison et al. 1994, Loh et al. 2009), appear resilient enough to withstand extensive periods of time between rain events, and may function to retain recruits of rare native species, should they emerge.

  The specific locations of native outplantings will be determined based on site-specific factors such as the size of the disturbed area, slope, erosion potential, and substrate. Due to physical

constraints of the site (i.e. the presence of surface bedrock material), KWP II may propose to direct some native outplantings outside of the immediate project area (i.e. near the puu), if such locations are deemed to offer a greater ecosystem and/or landscape level benefit. The specific locations of any outplanting areas adjacent to the site will be determined in consultation with DLNR, USFWS, and native plant community specialists.

KWP II biologists plan to approach this phase of the site revegetation plan in a manner that emulates the successful native plant reintroduction efforts at KWP while incorporating the knowledge of past experience working in the region. KWP II will work in collaboration with KWP to share resources and coordinate logistics. Knowledgeable experts will be consulted for their advice and guidance to ensure that appropriate site selection, species, and timing of outplanting will result in the highest probability of establishment.

The longer term revegetation efforts at KWP II are expected to be very successful given the success at KWP. A well-established seed collection and propagation program already exists in cooperation with local nurseries, other native plant specialists, contract landscape specialists, community conservation groups, and volunteers. The entire outplanting effort will be implemented, maintained, monitored, and documented using resources available at KWP II and KWP and in collaboration with community and conservation groups. This effort will be considered to be successful if a minimum of 5,000 individual plants are installed during the first three years following construction, with an average survival rate of greater than 75% (i.e., a minimum of 3,750 surviving plants), for all plants one year after installation, as determined by representative sampling of planted areas. If mortality exceeds 25%, replacement plantings will be installed as needed to achieve the 75% minimum.

In summary, the proposed project is not expected to have a significant impact on botanical resources because the vegetation in the Downroad Siting Area is dominated by non-native grasses, with scattered herbaceous species and low-growing shrubs (Hobdy 2009a). However, the project will result in the loss of some native vegetation within portions of the project area and KWP II LLC will re-introduce native plants in discrete locations of the project area over several years. To minimize impacts to existing native plants that occur in the project area and the vicinity, KWP II LLC will implement effective measures to minimize and avoid the introduction of invasive species to the area such as screening vehicles, equipment and raw materials. Furthermore, educating staff on fire prevention and response measures, as well as having fire-fighting equipment available on-site, will also minimize risks to flora. Thus, revegetation, invasive species control measures, and fire prevention measures are anticipated to reduce potential impacts to native flora.

4.10.2 Alternative 2 – Downwind/Downstring Siting Area

Construction of the facility in the Downwind/Downstring Siting Area would have a minor impact on existing flora (Hobdy 2006a, 2009b). Throughout Kaheawa, native plants are less prevalent at the lower, drier parts of the area where fires have more recently occurred (Hobdy 2009b). Thus, impacts to botanical resources would be greater in the Alternative 2 area than in the Alternative 1 area.

Similar mitigation and minimization measures would be implemented under this alternative. Roughly one third of the approximately 60-acre area that would be disturbed under the Alternative 2 would be revegetated upon completion of earthwork. The remainder would have either a gravel or concrete cover. Similar to Alternative 1, KWP II LLC proposes two stages of revegetation/restoration for Alternative 2. However, under this alternative, KWP II LLC proposes to install 10,000 individual plants during the first three years following construction (rather than 5,000) due to the greater number of native plants in the area and the greater amount of disturbed area.

4.10.3 Alternative 3 – No Action Alternative

No change in existing floristic conditions would occur in the project area under this alternative because the wind facility would not be constructed or operated.

4.11 Wildlife

Construction and operation of the proposed project has potential to impact wildlife through disturbance of on-site habitats and by creating a potential for collisions with WTGs, met towers, and other project components. The potential for WTGs to adversely affect birds and bats is well-documented in the continental United States (e.g., Horn et al. 2008; Kunz et al. 2007; Kingsley and Whittam 2007; Kerlinger 2005; Erickson 2003; Johnson et al. 2003a, 2003b). Documented avian fatality rates at wind energy facilities differ throughout the world (Erickson et al. 2001) and some species appear to have a higher risk of collision with wind energy facilities than others. For example, passerines are known to have comparatively high fatality rates (Erickson et al. 2001; Kingsley and Whittam 2007), while waterfowl and shorebirds seem to avoid turbines (Curtis 1977; Olsen and Olsen 1980; Kingsley and Whittam 2007; Powlesland 2009).

In the State of Hawaii, wind energy generation facilities are relatively new; thus, few wildlife monitoring impact studies have been conducted to document the direct or indirect impact of wind energy facilities on particular species. Post-construction monitoring to document downed wildlife has been conducted at the KWP facility since operations began in June 2006 (KWP LLC 2008b, 2008c). This information offers the best presently available insight into the potential impacts of WTGs in the adjacent KWP II project area, as well as a means to assess the accuracy of pre-construction mortality estimates made for the KWP II project. No Covered Species were found downed or dead during the first year of construction and operation of the KWP project (KWP LLC 2007, 2008b). During the subsequent years of monitoring (as of September 2011), KWP documented observed direct take of three federally listed species – three adult Hawaiian petrel, nine full-grown nene, and two Hawaiian hoary bats (First Wind and KWP LLC 2011). Other documented fatalities at KWP as of September 2011 include three native bird species protected by the MBTA: two Hawaiian short-eared owls, one great frigate bird, and six white-tailed tropicbirds. Documented fatalities of non-federally listed species not protected by the MBTA as of September 2011 include four ring-necked pheasants, six black francolins, two Eurasian skylarks, one Japanese white-eye, two spotted doves, and one barn owl (Spencer 2011).

Avian fatalities at wind energy facilities are very low compared to the numbers of fatalities resulting from some other human-related causes. Known sources of anthropogenic bird losses outside of wind energy sites include: lighted buildings, windows, communications towers, powerlines, smokestacks, vehicles, cat predation, pesticides, and hunting (Erickson et al. 2001; Martin and Padding 2002; Woodlot Alternatives, Inc. 2003; Mineau 2005). Seabird mortality due to collisions with other human-made objects, such as power lines, has been documented in Hawaii on the Islands of Maui (Hodges 1994) and Kauai (Telfer et al. 1987; Cooper and Day 1998; Podolsky et al. 1998).

In recognition of the growing wind energy industry in the U.S., the USFWS prepared *"Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines"* (USFWS 2003). These guidelines provide recommendations relating to site development and turbine design and operation. Table 4-3 discusses how KWP II LLC plans to comply with these recommendations. These recommendations relate to all wildlife, whether or not they are protected under the ESA or MBTA. If take of any MBTA species occurs, these will be documented in a similar fashion to that applied to any endangered or threatened species wildlife listed under the ESA.

Table 4-3. Compliance of the proposed KWP II facility with the USFWS *Interim Voluntary Guidelines for Wind Projects* (USFWS 2003).

USFWS Interim Voluntary Guidelines Site Development Recommendations	Proposed KWP II Facility
Avoid placing turbines in documented locations of any species of wildlife, fish, or plant protected under the Federal Endangered Species Act	There are no locations on Maui that are both: (a) suitable for a financially viable wind energy generation facility and (b) unlikely to be visited by listed species. Data from the existing KWP facility indicates that occurrence of the Covered Species on the site is relatively low, and take is commensurately at or below the Tier 1 Level identified in the KWP HCP. The proposed KWP II project minimizes habitat disturbance by sharing key infrastructure with KWP and likewise incorporates measures to avoid and minimize risk to Covered Species as much as possible while still meeting the basic project purpose.
Avoid locating turbines in known local bird migration pathways or in areas where birds are highly concentrated, unless mortality risk is low (e.g., birds present rarely enter the rotor-swept area). Examples of high concentration areas for birds are wetlands, State or Federal refuges, private duck clubs, staging areas, rookeries, leks, roosts, riparian areas along streams, and landfills. Avoid known daily movement flyways (e.g., between roosting and feeding areas) and areas with a high incidence of fog, mist, low cloud ceilings, and low visibility.	This recommendation has been followed as much as practicable while still meeting the basic project purpose. Survey data collected to date has shown that birds do not occur in the area in high concentrations.
Avoid placing turbines near known bat hibernation, breeding, and maternity/nursery colonies, in migration corridors, or in flight paths between colonies and feeding areas.	This recommendation has been followed, based on the little information available on Hawaiian hoary bats. The species is not known to hibernate or occur colonially. While a few bats have been confirmed to fly through the project area, no habitat considered suitable for roosting or breeding is present in or adjacent to the project area.
Configure turbine locations to avoid areas or features of the landscape known to attract raptors (hawks, falcons, eagles, owls). For example, golden eagles, hawks, and falcons use cliff/rim edges extensively; setbacks from these edges may reduce mortality. Other examples include not locating turbines in a dip or pass in a ridge, or in or near prairie dog colonies.	This recommendation has been followed, to the extent that it is applicable, by situating the turbines on high ground, outside of the Manawainui Gulch and Malalowaiaole Gulch where most owl activity has been observed. Much like what is observed at KWP, Hawaiian short-eared owls at KWP II are expected to be observed occasionally flying over grasslands of the proposed wind farm, but at low risk of collision with the WTGs and associated structures.
Configure turbine arrays to avoid potential avian mortality where feasible. For example, group turbines rather than spreading them widely, and orient rows of turbines parallel to known bird movements, thereby decreasing the potential for bird strikes. Implement appropriate storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species (e.g., sage grouse).	Turbines have been arranged as closely as feasible, given wind resource and terrain considerations, and in a linear fashion that is generally parallel to the direction of birds moving to and from the ocean. No potentially attractive water features will be constructed for the project.
Avoid fragmenting large, contiguous tracts of wildlife habitat. Where practical, place turbines on lands already altered or cultivated, and away from areas of intact and healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas.	The majority of the natural environment in the project area has been previously disturbed by wildfires, pasturing and grazing uses. Existing areas of native cover types are fragmented and interspersed with disturbed, non-native dominated cover. Nene do utilize open areas and rock outcrops, and the Applicant has micro-sited the proposed WTGs so as not to disturb the features that are most attractive to nene.

USFWS Interim Voluntary Guidelines Site Development Recommendations	Proposed KWP II Facility
Avoid placing turbines in habitat known to be occupied by prairie grouse or other species that exhibit extreme avoidance of vertical features and/or structural fragmentation. In known prairie grouse habitat, avoid placing turbines within five miles of known leks (communal pair formation grounds).	Not applicable - no such species occur in the area.
Minimize roads, fences, and other infrastructure. All infrastructure should be capable of withstanding periodic burning of vegetation, as natural fires or controlled burns are necessary for maintaining most prairie habitats.	This recommendation will be followed. A Wild Land Fire Contingency Plan is in place for KWP and will be administered at KWP II as well (note that controlled burn and prairie considerations are not applicable).
Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species. For example, avoid attracting high densities of prey animals (rodents, rabbits, etc.) used by raptors.	This recommendation will be followed. Revegetation of disturbed areas and other habitat improvement measures will be coordinated with DLNR staff.
Reduce availability of carrion by practicing responsible animal husbandry (removing carcasses, fencing out cattle, etc.) to avoid attracting Golden Eagles and other raptors.	This recommendation is not applicable as golden eagles and other raptors are not species of concern in the vicinity of the project.
Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities. Avoid placing external ladders and platforms on tubular towers to minimize perching and nesting. Avoid use of guy wires for turbine or met tower supports. All existing guy wires should be marked with recommended bird deterrent devices (Avian Power Line Interaction Committee 1994).	This recommendation has been, and will continue to be followed. Tubular towers are being utilized and the permanent met tower will be unguyed.
If taller turbines (top of the rotor-swept area is >199 feet above ground level) require lights for aviation safety, the minimum amount of pilot warning and obstruction avoidance lighting specified by the Federal Aviation Administration (FAA) should be used (FAA 2000). Unless otherwise requested by the FAA, only white strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. Solid red or pulsating red incandescent lights should not be used, as they appear to attract night-migrating birds at a much higher rate than white strobe lights.	KWP II LLC has received approval from the FAA to apply a minimal lighting scheme. Only 4 WTGs and the met tower will be fitted with synchronized red lights, as opposed to all WTGs. Other on-site lighting will be minimal, shielded and used infrequently.
Where the height of the rotor-swept area produces a high risk for wildlife, adjust tower height where feasible to reduce the risk of strikes.	This recommendation is generally not applicable in that the risk of strikes is not demonstrably related to the height of the rotor-swept area. However, the proposed 65-meter towers are the shortest that GE produces for its 1.5 MW machines.
Where feasible, place electric power lines underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Use recommendations of the Avian Power Line Interaction Committee (1994, 1996) for any required aboveground lines, transformers, or conductors.	This recommendation is being followed; all new power lines will be placed underground where feasible. APLIC guidelines for overhead collection lines have been followed.
High seasonal concentrations of birds may cause problems in some areas. If, however, power generation is critical in these areas, an average of three years monitoring data (e.g., acoustic, radar, infrared, or observational) should be collected and used to determine peak use dates for specific sites. Where feasible, turbines should be shut down during periods when birds are highly concentrated at those sites.	This recommendation is not applicable as there is no documented seasonal concentration of birds and no clear pattern of risk seems apparent for nene or seabirds. Though seabirds have been documented passing through the area, their numbers are low compared to other locations on Maui. Nene are present on site year round and flight activity does not vary with time of day. Furthermore, preliminary results of on-going acoustic monitoring of bats at KWP and KWP II indicate low levels bat activity on site between April to November and no activity between December to March.

USFWS Interim Voluntary Guidelines Site Development Recommendations	Proposed KWP II Facility
When upgrading or retrofitting turbines, follow the above guidelines as closely as possible. If studies indicate high mortality at specific older turbines, retrofitting or relocating is highly recommended.	This recommendation is not applicable to the current project as it will be a new facility.

4.11.1 Alternative 1 (Proposed Action) – Downroad Siting Area

4.11.1.1 Non-Federally Listed Species

The proposed project would result in the loss of approximately 43 ac of predominantly grassland habitat composed overwhelmingly of non-native plant species. Birds known to occur in the general area are also mostly introduced (see Table 3-5), with the exception of nene, Hawaiian short-eared owl, and Pacific golden-plover. Non-listed bird species occurring in the project area are largely common and widespread on Maui, and most are tolerant of some degree of development and human presence. The proposed project would reduce the amount of habitat available for non-listed bird species. This could result in the displacement of some individuals and slight reduction in some local numbers. However, because these birds are generally common and widespread, the amount of habitat lost represents a very small part of the total range available to each species. Consequently, any impacts to non-listed bird species are not expected to be significant at the population level. Clearing for the project may be slightly beneficial to Pacific golden-plover because grasslands in the project area are mostly too tall for use by this species; the cleared pads and road edges may provide increased foraging area for some members of this species (SWCA 2010).

Non-listed birds also have potential to collide with WTGs and the met tower. In particular, passerines are known to have comparatively high fatality rates (Erickson et al. 2001; Kingsley and Whittam 2007). Theoretically, any of the bird species occurring in the general project area have potential to collide with the proposed WTGs and met tower. Potential for collision with the met tower will be minimized through the use of streamers and bird diverters (see Section 2.1).

Post-construction mortality monitoring conducted at KWP from June 2006 until September 2011 has resulted in the discovery of several fatalities of non-federally listed birds. This includes four ring-necked pheasants, six black francolins, one barn owl, one great frigate bird, one Japanese white-eye, two spotted doves, six white-tailed tropicbirds, two spotted doves, two Hawaiian short-eared owls, and two Eurasian skylarks (Spencer 2011). No mortality attributable to collision with met towers has been observed. These low numbers suggest that avian collisions with components of the proposed project are likely to be rare events. Consequently, while individual birds are expected to be killed on a very infrequent basis, collisions with the proposed WTGs and met tower are not expected to cause significant impacts to any non-listed avian species at the population level.

The proposed mitigation measures outlined for the Covered Species (Section 4.11.1.2) also have the potential to benefit some non-listed avian species by decreasing their risk of predation by introduced mammals (e.g., rats, mongoose, cats, and dogs). For the Hawaiian short-eared owl, KWP II will provide mitigation to compensate for the impacts that the wind facility may have on the species in the vicinity. Mitigation for possible take of the Hawaiian short-eared owl by KWP II will consist of funding research and/or rehabilitation of injured owls. Therefore, within 60 days of the commercial operation date, KWP II LLC will contribute a total of $25,000 to appropriate programs or facilities such as the Hawaii Wildlife Center, to support owl research and rehabilitation.

Mammals expected to occur in grasslands in the project area are limited to introduced species that are generally considered harmful to native bird species (e.g., rats, mongoose, and feral cats). Non-native mammals can degrade ecosystems by consuming or trampling native flora and fauna, accelerating erosion, altering soil properties, and promoting the invasion of non-native plants (Stone et al. 1992; Courchamp et al. 2002; USFWS 2008). Because native Hawaiian flora and fauna did not evolve with these mammals, native species are not adapted to take advantage of, or protect themselves from, the activities of these animals (Stone 1985; Stone et al. 1992). Some non-native mammals can also be predators of some ESA-listed bird species.

Loss of on-site grassland would reduce the amount of habitat available for mammals in the project area. As with birds, loss of this habitat could result in displacement of some individual mammals and slight reduction in some local numbers. Loss of mammals may also occur occasionally as a result of collisions with project vehicles. Potential to cause adverse impacts to introduced mammals could be considered a positive effect of the Proposed Action, although given the scale of the project, any actual change in local mammal numbers is likely to be so low as to be insignificant. Therefore, the proposed project is generally expected to have a neutral effect on mammals.

The native mollusc documented in the project area is also likely to be present in similar habitats within Kaheawa Pastures; thus, careful planning and caution should be sufficient to protect the species within the project area (Severns 2009). This species may also benefit with the stabilization of the pasture and protection from fire as a result of the development of KWP II (Severns 2009).

4.11.1.2 Federally Listed Species

Construction and operation of the KWP II project under the Proposed Action would create the potential for the Covered Species to collide with the WTGs, temporary and permanent met towers, overhead collection lines, and cranes during the construction phase of the project. Cranes used during construction are typically comparable in height to the turbine towers (Kaheawa Wind Power, LLC 2006); however, cranes are intended for daytime use during a portion of the construction phase (three to four months) and will be lowered to a position that will reduce the risk of flight collision when not in use. The crane that will permanently be available for KWP II will be used only during the day and stored in its horizontal position at ground level when not in use. Therefore, the potential for Covered Species to collide with cranes on-site is considered to be negligible and not discussed further.

Estimating the potential for each Covered Species to collide with project components (i.e., **"direct take"**) was done using the results of the on-site surveys, information about the proposed project design, and the results of post-construction monitoring at the adjacent KWP facility. The fatality estimate models developed for KWP and used for KWP II incorporated rates of species occurrence, observed flight heights, encounter-rates with turbines and met towers, and estimates of the species abilities to avoid project components. For KWP II, the assumed ability of Hawaiian petrels and Newell's shearwaters to avoid turbines was varied in the models to create a range of probabilities of mortality for each species on an annual basis. Range of expected mortality coincides with the amount of "direct take" expected from construction and operation of the KWP II facility (SWCA 2010).

In addition to "direct take," it is possible (depending on time of year and breeding status of the individual) that adult birds directly taken during certain times of the year could have been tending to eggs, nestlings, or dependent fledglings, or that adult bats could have been tending to dependent juveniles. The loss of these adults could then also lead to the loss of eggs or dependent young. Loss of eggs or young would be **"indirect take"** attributable to the proposed project. Methods for determining indirect take for each species are described in detail in the HCP.

Pre-construction estimates of rates of take will not necessarily be accurate for all of the Covered Species. Post-construction monitoring will be used to estimate actual rates of take. The number of dead individuals of listed species found during monitoring will be used to reach an extrapolated level of "total direct take" that accounts for individuals that may not have been found because of limits to searcher efficiency and carcass removal by scavengers. **"Total direct take"** attributed to the KWP II project will be the sum of "observed direct take" (actual individuals found during post-construction monitoring) and "unobserved direct take" (individuals not found by searchers for various reasons, including vegetation cover and scavenging). A detailed protocol of how monitoring will take place at KWP II is provided in the HCP.

"Total direct take" and "indirect take" of each Covered Species is used to identify possible levels of take as "Tier 1," or "Tier 2" (SWCA 2011). The requested **Tier 1** level of total direct take for each species is derived based on the expected rate of annual mortality identified through the modeling using the most reasonable expectations of avoidance of collisions for each species (all rounded up to

the nearest integer). For Tier 1, the "estimated adjusted take" ("total direct take" + "indirect take") is also included for each Covered Species on an annual basis. As discussed in the individual species accounts, levels of adjusted take will be used to guide on-going mitigation efforts and identify need for adaptive management measures.

A **Tier 2** rate of take would be that which exceeds the authorized Tier 1 rate and is 1.5 times the Tier 1 rate of take over a 5- or 20-year period. Because of expected annual variability in actual rates of take, the HCP for the project proposes that different levels of take be authorized. More details on Tier 2 take levels are provided in the HCP.

Expected impacts to the Covered Species from the proposed project are described below. The sections below identify the number of individuals of each Covered Species for which KWP II LLC is seeking take authorization under a Federal ITP. The DLNR and ESRC require that applications for ITLs identify the number of individuals of each listed species expected to be taken on an annual basis, and require that ITL authorizations allow for take of at least one individual per year. In order to account for the stochasticity of take over time, where take in any given year may be higher or lower than the expected long-term average, 1-year, 5-year, and 20-year take limits are proposed (e.g. take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and not more than ten individuals for 20 years). Short-term take limits (1-year and 5-year limits) also provide benchmarks for the monitoring of take and will enable mitigation efforts to be tailored to respond to more immediate events. Twenty-year limits, however, are believed to be a better reflection of the long-term amount of take expected. A summary of the estimated and requested take of the Covered Species is provided in Table 4-4.

Table 4-4. Amount of Authorized Take Requested at Tier 1 and Tier 2 levels.

Covered Species	Tier	Requested ITP Authorization	
		Annual Limit	20-Yr Limit
Hawaiian Petrel, Uau	Tier 1	4 adults/ immatures and 3 chicks/eggs	19 adults/ immatures and 9 chicks/eggs
	Tier 2	up to 8 adults/ immatures and 5 chicks/eggs	up to 29 adults/ immatures and 14 chicks/eggs
Newell's Shearwater, Ao	Tier 1	2 adults/ immatures and 2 chicks/eggs	2 adults/ immatures and 2 chicks/eggs
	Tier 2	up to 5 adults/ immatures and 3 chicks/eggs	up to 5 adults/ immatures and 3 chicks/eggs
Hawaiian Goose, Nene	Tier 1	4 adults/ immatures and 1 fledgling	18 adults/ immatures and 2-3 fledglings
	Tier 2	up to 6 adults/ immatures and 1 fledgling	up to 27 adults/ immatures and 3 fledglings
Hawaiian Hoary Bat, Opeapea	Tier 1	4 adults/ immatures and 2 juveniles	6 adults/ immatures and 3 juveniles
	Tier 2	up to 9 adults/ immatures and 5 juveniles	up to 9 adults/ immatures and 5 juveniles

Mitigation measures proposed by KWP II LLC to compensate for the expected impacts of the project on the Covered Species were selected in collaboration with biologists from USFWS, DLNR-DOFAW,

First Wind, and SWCA, and with members of the ESRC. The mitigation proposed to compensate for impacts to the Covered Species is based on anticipated levels of incidental take as determined through on-site surveys, modeling, and the results of post-construction monitoring conducted at other wind projects in Hawaii and elsewhere in the U.S. Mitigation takes into account the expected annual rate of direct and indirect take.

Mitigation will be adjusted to account for rates of take found to differ from the Tier 1 level so mitigation for Tier 2 levels of take is also identified. According to USFWS policy (see 65 Fed. Reg. 35242 [June 1, 2000]), **adaptive management** is defined as a formal, structured approach to dealing with uncertainty in natural resources management, using the experience of management and the results of research as an on-going feedback loop for continuous improvement. In the case of KWP II, some uncertainty exists in the proposed project, from estimated rates of take to the success of the proposed mitigation measures.

The proposed tiered approach to mitigation was designed with adaptive management in mind because of the uncertainty and assumptions associated with models used to estimate impacts to Covered Species, and the ability of take monitoring to detect the rare collision events involving the covered species. The HCP acknowledges that actual rates of take may not match those projected through the seabird modeling and results of mortality monitoring performed to date at the KWP facility. Therefore, the HCP proposes to increase mitigation efforts to Tier 2, if monitoring demonstrates that incidental take is, or may be, occurring above Tier 1 levels, but within the Tier 2 levels identified in the KWP II HCP. Any changes in the mitigation effort would be made only with the concurrence of USFWS and DLNR.

Several mitigation alternatives are discussed at the end of each section for each of the Covered Species, and are summarized in Table 4-5. Appendix 6 provides the timeline and triggers for implementation of mitigation for each Covered Species.

The goal of the habitat conservation program (minimization, mitigation, and monitoring) is to compensate for the incidental take of each species authorized at each tier (Take Scenario), plus provide a net conservation benefit, as measured in biological terms. Thus, for example, although the overall expenditure at the Tier 1 level is not expected to exceed a total of $3.16 million, the budgeted amounts are estimates and are not necessarily fixed. KWP II will provide the required conservation measures in full, even if the actual costs are greater than anticipated. One way of accomplishing this is that past, current or future funds allocated to a specific Covered Species may be re-allocated where necessary to provide for the cost of implementing conservation measures for another Covered Species, and funding for any individual Covered Species is not limited to those amounts estimated in the HCP. KWP II also recognizes the cost of implementing habitat conservation measures in any one year may exceed that year's total budget allocation, even if the overall expenditure for the conservation program stays within the total amount budgeted over the life of the project. Accomplishing these measures may therefore require funds from future years to be expended, or likewise unspent funds from previous years to be carried forward for later use. For practical and commercial reasons, such reallocation of funds among years may require up to 18 months lead time in order to meet revenue and budgeting forecast requirements. However, if reallocation between species or budget years is not sufficient to provide the necessary conservation, KWP II will nonetheless be responsible for ensuring that the necessary conservation is provided. Funding re-allocation for one species to another will not impede the implementation of mitigation measures for either species.

4.11.1.2 (a) Hawaiian Petrel

<u>Direct Take</u>
KWP is the only operating wind energy generating facility in Hawaii where potential mortality of Hawaiian petrels and Newell's shearwaters is consistently being studied. KWP and KWP II have commissioned several independent studies using ornithological radar to estimate the movement rates for Hawaiian petrels and Newell's shearwaters through the site during the roughly eight month spring-fall breeding season when these birds are present near Kaheawa Pastures. The earlier of these (Cooper and Day 2004a; Day and Cooper 1999; Sanzenbacher and Cooper 2008, 2009) focused on the KWP project area. KWP biologists also independently conducted a radar study in the summer and fall of 2006. The most recent and comprehensive study was performed in summer and fall 2009 at

the Downroad portion of the proposed KWP II project area (Cooper and Day 2009; Appendix 3). Movement rates documented in this study were used to derive estimated annual fatality rates of petrels/shearwaters at the proposed turbine tower locations. For take estimates, it is assumed that the passage rates over KWP II are 1.3 times that over KWP (SWCA 2010).

Table 4-5. Proposed mitigation for the four Covered Species: Tier 1 and Tier 2 Take Scenarios.

Tier 1 mitigation	Tier 2
Hawaiian Petrel	
1. Implement a comprehensive plan for seabird colony management at Makamakaole, on West Maui near lower Kahakuloa Valley, that would include predator proof fencing an enclosure, eradication within the enclosure, social attraction and artificial burrows. The success of the social attraction project in establishing a breeding and growing colony will be determined after 5 years and if unsuccessful, additional measures will be implemented till mitigation is commensurate with the requested take. AND/OR 2. Participate in the management of the Hawaiian petrel colony breeding in the crater of Haleakala in an approximately 220 ac (89 ha) area with approximately 100 burrows. This would include contributing to contracting the labor and purchasing equipment (e.g., traps and bait) required to conduct predator trapping in this area (or a section thereof, depending on mitigation requirement), and to conduct monitoring to document success. AND/OR 3. Provide support for colony-based protection and productivity enhancement for Hawaiian petrels at the ATST mitigation site after 2016 when ATST mitigation obligations are fulfilled.	Tier 1 mitigation may be adequate to offset Tier 2 levels of take, if additional mitigation is needed, management will be initiated, or if already initiated for Tier 1 mitigation expanded to an area known to be occupied by unprotected burrows..
Newell's Shearwater	
1. Implement a comprehensive plan for seabird colony management at Makamakaole, on West Maui near lower Kahakuloa Valley, that would include predator proof fencing an enclosure, eradication within the enclosure, social attraction and artificial burrows. The success of the social attraction project in establishing a breeding and growing colony will be determined after 5 years and if unsuccessful, additional measures will be implemented till mitigation is commensurate with the requested take. AND/OR 2. Implement predator exclosure and social attraction scenario at an alternative site in East Maui, or implement predator exclosure at an in-situ site at upper Kahakuloa or alternative site on East Maui, if deemed feasible AND/OR 3. Provide support for colony-based protection and productivity enhancement, or social attraction and predator exclusion for Newell's shearwaters on Molokai or Lanai. .	Progress through Tier 1 mitigation alternatives, which were developed to offset Tier 1 and Tier 2 take.
Nene	

Tier 1 mitigation	Tier 2
1. Fund the building of a new release pen to accommodate spillover of nene from other pens or participate in the translocation of eggs, adults or family groups from Kauai. Additional funding for management of the new pen for the first five years will be provided regardless of take, this includes support for logistics, DOFAW staffing, predator control and vegetation management activities. Perform systematic visual observations of nene activity within KWP II site to document how nene use the project area following construction.	1. Extend management activities at pen constructed for Tier 1, including support for logistics, DOFAW staffing predator control and vegetation management. Monitor and model benefits of action to confirm mitigation offsets Tier 2 take
Hawaiian Hoary Bat	
1a. Conduct surveys to document bat occupancy at different habitat types (e.g., ridges vs. gulches) and elevational ranges at KWP II and vicinity to support Maui bat research. 1b. Restoration of bat habitat at an acreage commensurate with the requested take.	1a. Continue surveys to document bat occupancy at different habitat types (e.g., ridges vs. gulches) and elevational ranges at KWP II and vicinity to support Maui bat research. 1b. Restoration of additional bat habitat at an acreage commensurate with the requested take..

Fatality estimates by Cooper and Day (2009) were modeled for different avoidance rates. Avoidance rates represent the proportion of birds that will actively avoid turbines or other structures upon encountering them. For the purposes of estimating fatality rates at the turbines at KWP II, a 97.5% avoidance rate was found to result in a predicted mortality closest to the rate of direct take observed to date at KWP. Therefore, for the purposes of estimating fatality rates at KWP II, a 97.5% avoidance rate was used with the seabird fatality modeling from Cooper and Day (2009).

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

Fatality estimates were also modeled for one permanent un-guyed 213-foot (65-m) lattice met tower. This modeling predicts an average mortality of 0.007 to 0.073 Hawaiian petrels/met tower/year based on 90%, 95% and 99% avoidance rates. No met tower fatalities have been recorded at KWP. Given the very low rate of predicted met tower mortality, no adjustments to met tower avoidance rates were made in the modeling in response to the KWP monitoring results. Therefore, for the purposes of estimating fatality rates at KWP II, the 95% avoidance level was chosen, resulting in an estimated fatality rate for Hawaiian petrels at 0.036 birds/year/tower (SWCA 2011).

Potential also exists for Hawaiian petrels to collide with the 1,225 – 1,570 ft (374 - 479 m) section of the collection line that crosses the gulch at the upper portion of the project area (see Section 2.1). This line will be mounted on poles approximately 60 - 90 ft (18 - 25 m) above ground level and will be a maximum of 340 ft (104 m) above the deepest part of the gulch. Precautions to minimize collisions include installing marker balls on the collection line to enhance visibility and placing the collection line in close proximity to an existing transmission line of the same height that also crosses the gulch and is similarly marked. All overhead collection lines will be spaced according to Avian Power Line Interaction Committee (APLIC) guidelines to prevent possible electrocution of native species. Observation of Hawaiian petrels on Kauai by Day et al. (in review) suggests that collision avoidance rates of powerlines by Hawaiian petrels is very high (207 observed birds with 40 birds exhibiting collision avoidance responses and zero resultant collisions). Thus, the collision rate of Hawaiian petrels with overhead collection lines is considered very small and assigned a value of 0.05 birds/year (one bird every 20 years) given the low occurrence rate of species on the site, their avoidance capabilities, and mitigation measures that will be initiated.

In addition to collisions with turbines and the permanent met tower, direct take of Hawaiian petrels may occur as a result of collision with construction or maintenance vehicles traveling project roads (refers to birds already injured by collision with turbines or towers). No such mortality has occurred to date at the existing KWP facility. Project personnel will be trained to watch for downed petrels and other wildlife and speed limits (10 mph or 16 kph) will be enforced to minimize potential for vehicular strikes to result in death that otherwise might have been able to be rehabilitated. This source of potential mortality does not result in an increase in the amount of direct take expected from the proposed project because such birds would be those not avoiding the WTGs or met tower and, thus, have been accounted for in the mortality modeling.

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

<u>Indirect Take</u>

Adult and immature Hawaiian petrels have potential to collide with turbines and associated structures while commuting between nesting and feeding grounds during the pre-laying period (March to April) and incubation or chick-feeding periods (May through October). Indirect take calculations based on life history parameters of Hawaiian petrel are provided in Table 4-6. Indirect take would be assessed at the rate of 0.89 eggs or chicks per adult taken between May and July, 0.66 chicks per adult taken in August, 1.00 chick per adult taken in September, and 0.50 chick per adult taken in October.

Estimated Total Take

The estimated average mortality rate of Hawaiian petrel allowing for potential collisions with WTGs and the permanent met tower and adjusted for potential for collection line strikes is 0.91 petrel/year, or essentially one petrel per year. Based on estimated rates of direct and indirect take, take of this species resulting from project operations is expected to average approximately no more than approximately two birds per year (0.91 adults/yr + maximum of 0.91chick/yr) = 1.82 birds/yr). However, DLNR and ESRC have recommended that annual take limits allow for at least one observed take per year. Given that a direct take averaging about one petrel per year is expected at KWP II, this will lead to an assessment of total direct take for that year of greater than one that likely would be rounded up to two birds.

Table 4-6. Calculation of indirect take for Hawaiian Petrel.

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

Moreover, as take may be distributed unevenly over the years, KWP II LLC proposes that the ITP and ITL allow for a total direct take of up to four Hawaiian petrels and the indirect take of three chicks per year for the duration of the project. A 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. Expected rates of take and the requested rates of take to be authorized by the ITP and ITL through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as "Tier 2."

Expected Rate of Take

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

Requested Tier 1 ITP/ITL Authorization

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

Tier 2 Rate of Take

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

The current breeding population of Hawaiian petrel is estimated to be approximately 4,000 to 5,000 breeding pairs (Mitchell et al. 2005, Pyle and Pyle 2009). The requested Tier 1 rate of take represents approximately 0.007% of the population annually or approximately 0.14% of the estimated Hawaiian petrel population. The Tier 2 rate represents approximately 0.01% of the population annually or 0.22% in the unlikely event that all take occurs at once. The current estimated breeding population of Hawaiian petrel on Maui is roughly between 750 pairs (Pyle and Pyle 2009) and 1,000 pairs (Mitchell et al. 2005; Tetra Tech EC, Inc. 2008a, 2008b). The requested Tier 1 and Tier 2 rates of requested take over the 20 year period represent approximately 1.93% and 2.93% of Maui's breeding population, respectively. Given these very low percentages, it is considered extremely unlikely that

take of Hawaiian petrel at KWP II would result in significant adverse effects to Hawaiian petrel at the population level.

The seabird colony at Haleakala, Maui, is composed of as many as 1,000 nesting pairs or approximately one-fifth to one-quarter of the total breeding population (Mitchell et al. 2005; Tetra Tech EC, Inc. 2008a, 2008b). The number of birds breeding in West Maui is not known. The expected (two adult) and Tier 2 (four adults) rates of take could represent from 0.025% to 0.3% of the minimum (1,000 pairs) Maui population if all birds taken were breeding birds rather than non-breeding visitors to their colonies. These percentages are also quite low, although if a Tier 2 rate of annual take was realized consistently, it might eventually result in a measurable reduction in the Maui population in absence of the proposed mitigation measures. At current population levels, higher rates of take are expected to occur only in the unlikely event that less than 97.5% of the petrels passing over the site fail to detect and avoid the turbines and met towers (Sanzenbacher and Cooper 2009). Because it is anticipated that take will occur at an average rate of approximately one adult per year, loss of Hawaiian petrels as a result of the proposed project is considered unlikely to result in a biologically significant reduction in the Maui population of this species.

The proposed mitigation measures described in the following chapter are expected to offset the anticipated take and contribute to recovery of the species by providing a net conservation benefit, as required by State law. For this reason, no significant adverse impacts to the species' overall populations, and no significant cumulative impacts to the species, are anticipated. In fact, with the expected rate of take the proposed mitigation measures should produce a measurable net benefit in the form of a marginal increase in the population of Hawaiian petrels.

Minimization and/or Mitigation Measures:

The mitigation measures described below are expected to equally benefit both Hawaiian petrels and Newell's shearwaters found at the seabird colony. Mitigation efforts for seabirds will take into account the expected annual direct and indirect take of the species. The goal of the seabird mitigation efforts is to increase adult survival or productivity of seabirds such that they are commensurate with the level of take and provide a net benefit to the species. KWP and KWP II will cooperate to fulfill the total mitigation obligation for both projects by sharing staff and resources. For additional details, refer to the *KWP II HCP* (SWCA 2011).

<u>Tier 1 Mitigation</u>
The proposed Tier 1 mitigation for KWP I and KWP II follows a similar approach for both seabird species, and for each species consists of establishing a new colony by enclosing an area with a predator (dog, cat, mongoose, rat) proof fence, installing 50 artificial burrows, and broadcasting audio playbacks of conspecific calls (i.e., social attraction) to draw birds to the fenced area. Social attraction has been used to successfully establish colonies of colonial waterbird species throughout the world (Kress and Nettleship 1988, Gummer 2003). Ground-nesting and burrowing seabird species can be encouraged to nest at a prospective site by the placement of artificial burrows accompanied by vocalization play-backs. This increases the density of nesting pairs in the area which in turn attracts more individuals and ultimately allows for more effective management (Podolsky and Kress 1992).

Preferred Seabird Mitigation Option (Makamakaole): Discussions involving ESRC, USFWS, and DOFAW have led to a recommendation that KWP II and KWP pool resources and implement a comprehensive plan for seabird colony management that would including fencing, predator control, and, a social attraction project. Mitigation achieved from this pooled approach will be applied to each project on a prorated basis relative to the authorized take of each project.

Currently, the preferred mitigation site for the seabirds is situated on West Maui near lower Kahakuloa Valley, called the Makamakaole colony (Figure 4-3). The Makamakaole colony is close to existing development (which increases the likelihood of cats and human disturbance), is accessible, and therefore highly likely to benefit from management. The site is located on land within the State Forest Reserve System and within the Natural Area Reserves System (NARS). A portion of the area is currently managed by KWP which initiated a predator trapping program in 2009 to reduce cat and mongoose populations in the vicinity (Kaheawa Wind Power 2009). Makamakaole was identified as a possible Hawaiian petrel nesting site in 2007 by First Wind biologists based on observations of

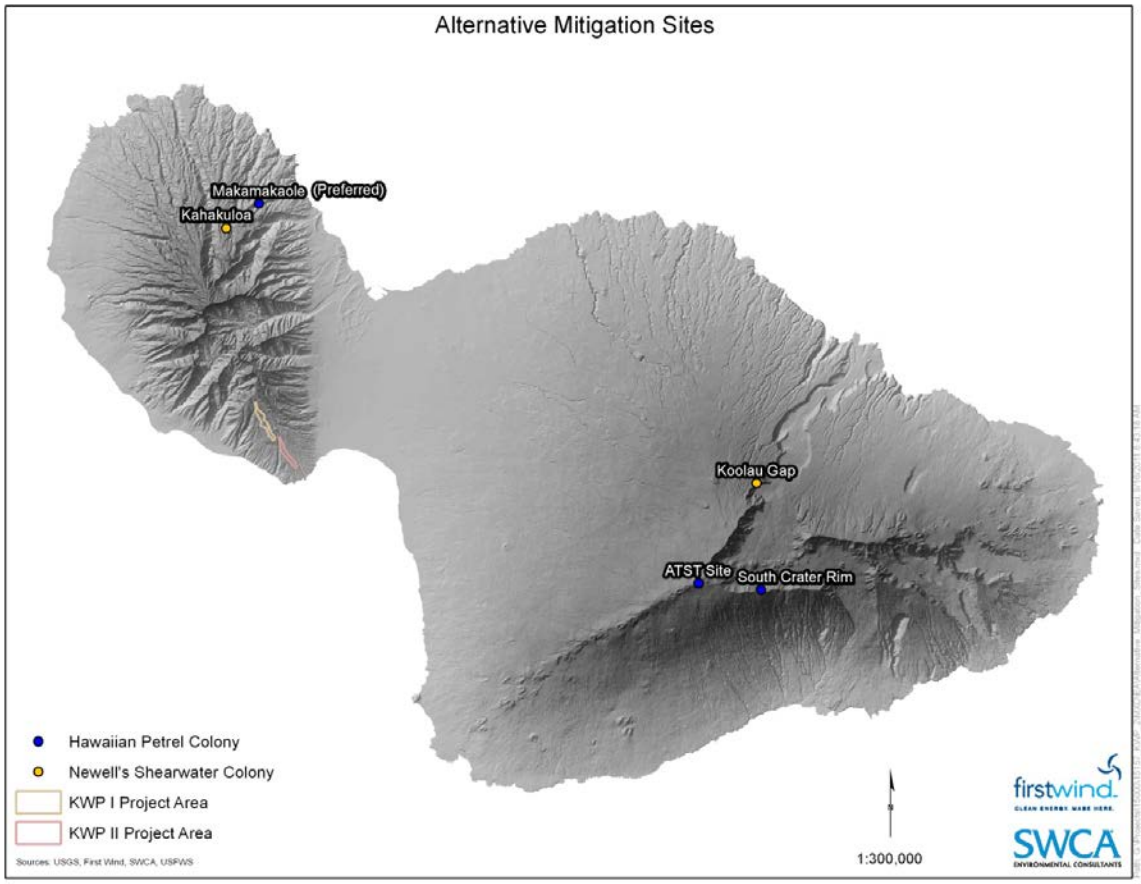
Hawaiian petrel activity in the area. This finding was corroborated by seabird biologists from DOFAW (Fern Duvall), USGS (Josh Adams), and H.T Harvey and Associates (David Ainley). Several assessments for the site were conducted in 2010 and 2011 to determine the extent of seabird activity. Significant Hawaiian petrel passage rates and calling activity, including circling and paired flights, were documented at Makamakaole, but only a single, unoccupied burrow was found. In July 2011, a canine team from Ecoworks (based in New Zealand) was brought in with two specially trained dogs to help find Hawaiian petrel burrows at Makamakaole. After a very comprehensive search effort, the team identified three old, disused burrows and one Hawaiian petrel carcass that was estimated to be several months old (Sawyer 2011). Based on the presence of inactive, old and disused burrows and the significant amount of Hawaiian petrel activity over the site, the area is believed to be a historic nesting site where nesting attempts still occur, but fail due to high predator densities.

An area has been identified for the construction of two approximately 5 ac predator (dog, cat, mongoose, rat) proof enclosures to protect breeding Hawaiian petrels and Newell's shearwaters. The enclosures themselves include design specifications, materials, and installation criteria based upon proven New Zealand pest-proof fence technology (Sawyer 2011; Day 2011). This enclosure size has proven to be optimal because it provides adequate space for 50 or more artificial and natural burrows while ensuring the effectiveness of the fence in excluding predators and pests (ungulates) and the practicability of eradicating the predator species from within the enclosure. The two enclosures will be separated from each other, in part to reduce the potential for competitive interactions. The placement of the fence will conform to the natural contours of the immediate landscape, and will be situated below the crests of ridgelines to in order to stay below the flight path of the petrels and assure a minimal risk of collision. Similar projects for Gadfly petrels and shearwaters in New Zealand have not encountered any problems related to seabirds colliding with fences such as proposed for this project. Having the enclosure uphill of the fence effectively increases the height of the fence for mammalian predators outside the fence. The layout of the fenced enclosures will be designed to avoid any waterways, which are difficult to manage and are a likely pathway for pest incursions. An electric wire will be placed 4 m from the fence to discourage ungulates from approaching and potentially compromising the fence.

The fence itself will be designed to keep out dogs, cats, mongoose, and rats, while allowing mice to come and go. Mice will be controlled down to an approximate 2% activity rate within the enclosure by maintaining a 25 m grid of bait stations (Diphacinone), and a trapping program will be carried out within a 100 m buffer zone around the enclosure using Conibear-type traps placed in ply boxes for cats and mongoose along ridges within a 1 km radius of the enclosure to depress predator densities in the surrounding buffer zone. All trapping and baiting activities will be in accordance with applicable regulations and labels. In addition, barn owl control will be implemented before petrels and shearwaters return to the area and may be continued during the breeding season if owls are observed re-occupying the area.

The acoustic attraction setup will be based on methods proven to be effective in New Zealand, and will consist of remote solar powered digital acoustic attraction players and weather-resistant omni-directional speakers using local Makamakaole, Lanaihale, and/or Haleakala Hawaiian petrel vocal recordings and as-available Newell's shearwater recordings. Each enclosure will only broadcast calls of one species (i.e. only Newell's shearwater calls will be broadcast within the designated Newell's shearwater enclosure). Before social attraction begins, 50 artificial burrows specifically designed for each species will be installed within a 40 m radius of the speakers, which may be followed in subsequent years by ongoing installation of up to 50 more burrows elsewhere within the enclosures and possibly additional speaker deployments. The use of artificial burrows has aided recolonization in social attraction projects for Procellariids in New Zealand and elsewhere.

Figure 4-3. Location of the preferred and alternative mitigation sites for Hawaiian petrel and Newell's shearwater.



The enclosures will be located within the Kahakuloa Natural Area Reserve. The Newell's shearwater enclosure will be located entirely within the existing fenced area, but the Hawaiian petrel enclosure, as presently designed will intersect with the existing ungulate fence along its northeastern corner. To ensure that the enclosure is entirely included within the existing ungulate fence, and to minimize collision risk, the portion of the existing fence that will intersect the Hawaiian petrel enclosure will be rerouted to follow the lower edge of the Makamakaole Stream precipice at least 4 meters from the predator proof fence. This action, which will be executed in cooperation with the NARS, will not impact the effectiveness of the existing ungulate fence and will be paid for by the Applicant.

A fencing and social attraction approach at Makamakaole is expected to have a very high chance of success. The site is very accessible, being located within walking distance from the end of a road, and includes a range of topographical features and aspects, including slope, gullies, flat areas, ridges, banks, as well as a range of soil types and options for birds to form natural burrows. The site primarily faces north into the prevailing wind, which aids the birds with takeoff. The proposed fence line will avoid waterways, which are more easily breached by vertebrate pests. The site is close to a community which may allow for community participation in the long-term conservation effort; those residents who so far are aware of the situation are supportive which will contribute to assuring long-term success (Sawyer 2011). In addition to providing protection to the target species of birds, the site can be used as a sanctuary for highly threatened and endangered plants and invertebrates if warranted.

The proposed mitigation project is expected to offset Tier 1 take within the 20 year life of the project. However, if the Makamakaole social attraction project does not produce the anticipated mitigation benefits, adaptive management at the Makamakaole site, or management at an additional site or sites would be conducted to ensure mitigation requirements are met within the life of the project. The proposed mitigation project at Makamakaole may be delayed due to unanticipated circumstances, or additional landowner permit requirements. Discussions with NARS are ongoing, and the NARS permitting process is not expected to cause significant delays to the project. Additional landowner permit requirements for the Makamakaole social attraction project are not anticipated.

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

If based on results achieved during years one through five, the success of the Makamakaole social attraction project does not appear capable of offsetting the level of take anticipated during the 20-year permit term, the Applicant will, in year six, implement one or more adaptive management or additional mitigation measures to supplement the mitigation effort to the extent necessary to offset anticipated levels of take. During years one through five, the Applicant will develop management plans for the following alternative Tier 1 mitigation project sites. Alternatives will be evaluated in the order listed below and implemented as needed to fulfill mitigation requirements. When mitigation commences at an alternative site, mitigation projects at the previous sites will continue for the duration of the permit term unless USFWS and DOFAW agree the conservation action may be terminated.

For the Hawaiian petrel, these include:

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

Under current conditions both seabird species are undergoing continuous population decline and, without intervention, are likely headed towards extinction on West Maui in the near future. As mentioned in Section 3.11.2, the major threats identified for the Covered seabirds are: introduced predators, which can prey on adults, eggs, and fledglings; feral ungulates, which degrade habitat and may trample burrows; and artificial lighting, which disorients fledglings and increase their risk of collision with artificial structures (Mitchell et al. 2005). Predation has been shown to have significant

negative effects on fledging success for the Hawaiian petrel (Hodges 1994; Hu et al. 2001; Hodges and Nagata 2001; Telfer 1986) and predation on adults has also been documented (Simons 1983). In Haleakala National Park, Hodges and Nagata (2001) identified predation as accounting for 41% of total terrestrial mortality (adults, fledglings, and eggs) in cases in which a cause of death could be determined. Predation mortality was attributed to cats and mongooses (38%), rats (41%), dogs (14%) and owls (6%) (Hodges and Nagata 2001). Data from Hodges (1994), Hu et al. (2001), and Hodges and Nagata (2001) show that predator control (trapping and fencing) generally results in a significant increase in Hawaiian petrel nesting success. Suppressing predator populations is also expected to increase adult survival rates at the colony. Attracting breeding individuals of both Hawaiian petrel and Newell's shearwater to an area within which they can be protected from predation threats is believed to have the potential of saving the remaining colonies of both species on West Maui. Thus, predator trapping and/or fencing at a chosen seabird colony is expected to increase overall productivity and provide a net benefit to the species. If the social attraction program is implemented, the colony may be further enhanced by attracting a greater number of seabirds to nest in the managed area. Thus, the proposed mitigation measures are expected to offset the anticipated take and contribute to both species' recovery by providing a net conservation benefit, as required by State law. To assure that mitigation goals will be met within 20 years, KWPII will ensure projected 20-year benefits of mitigation remain at or above the anticipated 20-year mitigation requirements during years five through 20. Projected 20-year mitigation benefits may fall short of projected mitigation requirements for one period, not to exceed 356 days in length, during years five through 20.

Potential Impacts: All of the mitigation measures proposed for KWP II would be implemented to provide net conservation benefits to the Covered Species (e.g., increase in adult survivorship or reproductive success); however, some short-term adverse impacts may occur.

Flora - Construction of the fence at Makamakaole would result in the disturbance and removal of limited amounts of vegetation. The fencelines for the two enclosures will be 0.8 mi long and roughly 12 ft of vegetation will be cleared along the fenceline. This will result in the removal of approximately 1.2 ac of vegetation. These narrow swaths of disturbance would be widely distributed over geography, and local impacts of constructing the fence would be minimal. Soil disturbance and impacts to topography are expected to be short-term with no significant impacts. A botanical survey of the proposed enclosures was conducted in September 2011 (Appendix 7). Twenty-four species of native plants (16 endemic, 8 indigenous) were observed during the survey. No federally or state endangered plants were observed in the area. During construction of the fence, native plants will be removed only when necessary, and removal of native plants greater than 6 inches in diameter will be avoided as much as possible. Cut vegetation will be left to decompose.

Designated critical habitat for two endangered plant species - haiwale (*Cyrtandra munroi*) and oha wai (*Clermontia oblongifolia* spp. *mauiensis*) – occurs immediate to the southwest of the Makamakaole mitigation area. Fence construction and monitoring, predator control, social attraction studies, and habitat management activities may result in minor impacts to designated critical habitats due to vegetation removal or trampling. In order to avoid and minimize impacts to critical habitat, fence contractors will be educated regarding the sensitivity of this project including working in critical habitat. Construction of the fence has the potential to benefit designated critical habitat due to reducing grazing, browsing, and/or trampling by non-native species.

Fence construction can create conditions that facilitate the establishment of non-native species, primarily due to soil and vegetation disturbance. Furthermore, the fencing crew has the potential to unintentionally introduce non-native species via equipment and field gear. Gear-cleaning procedures to reduce the introduction of noxious plant seeds and propagules, as well as arthropods will be strongly enforced for biologists and/or contractors. To reduce the potential for introduction of non-native invasive species at the site, all equipment and materials (including boots) will be stored in a weed-free area and inspected and cleaned prior to accessing the area. Inspection protocols and the need for any post-construction monitoring will be determined in cooperation with DOFAW, USFWS, and the Maui Invasive Species Committee (MISC).

Minor impacts to flora may occur due to trampling by monitors during the monitoring or implementation of seabird colony management measures such as ungulate control and predator control. Regular visits to the mitigation site will occur (daily, weekly, or monthly) and existing trails will be used whenever possible to reduce impacts to the flora.

Wildlife - Prior to construction, the final fence alignment will be surveyed by a qualified biologist to document sensitive wildlife, particularly seabird burrows and the Hawaiian hoary bat. The fence will be appropriately placed to avoid adverse impacts to these resources and fence contractors will be trained to identify seabird nesting burrows.

Noise associated with construction may temporarily disrupt seabirds nesting within the area; all construction activities will be conducted outside of the nesting season of the two Covered seabird species to minimize impacts. To minimize the potential for birds to collide with the fence, KWP II LLC will improve the visibility of the fence with steel reinforced white poly-vinyl tape. The tape will be interwoven horizontally at various heights along the fence.

Removal of trees greater than 15 ft will be avoided as much as possible and is not allowed during the Hawaiian hoary bat pupping season (July 1 – August 15). If cutting of trees during this period is required, acoustic surveys will be conducted in the vicinity to document absence of any hoary bat use. During fence construction, if a Hawaiian hoary bat (adult or pup) is discovered near construction activities, the area will be avoided as long as the bat is present. Due to the possibility of fence line impacts involving bats, there will be no barbed wire on any portion of the fence, thereby reducing any possible impalement on the fence. Because the project is designed to protect native habitat through fencing and predator removal, the total impact on the bat population is anticipated to be positive.

The Covered seabird species are not expected to be attracted to diphacinone or another rodenticide (if used to control mice or other predators within the fence) because the adults of the Covered seabird species feed by foraging for fish and other marine organisms offshore (DOFAW 2009b). Seabirds are not expected to be attracted to the toxin or to eat organisms that have been contaminated by eating rodenticide. Thus, the use of rodenticides is not anticipated to negatively impact seabird populations.

Historical/Archaeological/Cultural Resources - Prior to construction of the fence, the area to be disturbed will be surveyed by a qualified specialist to ensure that all sensitive historical, cultural, and archaeological resources are avoided. Construction of the fence is not expected to impact cultural practices by restricting access due to the remote location of the fence and the size of the area expected to be fenced. Because all historical, archaeological and cultural resources will be avoided during the implementation of mitigation and management measures, no adverse impacts are expected.

Topography/Geology/Soils - Minor impacts to soil resources and topography may occur due to trampling by monitors during fencing or implementation of predator control at the site. Regular visits to the mitigation site will occur and existing trails will be used whenever possible to reduce impacts to topography and soils. The removal of vegetation at the fence will result in temporary impacts to soil and topography, but the re-establishment of native vegetation will result in reduced erosion (Vitousek 1993). To minimize soil erosion, only minimal amounts of clearing will be conducted in order for the fence to be built and the extent and steepness of exposed ground areas will be reduced to the maximum extent possible. The placement of the fence will conform to the natural contours of the ridge. BMPs will also be incorporated as appropriate to reduce erosion and subsequent impacts to topography (e.g., avoiding earthwork during inclement weather, temporary stabilization with geotextile mats, and revegetation with native species). Although fencing will result in some permanent disturbance due to the construction of fence posts and fence burial designed to prevent ungulates from digging through the fence, these narrow swaths of disturbance will be widely distributed over geography, and local impacts of constructing the fence will be minimal. Soil disturbance and impacts to topography are expected to be short-term with no significant impacts expected.

Water Resources - Some impacts to the hydrology or water resources may occur due to trampling when monitoring the success of mitigation measures or while implementing measures such as trapping. However, impacts will be kept to a minimum as existing trails will be used as much as possible. No significant impacts to surface waters are anticipated from fence construction. The fence will be sited to avoid any waterways. Vegetation would be hand-cleared in areas adjacent to the fence if necessary, with stumps and roots remaining in the ground to prevent soil disturbance. In the event that fencelines are constructed adjacent to surface waters, surrounding vegetation would remain in place to prevent runoff from feral ungulates traversing the outside of the fenceline.

Ungulate control and predator control can potentially improve the water quality at the site by decreasing the number of ungulates and reducing soil erosion. Predator trapping will limit the input of disease-causing organisms (such as leptospirosis) into stream water by reducing the number of feral animals present within the mitigation area. Rodenticides will be contained within bait boxes and will comply with all labeled instructions accompanying the use of the rodenticide. No significant impacts to water resources are expected from the use of rodenticides.

Invasive plant control may include the use of herbicides. Only appropriate herbicides for the area will be used, in accordance with labeled instructions to ensure that no significant impacts to water resources are expected from the use of herbicides for plant control.

Air Quality - Only minor impacts are expected due to actions implemented for seabird mitigation. If fencing and vegetation removal occurs, vehicles and helicopters using fossil-fuel fired internal combustion engines will be used to transport staff and equipment to the mitigation site several times a week. After fencing is complete, regular visits (monthly or weekly) to the chosen site will be required to implement management measures and document reproductive success. The minor air quality impacts will be primarily due to vehicles and helicopters using fossil-fuel fired internal combustion engines transporting staff and equipment to the study site.

Noise - Vehicles will be used to conduct regular site visits to mitigation sites during the monitoring or implementation of mitigation measures. Regular visits to the mitigation sites will occur (weekly or monthly) and the noise due to transportation is anticipated to be of short duration and of low intensity and is not anticipated to significantly increase the noise levels at the site. Minor increases in noise are expected during fence construction and vegetation removal due to the possible use of machinery to accomplish the required work. However, the noise is expected to be during normal work hours and the mitigation sites are not near populated areas; thus, noise impacts from these activities are expected to be insignificant. The transportation of equipment and employees by helicopter will temporarily increase noise levels along the flight path. Because relatively few helicopter flights are expected to occur, and flights would occur during normal work hours, this not expected to substantially change the sound levels in the affected areas.

The acoustic attraction proposed for seabirds will involve the nightly use of remote solar powered digital acoustic attraction players and speakers during the breading season. The use of this equipment will continue until deemed appropriate by USFWS, DLNR, and the Applicant. Due to the remote location of the fence and the low volume of these devices, no significant adverse noise impacts are expected.

Scenic Resources - Most of the fences and corridors will be constructed away from populated areas and will likely not be visible from most public vantage points due to screening by vegetation or other physical features in the landscape. If visible at all, the visual impact would be temporary until regrowth of the understory.

Hazardous Substances and Materials - Fuel (diesel or gasoline) will be used to operate vehicles to transport staff and equipment to the site and fuel may be used to run equipment to carry out mitigation measures. Herbicides may be used as part of vegetation control. Proper precautions will be taken when driving and operating equipment and the herbicide will only be

applied according the labeled instructions. Therefore, monitoring and implementation of mitigation will not result in any significant impacts due to hazardous materials.

Land Use - The proposed seabird mitigation sites are located on state-owned conservation land. Thus, no mitigation measures are anticipated to have any effect on current or planned land uses.

Utilities/Public Services - The vehicles and vehicular trips required for monitoring and implementation of mitigation measures will involve too few vehicle trips (weekly to monthly trips) to significantly affect transportation and traffic.

Makamakaole is considered by DOFAW, USFWS and others to be an important site for the recovery of the species. However, if the preferred mitigation site is unsuccessful, or does not fulfill mitigation requirements, additional alternative mitigation actions are proposed. These alternatives are discussed below and shown in Figure 4-3.

Hawaiian Petrel Mitigation Option 2 (south rim of Haleakala crater): If necessary to offset KWP I and KWP II Tier 1 take of the Hawaiian petrel, KWP II LLC would augment the Makamakaole social attraction efforts by implementing management measures at the south crater rim of Haleakala Crater. The National Park Service (NPS) has identified at least 100 burrows, and based on Hawaiian petrel monitoring and GIS modeling, they assert that at least 600 active burrows are present along the South Rim (Bailey 2011). The nesting area is composed of large boulders, rocky outcrops, and cinder fields (Simons 1983). Vegetation in the area is very sparse (Hodges and Nagata 2001). NPS has confirmed this area is protected from habitat damage by feral goats and pigs, but burrows within this area are not protected from mammalian predators, experiencing a much lower level of breeding attempts and breeding success (Hodges and Nagata 2001). If KWP II participates in the management effort with KWP, the two entities will contract the labor and purchase equipment (e.g., traps and bait) required to conduct predator trapping in this area (or a section thereof, depending on mitigation requirements), and to conduct monitoring to document success. Trapping and monitoring protocols will closely follow the protocols that have already been established by NPS for managing the rest of the colony (Hodges and Nagata 2001). The National Science Foundation (NSF) has proposed six years of monitoring at a control site on Haleakala pursuant to their Advanced Technology Solar Telescope (ATST) project. Measured rates of reproductive effort, reproductive success, and adult and juvenile survival at the mitigation site would be compared to vital rates measured at the ATST or another control site. If appropriate control site monitoring data are not available, reproductive effort, reproductive success, and juvenile and adult survival rates agreed to by the Agencies shall be used in place of control site monitoring data. This effort would run for an initial period of 13 years (permit years 6 through 18, assuming initiated as adaptive management after year 5); population modeling by H.T. Harvey and Associates indicates 13 years of management of approximately 100 burrows would offset all of the Tier 1 level of take requested in the KWP and KWP II permit applications. If after the initial 13 years of predator trapping, mitigation is still not at least one fledgling above Tier 1 requested take for both projects, mitigation will continue until that is achieved. Other details of the mitigation efforts will be refined with concurrence of NPS, DLNR and USFWS.

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

The anticipated benefit of predator control were calculated by comparing future population sizes that would have occurred under current predation rates versus the size of the population under the reduced rate of predation. We input Hawaiian petrel survival and reproductive success rates which,

based on our review of the available literature and data (Table 4-7), are likely to occur under varying predation severities.

Table 4-7. Hawaiian petrel vital rates under varying predation severities based on best available local data.

Predation Severity	Life History Parameters (Annual Rates)				Model Results (Lambda)
	Adult Survival	Juvenile survival (Simons 1984 p. 1070)	Percent of Active Burrows Laying an Egg (Simons 1984 p. 1069)	Fecundity (Fledglings per Egg Laid)	
Mild Predation (Cat/Mongoose/Trapping Only)	0.90 (Simons 1984 p. 1070)	0.8034	0.75	0.60 (Simons 1984 p. 1070)	0.978
Moderate Predation (No Management)	0.85 (Simons 1984 p. 1070)	0.8034	0.75	0.49 (Simons 1985 p. 237)	0.933

Figure 4-4 shows the modeled trajectory of the number of Hawaiian petrels likely to occupy the 99 Hawaiian petrel burrows at the Crater Rim site (GIS data the Service received from NPS, Bailey, pers. comm. 2011, indicates 99 Hawaiian petrel burrows have been mapped at the Applicant's proposed Crater Rim mitigation site). Implementation of predator control benefits the population by slowing the rate of population decline. Population modeling indicates the Hawaiian petrel population at the Crater Rim (with 99 total burrows with 60 active burrows and 45 breeding pairs in 2011) would contain 29 more adults if predator control years 6 through 20 is implemented than would have been there in the absence of predator management.

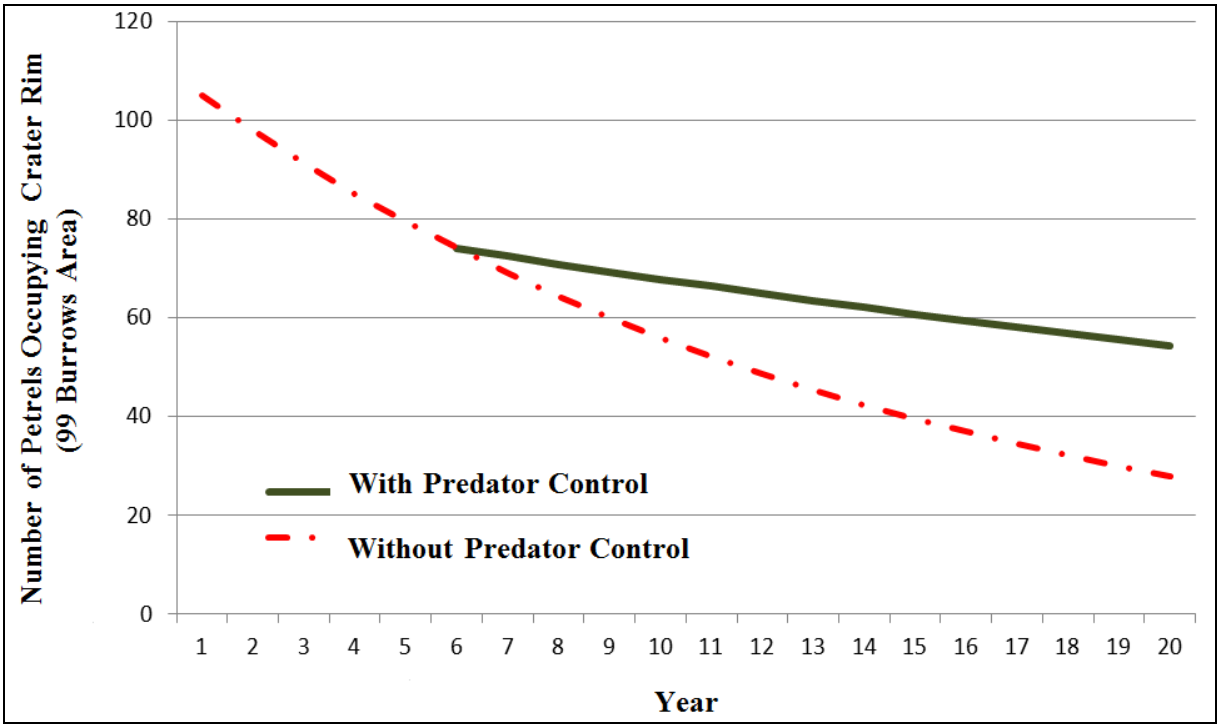


Figure 4-4. By implementing predator control at the Crater Rim site in year 6, the Applicant's predator control project would result in an increased number of Hawaiian petrels occupying the site in year 20.

Potential Impacts: All of the mitigation measures proposed for KWP II would be implemented to provide net conservation benefits to the Covered Species (e.g., increase in adult survivorship or reproductive success); however, some short-term adverse impacts may occur as described below.

Flora - Vegetation in the nesting area at Haleakala is very sparse (Simons 1983, Hodges and Nagata 2001). However, designated critical habitat for the threatened ahinahina or Haleakala silversword (*Argyroxiphium sandwicense* spp. *macrocephalum*) occurs in the proposed mitigation site. Two additional endangered species - kookoolau (*Bidens micrantha* ssp. *kalealaha*) and laukahi kuahiwi (*Plantago princeps*) - also have critical habitat in the vicinity. Predator control and habitat management activities have the potential to impact listed plants and their designated critical habitats. Because this site is situated on federal land within a National Park, a survey will be conducted prior to management activities to determine the locations of listed plants, if present. In order to avoid impacts to listed plants, all listed individuals in the vicinity will be clearly flagged, and appropriate protocols will be used to avoid direct or indirect impacts to listed plants. Gear-cleaning procedures to reduce the introduction of invasive plants and arthropods will be strongly enforced for biologists and/or contractors that conduct predator control or monitoring efforts. By implementing the measures described above, adverse impacts to *A. sandwicense* spp. *macrocephalum* and its critical habitat will be insignificant.

Wildlife - There is some potential for seabirds to get caught in traps, and on rare occasions, this can result in the death of the bird. Trapping and monitoring at Haleakala would closely follow the protocols that have already been established by NPS. This includes appropriate trap placement and regular monitoring. Therefore, potential adverse impacts to seabirds as a result of the proposed mitigation are anticipated to be minimal. The National Park Service indicates that an incidental Hawaiian petrel capture rate occurs at a rate of 0.17 birds/100 traps/year (NPS, pers. Comm. 11/25/2011). These birds are released unharmed.

If diphacinone (or another rodenticide) is used to control rats at Haleakala, the adults of the Covered seabird species are not expected to be attracted to the toxin or eat organisms that have been contaminated (as described above). Thus, the use of rodenticides is not anticipated to negatively impact seabird populations (DOFAW 2009b).

Historical/Archaeological/Cultural Resources - Because all historical, archaeological and cultural resources will be avoided during the implementation of mitigation and management measures, no adverse impacts are expected.

Topography/Geology/Soils - Minor impacts to soil resources and topography may occur due to trampling by monitors during fencing or implementation of predator control at the site. Regular visits to the mitigation site will occur and existing trails will be used whenever possible to reduce impacts to topography and soils.

Water Resources - Some impacts to the local hydrology or water resources may occur due to trampling when monitoring the success of mitigation measures or while implementing measures such as trapping. However, impacts will be kept to a minimum as existing trails will be used as much as possible. Rodenticides will be contained within bait boxes and will comply with all labeled instructions accompanying the use of the rodenticide. No significant impacts to water resources are expected from the use of rodenticides.

Air Quality - Only minor impacts to air quality are expected as a result of vehicles and helicopters using fossil-fuel fired internal combustion engines transporting staff and equipment to the site during implementation and monitoring of mitigation measures.

Noise - Vehicles will be used to conduct regular site visits to mitigation sites during the monitoring or implementation of mitigation measures. Regular visits to the mitigation sites will occur (weekly or monthly) and the noise due to transportation is anticipated to be of short duration and of low intensity and is not anticipated to significantly increase the noise levels at the site.

Hazardous Substances and Materials - Fuel (diesel or gasoline) will be used to operate vehicles to transport staff and equipment to the site and fuel may be used to run equipment to carry out mitigation measures. Herbicides may be used as part of vegetation control. Proper precautions will be taken when driving and operating equipment and the herbicide will only be applied according the labeled instructions. Therefore, monitoring and implementation of mitigation measures will not result in any significant impacts due to hazardous materials.

Land Use - The proposed seabird mitigation sites are located on state-owned conservation land. Thus, no mitigation measures are anticipated to have any effect on current or planned land uses.

Utilities/Public Services - The vehicles and vehicular trips required for monitoring and implementation of mitigation measures will involve too few vehicle trips (weekly to monthly trips) to significantly affect transportation and traffic.

If Option 2 for Hawaiian petrels is chosen pursuant to the adaptive management strategy, mitigation for Newell's shearwater would be implemented as described in Section 4.11.1.2 (b).

Hawaiian Petrel Mitigation Option 3 (ATST mitigation site): The National Science Foundation (NSF) has proposed six years of monitoring at a 328 acre (133 ha) mitigation site on Haleakala pursuant to their Advanced Technology Solar Telescope (ATST) project (NSF 2010; 2011). The site is located adjacent to the western perimeter of Haleakala National Park on unencumbered land owned by the State of Hawaii. It includes all observatories, broadcast facilities, communication towers, and other structures in the area. The site includes 131 known Hawaiian petrel burrows, 61 of which have been identified as active (NSF 2010). The burrow density in the area adjacent to this mitigation area was found to have a significantly lower burrow density than areas inside the National Park (Hodges and Nagata 2001), and with an expanding population at the National Park and initial implementation of ungulate and

predator control at the site by NSF (NSF 2010), the number of burrows may be higher. Mitigation measures are proposed to be implemented under the ATST HCP until 2016, after which the site may be available as an alternative site for this HCP, if the site has not been allocated as a management site for another project.

Potential Impacts: All of the mitigation measures proposed for KWP II would be implemented to provide net conservation benefits to the Covered Species (e.g., increase in adult survivorship or reproductive success); however, some short-term adverse impacts may occur as described below.

Flora - According to the EA for the ATST conservation measures (NSF 2011), vegetation cover at the ATST mitigation site is generally sparse and no federally or state listed plant species have been observed within the mitigation area. However, the threatened ahinahina or Haleakala silversword (*Argyroxiphium sandwicense* spp. *macrocephalum*) has designated critical habitat within the northwestern portion of the proposed ATST mitigation site (NSF 2011). Predator control and habitat management activities have the potential to result in minor impacts to designated critical habitats due to vegetation disturbance. In order to avoid impacts, gear-cleaning procedures to reduce the introduction of invasive plants and arthropods will be strongly enforced for biologists and/or contractors that conduct predator control or monitoring efforts. By implementing the measures described above, adverse impacts to flora will be insignificant.

Wildlife - There is some potential for seabirds to get caught in traps, and on rare occasions, this can result in the death of the bird. Trapping and monitoring would closely follow the protocols that have already been established at Haleakala by NPS. This includes appropriate trap placement and regular monitoring. Therefore, potential adverse impacts to seabirds as a result of the proposed mitigation are not anticipated.

If diphacinone (or another rodenticide) is used to control mice or other predators, the adults of the Covered seabird species are not expected to be attracted to the toxin or eat organisms that have been contaminated (as described above). Thus, the use of rodenticides is not anticipated to negatively impact seabird populations (DOFAW 2009b).

Topography/Geology/Soils - Minor impacts to soil resources and topography may occur due to trampling by monitors during fencing or implementation of predator control at the site. Regular visits to the mitigation site will occur and existing trails will be used whenever possible to reduce impacts to topography and soils.

Water Resources - Some impacts to the local hydrology or water resources may occur due to trampling when monitoring the success of mitigation measures or while implementing measures such as trapping. However, impacts will be kept to a minimum as existing trails will be used as much as possible. Rodenticides will be contained within bait boxes and will comply with all labeled instructions accompanying the use of the rodenticide. No significant impacts to water resources are expected from the use of rodenticides.

Air Quality - Only minor impacts to air quality are expected as a result of vehicles and helicopters using fossil-fuel fired internal combustion engines transporting staff and equipment to the site during implementation and monitoring of mitigation measures.

Noise - Vehicles will be used to conduct regular site visits to mitigation sites during the monitoring or implementation of mitigation measures. Regular visits to the mitigation sites will occur (weekly or monthly) and the noise due to transportation is anticipated to be of short duration and of low intensity and is not anticipated to significantly increase the noise levels at the site.

Hazardous Substances and Materials - Fuel (diesel or gasoline) will be used to operate vehicles to transport staff and equipment to the site and fuel may be used to run equipment to carry out mitigation measures. Herbicides may be used as part of vegetation control. Proper precautions will be taken when driving and operating equipment and the herbicide will only be

applied according the labeled instructions. Therefore, monitoring and implementation of mitigation measures will not result in any significant impacts due to hazardous materials.

Land Use - The proposed seabird mitigation sites are located on state-owned conservation land. Thus, no mitigation measures are anticipated to have any effect on current or planned land uses.

Utilities/Public Services - The vehicles and vehicular trips required for monitoring and implementation of mitigation measures will involve too few vehicle trips (weekly to monthly trips) to significantly affect transportation and traffic.

If Option 3 for Hawaiian petrels is chosen pursuant to the adaptive management strategy, mitigation for Newell's shearwater would be implemented as described in Section 4.11.1.2 (b).

Tier 2 Mitigation

The best available information indicates the mitigation projects described in the Tier 1 mitigation section, when combined, would produce mitigation benefits adequate to offset all Tier 1 and Tier 2 take addressed in the KWP I and KWP II permit applications. The proposed Makamakaole social attraction mitigation project is expected to mitigate for all of the Tier 1 take of KWP I and KWP II, and at least a portion of the requested take under the Tier 2 of take. For Hawaiian petrels, the proposed project is projected to cover 32% of Tier 2 take for adults and 40% of the Tier 2 for fledglings. Proposed mitigation at the Haleakala Crater Rim site, in conjunction with anticipated benefits at Makamakaole, is sufficient to fully offset all Tier 1 and Tier 2 take of Hawaiian petrel.

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

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

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

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

The mitigation area proposed for mitigation for ATST may be used instead of or in addition to the additional Haleakala Crater South Rim Hawaiian petrel mitigation area to offset Tier 2 project-related take. The site includes 131 known Hawaiian petrel burrows, 61 of which have been identified as active (NSF 2010). The burrow density in the area adjacent to this mitigation area was found to have a significantly lower burrow density than areas inside the National Park (Hodges and Nagata 2001), and with an expanding population at the National Park and initial implementation of ungulate and predator control at the site by NSF (NSF 2010) the number of burrows may well be higher. Mitigation measures are proposed to be implemented under the ATST HCP until 2016, after which the site may be available as an alternative site for this HCP, if the site has not been allocated as a management site for another project. Considering this area's similarity to the South Rim site described above, the number of burrows needed to offset the requested Tier 1 take will be the same as determined for the South Rim site.

4.11.1.2 (b) Newell's Shearwater

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

In addition to collisions with turbines and the permanent met tower, direct take of Newell's shearwater may occur as a result of collision with construction or maintenance vehicles traveling project roads (refers to birds already injured by collision with turbines or towers). No such mortality has occurred to date at the existing KWP facility. Project personnel will be trained to watch for downed petrels and other wildlife and speed limits (10 mph or 16 kph) will be enforced to minimize potential for vehicular strikes to result in death of birds that otherwise might have been able to be rehabilitated. This source of potential mortality does not result in an increase in the amount of direct take expected from the proposed project because such birds would be those not avoiding the WTGs or met tower and, thus, have been accounted for in the mortality modeling.

Potential also exists for Newell's shearwaters to collide with the 1,225 ft (374 m) section of the collection line that crosses the gulch at the upper portion of the project area. This line will be mounted on poles approximately 60 - 90 ft (18 - 25 m) above ground level and will be a maximum of 340 ft (104 m) above the deepest part of the gulch. Precautions to minimize collisions include installing marker balls on the collection line to enhance visibility and placing the collection line in close proximity to an existing transmission line of the same height that also crosses the gulch and is similarly marked. Observation of Newell's shearwaters on Kauai by Day et al. (in review) suggests that collision avoidance rates of powerlines by Newell's shearwaters may be approximately 97% (392 observed birds with 29 birds exhibiting collision avoidance responses and one resultant collision

(=1/30)). Thus, the collision rate of Newell's shearwaters with the overhead collection line is expected to be low. Given that the collision rate with overhead collection lines for Hawaiian petrels is estimated to be 0.05 birds/year (one bird every 20 years), and only 10% of the seabirds transiting the site are Newell's shearwaters, the estimated collision rate of Newell's shearwaters with overhead collection lines is 0.1 birds in 20 years (1 bird/9= 0.1 birds). Given the low occurrence rate of species on the site, their avoidance capabilities, the minimization measures that will be emplaced, the risk of collision for Newell' shearwater on the overhead lines is considered negligible.

The HCP projects that take of Newell's shearwater as a result of collision with project components and vehicle strikes will occur at the average rate of 0.1 shearwaters/year.

Indirect Take

As with Hawaiian petrels, adult and immature shearwaters are most likely to collide with turbines or associated structures while commuting between nesting and feeding grounds during the pre-laying period (April to May), incubation and chick-feeding periods (June to October), and fledging period (October to November). Newell's shearwaters are not expected to be flying across the project area at other times of year. Based on the life history parameters of the species (see HCP) indirect take would be assessed at the rate of 0.46 eggs or chicks per adult taken between May and August, 1.00 chick per adult taken in September through October (Table 4-8).

Estimated Total Take

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

Table 4-8. Calculation of indirect take for Newell's Shearwater.

Newell's shearwater	Season	Average no. of chicks per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Adult	Apr - May	--	0.00	--	0.00
Adult	Jun-Aug	1	0.46	1.0	0.46 eggs/chicks
Adult	Sept-Oct	1	1	1.0	1 chick
Adult	Nov - May	--	0.00	--	0.00
Immature	All year	--	0.00	--	0.00

Because of assumptions concerning unobserved direct take, any one Newell's shearwater found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one, with total direct take then likely to be rounded up to two birds (based on expected results from take monitoring and subsequent adjustments for searcher efficiency and scavenging rates). Moreover, KWP II LLC suggests the ITP and ITL should allow for a total direct take of up to four Newell's shearwaters and the indirect take of two chicks for any given year for the duration of the project. A 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and 15 adults every 20 years).

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

Expected Rate of Take

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

Requested Tier 1 ITP/ ITL Authorization

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

Tier 2 Rate of Take

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

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

KWPII funding assurance for mitigation for all Covered Species of $1,000,000 will be secured in a form approved by the USFWS and DLNR within 30 days of KWPII Permit issuance. KWPII Newell's shearwater take requested will be limited to the Tier 1 take level until KWPII LLC secures, in a form approved by the USFWS and DLNR, a total of $1,554,590, or less with approval of USFWS and DLNR, in funding assurance for the KWPII project, in addition to the seabird mitigation funding already in place pursuant to the KWPI HCP. The KWPII Newell's shearwater take level requested will increase to the Tier 2 level when the KWPII funding assurances are increased to $1,554,590, or with approval of USFWS and DLNR, an amount commensurate with the anticipated remaining mitigation need for this species. KWPII will secure the additional funding assurance within two years of KWPII Permit (License) issuance or within one month of a detected take of Newell's shearwater at KWPII, whichever is sooner.

Based on data collected in the 1990's the population of Newell's shearwater was estimated to be approximately 84,000 breeding and non breeding birds, with a possible range of 57,000 to 115,000 birds (Ainley et al. 1997). Radar studies on Kauai showed a 63% decrease in detections of shearwaters between 1993 and 2001 (Day et al. 2003a). More recently, Griesemer and Holmes (2011) suggest a 75% population decrease over the past two decades, based on radar surveys and Save Our Shearwater (SOS) data. This puts the total population estimate on the order of 21,000 birds. A recent population estimate of Newell's shearwater breeding pairs was approximately 10,305 pairs (Pyle and Pyle 2009). On Maui, it is estimated that there are at least 80, and no more than 200 breeding pairs. Recent declines in Newell's shearwater populations are attributed to loss of nesting habitat, predation by introduced mammals (mongoose, feral cats, rats, and feral pigs) at nesting sites, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997; Mitchell et al. 2005; Hays and Conant 2007).

The requested Tier 1 rate of take over the lifetime of the project represents approximately 0.01% of the total Newell's shearwater breeding population. The requested Tier 2 rate of take over the 20 year period represents approximately 0.02% of the total breeding population. The requested Tier 1 and Tier 2 rate of requested take over the 20-year period represent approximately 1% and 2% of Maui's breeding population, respectively.

Given these very low percentages to the overall population and the expectation of the mitigation program to offset these interim impacts, it is considered extremely unlikely that take caused by the proposed project would result in significant adverse effects to Newell's shearwater at the population level. Rates of take at the Tier 2 level may present a greater risk for the subset of the population that breeds on Maui, which is poorly known but presumed small. Again, at current population levels, Tier 2 rates of take are expected to occur only in the unlikely event that less than 97.5% of the shearwaters passing over the site fail to detect and avoid the turbines and met tower (Sanzenbacher and Cooper

2009). Lack of observed Newell's shearwater mortality at KWP after three years of operation suggests that Tier 2 rates of take are unlikely to occur. As such, the proposed mitigation measures are expected to offset the anticipated take and contribute to the species' recovery by providing a net conservation benefit, as required by State law. For this reason, no significant adverse impacts to the species' overall population, and no significant cumulative impacts to the species, are anticipated.

Minimization and/or Mitigation Measures:

Tier 1 Mitigation

As described above and discussed and agreed upon with the agencies, Makamakaole is the preferred site for seabird mitigation. West Maui is largely dark and free from power lines that project above surrounding terrain. Based on feasibility and location within the Newell's shearwater flight path of the Makamakaole-Kahakuloa watershed, the proposed project has a very high likelihood of success.

However, if the preferred alternative is unsuccessful, or does not fulfill mitigation requirements, the following alternative mitigation actions are proposed for Newell's shearwater. After discussing with the Applicant, DOFAW and USFWS will determine the most appropriate alternative to mitigate the impacts of the project. During years one through five, the Applicant will develop management plans for the following alternative Tier 1 mitigation project sites. Alternatives will be evaluated in the order listed below and implemented as needed to fulfill mitigation requirements:

a) Install predator fencing and manage predators around a Newell's shearwater colony or colonies in West Maui or, if USFWS and DOFAW agree management of a West Maui site is not feasible, control predators at a Newell's shearwater colony or colonies in East Maui.
b) If based on feasibility criteria, in-situ management of Newell's shearwater colonies is not feasible in West Maui, implement a social attraction project at an alternative site on Maui.
c) If USFWS and DOFAW agree that neither in-situ management nor social attraction of Maui Newell's shearwaters are feasible, install predator fencing and manage predators around a Newell's shearwater colony or colonies on either Molokai or Lanai.
d) If DOFAW and USFWS confirm management of Maui Newell's shearwater colonies is not feasible, or will fall short of mitigation goals, implement a social attraction project or projects on Molokai or Lanai to ensure that the collective mitigation efforts result in successful achievement of mitigation goals for KWP II Tier 1 requested take in addition to KWP I's anticipated 20-year take levels and KWP II's Tier 2 requested take level, if triggered based on observed take.

For Newell's shearwaters, there are two possible sites on Maui where in-situ colony protection may be possible (Figure 4-3), but not enough information is available to confirm feasibility of management at these sites. Therefore, as part of the preferred mitigation plan, during the first breeding season after issuance of the ITL/ITP, the Applicant will confirm a breeding site at the upper Kahakuloa area where Newell's shearwaters have been detected previously, including no fewer than 14 survey nights, but no more than 20 survey nights, not necessarily consecutive, between the months of May and August. Fewer nights will be acceptable if the Applicant and USFWS/DOFAW agree that data collected is sufficient to support decisions regarding delineation of a breeding site, determine the feasibility of management and determination of fencing or alternative actions. Surveys may be finished during the second year, at which time the Applicant will assure applicable landowner permitting processes in support of proposed management actions are completed. This approach will be carried out either concurrently or in consecutive years (within years 1-5) at a second site on East Maui to ensure the most informed decisions about feasibility of in-situ colony protection at these sites can be made. There is no indication or data available at this time to suggest that other locations on Maui offer colony protection opportunities.

Both of the potential alternative in-situ colony protection sites are located within areas already fenced for the purposes of ungulate control. Measures to protect the Newell's shearwaters at these sites will consist of the construction of a pest-proof fenced enclosure, similar to the fenced enclosure proposed for the preferred mitigation site. Further protection measures will be similar to those described for Makamakaole, if feasible. The size and location of the fenced enclosure will depend on where the birds are found, and on the landscape features at those sites. Minor crossings of drainages will be

minimized, but may be possible using one-way valves in culverts, allowing unobstructed runoff flow to ensure predators are kept out of the enclosure. Additional feasibility considerations include the topography (excessively steep slopes and significant gulches are not possible to fence), accessibility (the site needs to be accessed fairly reliably for predator control and monitoring purposes), and the enclosure has to be maintained and kept reliably predator free. Regardless of physical constraints to feasibility of this approach, approval of the landowner(s) will have to be obtained, and a contractor will have to be able and willing to construct the enclosure. Feasibility will be made in consultation with the project contractor, landowner(s), DOFAW, USFWS, and other subject specialists when applicable.

The site chosen by KWP II for colony-based mitigation would be selected with the concurrence of the DLNR and USFWS. It is likely that KWP II and KWP will collaborate for this mitigation effort. KWP II would either support an existing conservation need at a known colony or direct mitigation at a newly discovered colony where no management presently exists. The success of the mitigation efforts of KWP II will be measured using the method that is currently implemented at that site at the time. If the chosen mitigation site was previously unmanaged, the same measures of success used to estimate success at managed sites will be applied as appropriate.

If USFWS and DLNR determine that the Makamakaole social attraction site is insufficient and it is determined that in-situ management opportunities are not feasible in West Maui, a second social attraction site will be implemented, as necessary, to offset project-related take of Newell's shearwater. During years 1-5, the Applicant will locate the area or areas in East Maui best suited for Newell's shearwater social attraction project(s) based on flight passage rates and access (landowner permission, terrain, and accessibility). Because the population of Newell's shearwater may be higher in East Maui than it is in West Maui, the benefits of a Newell's shearwater social attraction project or projects in East Maui are expected to be greater than those described for the Makamakaole social attraction project. The most likely sites may be on state land and TNC-managed land along the Koolau Gap or Keanae Valley located north of Haleakala National Park, and on state land east of Haleakala National Park. The Applicant will also conduct surveys consisting of at least 14 survey nights, and no fewer 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 and August. Fewer nights will be acceptable if the Applicant and USFWS/DOFAW agree that data collected is sufficient to support decisions regarding feasibility of implementing subsequent social attraction projects. By the end of year 5, DLNR and USFWS, in consultation with the ESRC and/or Seabird Recovery Working Group, will select the area and the Applicant's plans will be finalized so that implementation of an East Maui social attraction project could begin as early as year 6 if needed.

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

The USFWS requires that if the previously identified in-situ management and social attraction projects on Maui are not feasible, or combined do not fulfill mitigation requirements, opportunities for predator exclusion or management be investigated on Molokai or Lanai. During the first breeding season after the determination that mitigation requirements cannot be met through the proposed projects on Maui, the Applicant will confirm a breeding site on south east Molokai at Kainalu Gulch where Newell's shearwaters have been detected previously, including no fewer than 14 survey nights, but no more than 20 survey nights, not necessarily consecutive, between the months of May and August. Fewer nights will be acceptable if the Applicant and USFWS/DOFAW agree that data collected is sufficient to support decisions regarding delineation of a breeding site, determine the feasibility of management and determination of fencing or alternative actions. Surveys may be finished during the second year, at which time the Applicant will assure applicable landowner permitting processes in support of proposed management actions are completed. This approach will be carried out either concurrently or in consecutive year at a site on Lanai where Newell's shearwaters have been detected previously, to

ensure the most informed decisions about feasibility of in-situ colony protection at these sites can be made. The surveys and determinations may be completed in series, if alternatives are still needed, but will be concluded within the first five years of the KWP II permit life. The surveys and feasibility determinations will be carried out in series according to the sequence outlined above, starting with upper Kahakuloa. Once a feasible alternative has been identified, no further surveys at that, or other sites, will be required.

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

Proposed mitigation measures are expected to offset the anticipated take and contribute to the species' recovery by providing a net conservation benefit, as required by State law. For this reason, no significant adverse impacts to the species' overall population, and no significant cumulative impacts to the species, are anticipated. However, in the event that mitigation efforts are not sufficient to meet the mitigation requirements for one of the seabird species, funding for management actions such as predator control or habitat enhancement will be funded or conducted at an existing seabird colony of that species either on Maui or another island, as practicable.

Potential Impacts: All of the mitigation measures proposed for KWP II would be implemented to provide net conservation benefits to the Covered Species (e.g., increase in adult survivorship or reproductive success); however, some short-term adverse impacts may occur. The potential impacts of the alternative Newell's shearwater mitigation options would be similar to those described for Makamakaole. The exact locations of the alternative Newell's shearwater sites have not be determined; however, critical habitat is known to exist for several plants species in the Kahakuloa and Koolau Gap areas. All applicable state permits and processes will be completed prior to the implementation of the mitigation measures.

Flora - Construction of the fence at Kahakuloa would result in the disturbance and removal of limited amounts of vegetation. The fencelines for the enclosure will be up to 2.4 mi long and 12 ft of vegetation cleared along the fenceline. This will result in the removal of 3.5 ac of vegetation. Construction of the fence at Koolau gap would also result in the disturbance and removal of limited amounts of vegetation. The fencelines for the enclosure will be up to 0.4 mi long and 12 ft of vegetation cleared along the fenceline. This will result in the removal of 30.6 ac of vegetation. For both options, these narrow swaths of disturbance would be widely distributed over geography, and local impacts of constructing the fence would be minimal. Soil disturbance and impacts to topography are expected to be short-term with no significant impacts.

At Kahakuloa, designated critical habitat for four endangered plant species – *Cyanea lobata, Pteris lidgatei,* haiwale (*Cyrtandra munroi*) and oha wai (*Clermontia oblongifolia* spp. *mauiensis*) – occur in the area. In order to avoid and minimize impacts to listed plants and critical habitat, KWP II LLC will hire a qualified botanist to fully survey the area prior to construction and implementation of management activities. Any listed or candidate plant species discovered in the area will be clearly flagged, and appropriate protocols will be used to avoid direct or indirect impacts to listed plants. Fence contractors will be educated regarding the sensitivity of this project including working in critical habitat. Construction of the fence has the potential to benefit designated critical habitat due to reducing grazing, browsing, and/or trampling by non-native species.

At Koolau gap, designated critical habitat for three endangered plant species may potentially occur in the fenced area, depending on where the enclosure is ultimately located. The three plant species are – *Cyanea mceldowneyi*, *Diplazium molokaiense* and nohoanu (*Geranium multiflorum*). In order to avoid and minimize impacts to listed plants and critical habitat, KWP II LLC will hire a qualified botanist to fully survey the area prior to construction and implementation of management activities. Any listed or candidate plant species discovered in the area will be clearly flagged, and appropriate protocols will be used to avoid direct or indirect impacts to listed plants. Fence contractors will be educated regarding the sensitivity of this project including working in critical habitat. Construction of the fence has the potential to benefit designated critical habitat due to reducing grazing, browsing, and/or trampling by non-native species.

The following impacts apply to either mitigation activities at Kahakuloa or Koolau gap or other chosen mitigation sites.

Fence construction can create conditions that facilitate the establishment of non-native species, primarily due to soil and vegetation disturbance. Furthermore, the fencing crew has the potential to unintentionally introduce non-native species via equipment and field gear. Gear-cleaning procedures to reduce the introduction of noxious plant seeds and propagules, as well as arthropods will be strongly enforced for biologists and/or contractors. To reduce the potential for introduction of non-native invasive species at the site, all equipment and materials (including boots) will be stored in a weed-free area and inspected and cleaned prior to accessing the area. Inspection protocols and the need for any post-construction monitoring will be determined in cooperation with DOFAW, USFWS, and MISC.

Minor impacts to flora may occur due to trampling by monitors during the monitoring or implementation of seabird colony management measures such as ungulate control and

predator control. Regular visits to the mitigation site will occur (daily, weekly, or monthly) and existing trails will be used whenever possible to reduce impacts to the flora.

Wildlife - Prior to construction, the final fence alignment will be surveyed by a qualified biologist to document sensitive wildlife, particularly seabird burrows and the Hawaiian hoary bat. The fence will be appropriately placed to avoid adverse impacts to these resources and fence contractors will be trained to identify seabird nesting burrows.

Noise associated with construction may temporarily disrupt seabirds nesting within the area; all construction activities will be conducted outside of the nesting season of the two Covered seabird species to minimize impacts. To minimize the potential for birds to collide with the fence, KWP II LLC will improve the visibility of the fence with steel reinforced white poly-vinyl tape. The tape will be interwoven horizontally at various heights along the fence.

Removal of trees greater than 15 ft will be avoided as much as possible and is not allowed during the Hawaiian hoary bat pupping season (July 1 – August 15). If cutting of trees during this period is required, acoustic surveys will be conducted in the vicinity to document absence of any hoary bat use. During fence construction, if a Hawaiian hoary bat (adult or pup) is discovered near construction activities, the area will be avoided as long as the bat is present. Due to the possibility of fence line impacts involving bats, there will be no barbed wire on any portion of the fence, thereby reducing any possible impalement on the fence. Because the project is designed to protect native habitat through fencing and predator removal, the total impact on the bat population is anticipated to be positive.

The Covered seabird species are not expected to be attracted to diphacinone or another rodenticide (if used to control mice or other predators within the fence) because the adults of the Covered seabird species feed by foraging for fish and other marine organisms offshore (DOFAW 2009b). Seabirds are not expected to be attracted to the toxin or to eat organisms that have been contaminated by eating rodenticide. Thus, the use of rodenticides is not anticipated to negatively impact seabird populations.

There is some potential for seabirds to get caught in traps, and on rare occasions, this can result in the death of the bird. Trap design and placement is aimed at avoiding these non-target effects Therefore, potential adverse impacts to seabirds as a result of the proposed mitigation are not anticipated.

Historical/Archaeological/Cultural Resources - Prior to construction of the fence, the area to be disturbed will be surveyed by a qualified specialist to ensure that all sensitive historical, cultural, and archaeological resources are avoided. Construction of the fence is not expected to impact cultural practices by restricting access due to the remote location of the fence and the size of the area expected to be fenced. Because all historical, archaeological and cultural resources will be avoided during the implementation of mitigation and management measures, no adverse impacts are expected.

Topography/Geology/Soils - Minor impacts to soil resources and topography may occur due to trampling by monitors during fencing or implementation of predator control at the site. Regular visits to the mitigation site will occur and existing trails will be used whenever possible to reduce impacts to topography and soils. The removal of vegetation at the fence will result in temporary impacts to soil and topography, but the re-establishment of native vegetation will result in reduced erosion (Vitousek 1993). To minimize soil erosion, only minimal amounts of clearing will be conducted in order for the fence to be built and the extent and steepness of exposed ground areas will be reduced to the maximum extent possible. The placement of the fence will conform to the natural contours of the ridge. BMPs will also be incorporated as appropriate to reduce erosion and subsequent impacts to topography (e.g., avoiding earthwork during inclement weather, temporary stabilization with geotextile mats, and revegetation with native species). Although fencing will result in some permanent disturbance due to the construction of fence posts and fence burial designed to prevent ungulates from digging through the fence, these narrow swaths of disturbance will be widely distributed over geography, and local impacts of constructing the fence will be minimal. Soil

disturbance and impacts to topography are expected to be short-term with no significant impacts expected.

Water Resources - Some impacts to the hydrology or water resources may occur due to trampling when monitoring the success of mitigation measures or while implementing measures such as trapping. However, impacts will be kept to a minimum as existing trails will be used as much as possible. No significant impacts to surface waters are anticipated from fence construction. The fence will be sited to avoid any waterways. Vegetation would be hand-cleared in areas adjacent to the fence if necessary, with stumps and roots remaining in the ground to prevent soil disturbance. In the event that fencelines are constructed adjacent to surface waters, surrounding vegetation would remain in place to prevent runoff from feral ungulates traversing the outside of the fenceline.

Ungulate control and predator control can potentially improve the water quality at the site by decreasing the number of ungulates and reducing soil erosion. Predator trapping or eradication will limit the input of disease-causing organisms (such as leptospirosis caused by rats) into stream water by reducing the number of feral animals present within the mitigation area. Rodenticides will be contained within bait boxes and will comply with all labeled instructions accompanying the use of the rodenticide. No significant impacts to water resources are expected from the use of rodenticides.

Invasive plant control may include the use of herbicides. Only appropriate herbicides for the area will be used, in accordance with labeled instructions to ensure that no significant impacts to water resources are expected from the use of herbicides for plant control.

Air Quality - Only minor impacts are expected due to actions implemented for seabird mitigation. If fencing and vegetation removal occurs, vehicles and helicopters using fossil-fuel fired internal combustion engines will be used to transport staff and equipment to the mitigation site several times a week. After fencing is complete, regular visits (monthly or weekly) to the chosen site will be required to implement management measures and document reproductive success. The minor air quality impacts will be primarily due to vehicles and helicopters using fossil-fuel fired internal combustion engines transporting staff and equipment to the study site.

Noise - Vehicles or helicopters could be used to conduct regular site visits to mitigation sites during the monitoring or implementation of mitigation measures. Regular visits to the mitigation sites will occur (weekly or monthly) and the noise due to transportation is anticipated to be of short duration and of low intensity and is not anticipated to significantly increase the noise levels at the site. Minor increases in noise are expected during fence construction and vegetation removal due to the possible use of machinery to accomplish the required work. However, the noise is expected to be during normal work hours and the mitigation sites are not near populated areas; thus, noise impacts from these activities are expected to be insignificant. The transportation of equipment and employees by helicopter will temporarily increase noise levels along the flight path. Because relatively few helicopter flights are expected to occur, and flights would occur during normal work hours, this not expected to substantially change the sound levels in the affected areas.

The acoustic attraction proposed for seabirds (if used) will involve the nightly use of remote solar powered digital acoustic attraction players and speakers during the breading season. The use of this equipment will continue until deemed appropriate by USFWS, DLNR, and the Applicant. Due to the remote location of the fence and the low volume of these devices, no significant adverse noise impacts are expected.

Scenic Resources - Most of the fences and corridors will be constructed away from populated areas and will likely not be visible from most public vantage points due to screening by vegetation or other physical features in the landscape. If visible at all, the visual impact would be temporary until regrowth of the understory.

Hazardous Substances and Materials - Fuel (diesel or gasoline) will be used to operate vehicles to transport staff and equipment to the site and fuel may be used to run equipment to carry out mitigation measures. Herbicides may be used as part of vegetation control. Proper precautions will be taken when driving and operating equipment and the herbicide will only be applied according the labeled instructions. Therefore, monitoring and implementation of mitigation will not result in any significant impacts due to hazardous materials.

Land Use - The proposed seabird mitigation sites are located on state-owned conservation land. Thus, no mitigation measures are anticipated to have any effect on current or planned land uses.

Utilities/Public Services - The vehicles and vehicular trips required for monitoring and implementation of mitigation measures will involve too few vehicle trips (weekly to monthly trips) to significantly affect transportation and traffic.

Tier 2 Mitigation

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

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

4.11.1.2 (c) Nene

Past surveys and extensive monitoring prior to and during the nearly five years of operation of KWP have established that a population of nene occurs in the general project area of KWP and KWP II (Day and Cooper 1999; Cooper and Day 2004a; KWP LLC 2007a, 2008a, 2008b). DOFAW operation of the captive release and reintroduction pen at Hanaula near the upper end of the KWP area has, for all intents, led to the establishment of a population of nene in the Kaheawa area. As of 2006, 104 nene had been released from this pen since releases began in 1994. The current population is estimated at 106 birds (DOFAW 2009a). Observations at KWP confirm that nene are resident in and around the KWP and KWP II area. At KWP, birds are on the ground browsing, socializing, nesting, and using habitat and terrain features for cover. Nene are not expected to nest at the KWP II Downroad area owing to a lack of suitable nesting habitat. Nene commonly fly at altitudes that are within the RSZ of the KWP and proposed KWP II WTGs, with most birds observed during daylight and crepuscular periods (SWCA 2010). Potential for the proposed KWP II project to displace any of these birds is discussed below.

Ground Displacement

The KWP II project area supports vegetation that provides limited browsing and sheltering opportunities for nene. Clearing for turbine pads, roads, and other project-related facilities would cause the loss of approximately 43 ac of mostly grassy vegetation out of the 143-ac KWP II project area, with the clearing generally occurring in linear swaths or in circular areas around turbine locations.

Although clearing for the project will result in the presence of (mostly linear and narrow) barren areas within the otherwise rocky and vegetated landscape of KWP II, it is not expected to cause adverse effects to nene as a result of habitat fragmentation. Through the first five years of KWP operations, KWP and DOFAW biologists have observed nene using portions of the combined KWP and KWP II area and, at KWP, successfully nesting within and adjacent to the project area. Nene are frequently seen at KWP utilizing the roads and turbine pads for loafing, walking, and vigilance (behavioral categories from Woog and Black 2001). These observations suggest that nene may readily adapt to the presence of WTGs and should continue to utilize available habitat in the vicinity of the KWP II facilities.

Differences in vegetation between the KWP and KWP II project areas and observations of habitat usage patterns by nene at KWP and KWP II indicate that the quality of nene habitat is not consistent between the two project areas. Habitat such as that in the KWP project area, which has proven capable of supporting nesting and the nutritional requirements of nene, does not appear to be present in the proposed KWP II area (SWCA 2010). Unlike the KWP project area, vegetation in the KWP II project area is dominated by non-native, fire-adapted grasses with some scattered native and non-native shrubs and trees in gulches. The KWP II area is also drier than the KWP area, with lower elevations of the KWP II area receiving as much as 20 inches less rainfall than the upper parts of KWP (SWCA 2010).

Some of the native plant species present at KWP II are identified as species that nene can utilize either as a food source or shrubs to shelter or nest under including ilima, pili, ulei, and aalii (USFWS 2004). Ilima is widely scattered throughout the KWP II area, but of very short stature; pili, aalii, and ulei are scattered sparsely throughout the area or occur only in a few small patches (Hobdy 2009, 2010). Nene food plants that may be impacted by trenching for the underground cables include naupaka kuahiwi (*Scaevola gaudichaudii*), pukiawe (*Leptecophylla tameiameiae*), and ilima. All three species are either scattered sparsely throughout the area, occur only in a few small patches, or consist of a few isolated individuals (uncommon to rare in the area).

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

Over the years repeated wildfire events have severely affected this region and appear to have suppressed the growth of certain native shrubs, which do not occur in large enough patches or high enough stature to provide adequate nesting or shelter for the nene in the area. So far, observations suggest that the higher elevation portions of the upper KWP II project area may only provide a temporary foraging habitat for nene particularly after the rains, and no nene thus far have been detected nesting in the proposed project area. The absence of suitable nesting/sheltering habitat and the low nutritional quality of most plant species common in the area have probably discouraged nene from becoming more established in the KWP II project area (First Wind 2010). The proposed conversion of approximately 43 ac of open field habitat for KWP II project-related purposes may reduce to some degree the amount of low-quality foraging habitat available for nene in the project area.

In addition, a small area will be trenched for the underground cables, which may temporarily eliminate a limited number of native food plants or plants that have potential shelter or nesting functions. Another 2 ac will be permanently disturbed for the construction of the maintenance building, BESS, and substation. These two activities will result in the loss of some native food plants such as ulei, which is common in the area and pukiawe, ilima and ohia (*Metrosideros polymorpha*) which are either scattered sparsely throughout the area or occur only in a few small patches or consisted of a few isolated individuals (uncommon to rare in the area). Aalii is also a common native shrub species in the area, and some individuals may be lost during clearing but are not expected to measurably displace the sheltering/nesting habits of the species. Given the very limited functional value of the areas to be altered, and the abundance of better quality habitat elsewhere, the construction of KWP II is not expected to measurably displace or significantly reduce nene foraging or nesting opportunities.

Direct Take

During flight, nene at KWP are commonly observed displaying avoidance behavior and maneuverability in the vicinity of project structures and moving rotors (KWP LLC 2008b). While this indicates that the geese generally see and avoid the WTGs, nine nene mortalities from wind turbine collisions have been observed since June 2006, when the 20 KWP WTGs became operational. The first incident in October 2007 occurred during an ordinary period of strong trade winds. The second and third incidents were closely correlated with abrupt changes in local weather that included increases in local wind speeds and cloud cover associated with large scale weather events that may have significantly reduced visibility of the WTGs. This suggests that nene may be more vulnerable to collisions with WTGs, met towers, and other structures during periods of strong winds and low visibility (SWCA 2010). Circumstances surrounding the fourth fatality are unknown; the carcass was in an advanced stage of deterioration by the time it was discovered. Five observed mortalities occurred in 2011, largely attributed to the increased number of nene present at one particular site where hydroseeding had taken place.

After adjusting the observed direct take at KWP for the effects of searcher efficiency and carcass removal by scavengers, the estimated total direct take at this facility after five years of operation has been 12.848 birds/year (Kaheawa Wind Power 2009, 2010). However, the take has not been evenly distributed over the years, 2011 was an abnormally high year for nene take with more than twice the take of previous years. This has been attributed to the hydroseeding of a work area at KWP which attracted nene to feed in this area which resulted in a greater number of collisions with the turbines in 2011. No future hydroseeding is expected in the coming years and, based on the consequences observed, other alternatives will be implemented if erosion control is needed, to avoid attracting nene to the project area.

Consequently, to calculate the expected rate of take at KWP II, the average rate of take at KWP is calculated based only on years 2007 to 2010. The total adjusted take for 2007-2010 is 5.5 birds over 4 years, or 1.4 birds/year or 0.07 birds/turbine at KWP. As nene are encountered less frequently in the KWP II area than at KWP (35% of all nene sightings have been made in the Downroad area vs. 65% of sightings at KWP, see Section 3.11.2 (c)), the risk of nene colliding with the turbines is assumed to be 0.54 (=35/65) times the risk at KWP per turbine. This results in an expected mortality of 0.04 birds/turbine/year or 0.5 birds/year for all 14 turbines combined (SWCA 2011).

In addition to collisions with WTGs, some potential exists for nene to collide with the permanent met tower or overhead lines. To date, no nene has been found to have collided with met towers or overhead lines at KWP. This likely was and has been the result of these birds largely being diurnal and highly capable of avoiding stationary objects. The potential for nene to collide with the met tower is essentially accounted for in the estimated rate of take extrapolated from the KWP data since the rate of take at KWP was developed by dividing the sum of all project-related take (take caused by the permanent met tower was zero) and dividing that by the number of turbines (SWCA 2010).

Concerns that revegetation measures conducted on-site may present foraging opportunities for nene, thereby attracting nene to the vicinity of the WTGs, have arisen during discussions with DLNR and KWP II. However, based on observations by KWP biologists, nene are attracted to grass used in immediate revegetation mainly during the early emergent phase of growth and hence revegetation measures will be a source of attraction for only a short period of time. Nene in flight have also been documented to exhibit avoidance behavior around turbines (Kaheawa Wind Power 2008b, 2008c), hence the risk to nene due to attraction resulting from revegetation with grasses is considered minimal.

Indirect Take

It is assumed that adult nene are most likely to collide with turbines and associated structures during non-breeding periods (May through July) or at the end of their breeding period when the adults and young fledglings may travel as family groups. Indirect take to account for loss of dependent young will be assessed for adult nene only when mortality occurs during the breeding season (August to April). Based on life history information on the species (see HCP), the amount of indirect take that would be assessed for each direct take of an adult nene during the months of October through March is 0.09. The amount of indirect take assessed for each direct take of an adult bird during the breeding season would be 0.04 (Table 4-9).

Table 4-9. Calculation of indirect take of Nene.

Nene	Season	No. fledglings per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect (A*B*C)
Adult, any gender	Oct-Mar	0.3	0.60	0.5	0.09
Adult, any gender	April, Aug, and Sep	0.3	0.25	0.5	0.04
Adult, any gender	May–July	--	0.00	--	0.00
Immature	All year	--	0.00	--	0.00

Estimated Total Take

Based on estimated rates of direct and indirect take, annual take of this species resulting from project operations is expected to be no more than 0.55 birds or essentially one bird per year. This is based on the expected rate of 0.50 adults/year with assessment for indirect take (0.50 + (0.09 fledglings/year x 0.50) = 0.55).

The DLNR and ESRC have recommended that annual take limits allow for at least one observed take a year. Because of assumptions concerning unobserved direct take, any one nene found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one that would be rounded up to two birds. Moreover, as take may be distributed unevenly over the years, KWP II LLC suggests the ITP and ITL should allow for a total direct take of at least four adult nene and the indirect take of one fledgling for any given year for the duration of the project. While the second bird taken under this scenario would be assumed and, therefore, of unknown age or gender, it will be assumed that all birds taken through "unobserved direct take" are adults. Because nene could be flying through the project area at any time of year, the likelihood of an "assumed taken" nene being in breeding condition is 37.5% based on a breeding period of 4.5 months (a one month incubation period followed by parental care for 3.5 months; 4.5 / 12 = 0.375).

Consequently, following the above table, indirect take will be assessed to nene lost through "unobserved direct take" at the rate of 0.06 fledglings/nene (0.3 x 0.375 x 0.50 = 0.0563). In addition to the annual rate of take, a 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year (e.g., take for Species A could be authorized as three individuals in any given year but not more than five individuals total every 5 years and 15 adults every 20 years). Expected rates of take and rates of take requested to be authorized by the ITP and ITL through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as "Tier 2".

Expected Rate of Take

Annual average	0.50 adults/immatures and 0.05 fledglings
20-year project life	11 adults/immatures and 1 fledgling

Requested Tier 1 ITP/ITL Authorization

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

Tier 2 Rate of Take

One-year period	Total direct take of >4-6 adults/immatures and >1 fledgling
5-year period	Total direct take of >8-12 adults/immatures and >2-3 fledglings
20-year limit	Total direct take of >18-27 adults/immatures and >2-3 fledglings

The most current statewide population estimate for nene is between 1,300 and 1,500 individuals, with 315 birds occurring on Maui (DOFAW, unpubl.). For the statewide population, the Tier 1 rate (1.05 birds/yr) and Tier 2 rate (1.5 birds/yr) of take requested for nene over the 20-year period represents a take of 0.08% and 0.12% of the population per year. In the unlikely event that all the requested take were to occur at once, it will impact roughly 1.62% (Tier1) and 2.31% (Tier 2) of the species' population, respectively. This is not expected to cause a decline in the status of the species. For the Island of Maui, the Tier 1 rate of take represents 0.3% of the island's population per year and the Tier 2 rate represents 0.5% of the island's population per year. In the unlikely event that all the requested take were to occur at once, it will impact roughly 15.56% of the island's population and the Tier 2 rate represents 22.22% of the island's population. Should take occur at Tier 2 levels and persist indefinitely, this could result in a decline of the local population that has been established in the vicinity of the Hanaula release pen. However, when considered in light of the proposed mitigation, Tier 1 and Tier 2 mitigation are expected to exceed the requested take at the required tier well before the end of the permit term and, for this reason, no significant adverse impacts to the species' overall populations are anticipated.

Minimization and/or Mitigation Measures:

The following measures will be employed to avoid and minimize the potential for construction and operation of the proposed project to adversely affect nene:

- Surveys will be performed in areas to be cleared for project construction to ensure that no active nene nests would be disturbed or destroyed by vegetation clearing activities;
- Areas temporarily disturbed during construction of the KWP II project will be revegetated in consultation with DOFAW to ensure that nene will not be attracted to areas where they would be at increased risk of adverse impacts from project operation or create a fire hazard; and
- Any ongoing management of vegetation in the project area (such as mowing, clearing, or planting) will be conducted in consultation with DOFAW biologists to ensure that nene will not be attracted to areas where they would be at increased risk of adverse impacts from project operation.

Mitigation for nene will take into account the expected annual direct and indirect take of the species, as well as any loss of productivity that might occur. Mitigation for any direct take of adults and direct or indirect take of goslings or fledglings will be provided through replacement by fledglings and possibly adults. However, when adults are replaced by fledglings, the survival rate of fledglings to adulthood will be taken into account in determining the number of fledglings needed to offset expected levels of take of adult birds. The proposed mitigation will also account for possible loss of production during the lag years between take of adult birds and the sexual maturity of fledglings.

In addition to the implementation of mitigation measures, a wildlife biologist will make systematic visual observations of nene activity from representative locations within the KWP II project area during the first year of project operation. The objective of these observations will be to document how nene use the project area following construction and to record observations of nene behavior and activity in the vicinity of the WTGs, including in-flight response to collision hazards (e.g., changing flight direction to avoid WTGs). Incidental observations of nene activity and response to the turbines will also be recorded under the WEOP.

<u>Tier 1 Mitigation</u>
DLNR and the State Department of Transportation have been directed to develop and implement a five-year Nene Action Plan that will translocate and monitor the Kauai Lagoons nene population. According to the proclamation signed on April 14, 2911, "the five-year Nene Action Plan will be consistent with efforts to protect, maintain, restore, or enhance the endangered species to the greatest degree practicable." The emergency proclamation signed by Governor Abercrombie is to terminate on June 30, 2016. The nene are being translocated from Kauai to release pens on Maui and on the Island of Hawaii and their monitoring and management subsequent to their release is funded by the proclamation for five years till June 2016. DOFAW anticipates that the translocated nene populations will increase and at the end of the proclamation, additional release pens will be needed to accommodate the increased bird population. Birds return to the release pen to nest and productivity of nesting pairs fall as a result of overcrowding. In 2010, at Puu O Hoku Ranch on Molokai, 42

goslings hatched but only two fledged into the wild, resulting in a 5% rate of fledging success for goslings. The high mortality was due to aggressive adults harassing and trampling young, which was attributed to overcrowding. Under normal managed conditions, all goslings bred within the release pen are expected to fledge (Medeiros 2011).

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

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

It is expected that five breeding pairs with their goslings will be transferred to the pen from overcrowded pens *each year* (Medeiros 2011). The five breeding pairs that are transferred are expected to be moved with at least 10 associated goslings (Medeiros 2011). Table 6.9 shows that KWP II will be expected to accrue a minimum 42 fledglings after five years of management. This is calculated with the assumptions that 90% of the goslings fledge under managed conditions in the new pen, that a small amount of natural mortality occurs, and that these goslings would have had a 5% chance of survival in the overcrowded pen. This rate of accrual will exceed the Tier 1 requested take by eight fledglings (a total of 34 fledglings needed, see Table 6.8) in five years. Table 4-10 does not take into account the increasing number of breeding pairs that will be present each year, only the goslings from the five breeding pairs that are transferred each year. In reality, a total of 25 breeding pairs that could be nesting in the pen will have been added by the end of Year 5. This additional accrual is not accounted for in Table 4-10 as the previously released breeding pairs are not expected to return to the pen to breed every year. In addition, fledglings that have matured may also be expected to return to the pen to breed in subsequent years. Therefore, it is anticipated that there will be substantially more than five breeding pairs in the new release pen after five years of management. Thus, the accrual of 42 fledglings after five years of management is considered to be a very conservative estimate.

Table 4-10. Fledgling accrual for KWP II Tier 1 mitigation.

	Number of goslings					Total Accrual
No. goslings reared in pen (from 5 breeding pairs)	10	10	10	10	10	
No. fledge (90% of all goslings)	9.00	9.00	9.00	9.00	9.00	
Accrual (minus baseline of 5% survival in a crowded pen)	8.6	8.6	8.6	8.6	8.6	**42.8**

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

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

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

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

Potential Impacts: All of the mitigation measures proposed for KWP II would be implemented to provide net conservation benefits to the Covered Species (e.g., increase in adult survivorship or reproductive success); however, some short-term adverse impacts may occur as described below.

Wildlife - No adverse impacts are expected from the proposed mitigation activities are expected because established protocols will be followed to avoid disturbances to nene, as outlined in the Haleakala Ranch Safe Harbor Agreement (2009).

Flora - Botanical surveys will be conducted prior to the construction of the release pen and any sensitive or listed species will be avoided. The release pen is anticipated to be 5-6 ac large, with a fenceline of approximately 1.2 mi (2 km) long with up to 12 ft of vegetation removed along the fenceline. This will result in the clearing of up to 1.7 ac of vegetation. The vegetation at the potential release pen site(s) are primarily non-native grassland that is actively grazed (Hufana 2011) and are expected to grow back after removal. No critical habitat exists in the areas where the nene release pen will be erected. These narrow swaths of disturbance would be widely distributed over geography, and local impacts of constructing the fence would be minimal. Soil disturbance and impacts to topography are expected to be short-term with no significant impacts.

Topography/Geology/Soils - Minor impacts to soil resources and topography may occur due to trampling by monitors during fencing or implementation of predator control at the site. Regular visits to the mitigation site will occur and existing trails will be used whenever possible to reduce impacts to topography and soils.

Water Resources - Some impacts to the local hydrology or water resources may occur due to trampling when monitoring the success of mitigation measures or while implementing measures such as trapping. However, impacts will be kept to a minimum as existing trails will be used as much as possible.

Air Quality - Only minor impacts to air quality are expected as a result of vehicles and helicopters using fossil-fuel fired internal combustion engines transporting staff and equipment to the site during implementation and monitoring of mitigation measures.

Noise - Vehicles will be used to conduct regular site visits to mitigation sites during the monitoring or implementation of mitigation measures. Regular visits to the mitigation sites will occur (weekly or monthly) and the noise due to transportation is anticipated to be of short duration and of low intensity and is not anticipated to significantly increase the noise levels at the site.

Hazardous Substances and Materials - Fuel (diesel or gasoline) will be used to operate vehicles to transport staff and equipment to the site and fuel may be used to run equipment to carry out mitigation measures. Herbicides may be used as part of vegetation control. Proper precautions will be taken when driving and operating equipment and the herbicide will only be applied according the labeled instructions. Therefore, monitoring and implementation of mitigation measures will not result in any significant impacts due to hazardous materials.

Land Use - The proposed mitigation site is located on private land. Present operations on Haleakala Ranch include cattle ranching, recreational camping, and recreational hunting (Haleakala Ranch Company 2009). An open-top release pen was constructed at the site in May 2011 to help establish a population of nene in the area. Thus, no mitigation measures are anticipated to have any effect on current or planned land uses.

Utilities/Public Services - The vehicles and vehicular trips required for monitoring and implementation of mitigation measures will involve too few vehicle trips (weekly to monthly trips) to significantly affect transportation and traffic.

Tier 2 Mitigation

The Applicant will provide additional funding for three years of management and releases at the nene release pen as described in Tier 1 mitigation above.

Additional Mitigation

KWP II LLC will also fund the construction and operation of an additional nene release pen at an approximate cost of $150,000 and at a location to be determined by DLNR, and provide funding for a truck (up to $10,000), up to three years of staffing ($20,000/yr), helicopter gosling release ($2,000/yr), and the purchase of goslings (number yet to be determined), if any of the following occurs:

1. The nene mitigation occurs at a site with a SHA which is terminated before the end of the terms of this HCP. The replacement pen will be established at a replacement site prior to the return of the original site to baseline conditions. The birds present at the original site will be translocated to the replacement site as needed.
2. The nene population at Hanaula (associated with the release facility located above the KWP II project area), which is currently on the increase and believed to be self-sustaining, shows a decline over any five-year period for reasons directly attributable to take resulting from operation of the KWP II project.

4.11.1.2 (d) Hawaiian Hoary Bat

Low rates of activity by the Hawaiian hoary bat have been measured in the project area. The lack of visual observations and low recorded activity levels suggest that only a small number utilize the general area. Bats are not expected to breed or roost in the project area due to the lack of trees. Due to the similarity in terrain between KWP and KWP II, the estimated mortality at KWP II is expected to be similar or lower than the mortality rates occurring at the existing KWP site. Hawaiian hoary bats breed from 0 to 4,200 feet (1,280 m) in elevation (Menard 2001); thus, it is possible that volent juveniles occur in the project area in the latter portion of the breeding season.

Direct Take

The potential for take of the Hawaiian hoary bat is believed to be very low based on the surveys that have been conducted at the KWP and KWP II project areas, the limited available information regarding the species occurrence on West Maui, and the apparent relatively low susceptibility of resident (versus migrating) bats to collisions with wind turbines in general. However, the occurrence of at least a few individuals in the project area has been documented, and two observed fatalities have been recorded at the KWP facility over five years of project operation (First Wind and KWP LLC 2011). The two fatalities recorded at KWP equate to an observed direct take of 6 bats after adjustments for

unobserved take, resulting in an average of 1.2 bats/year or 0.06 bats/turbine/year (First Wind and KWP LLC 2011). Extrapolating this rate to KWP II results in an average direct take of 0.84 bats/year for all 14 turbines proposed at KWP II (SWCA 2011).

Potential for bats to collide with met towers or cranes is considered to be negligible because they would be immobile and should be readily detectable by the bats through echolocation. At Mountaineer Wind Energy Center in West Virginia, bat fatalities were recorded at operating turbines, but not at turbines that remained non-operational. This supports the expectation that presence of the stationary structures such as an un-guyed lattice met tower and cranes should not result in bat fatalities (Kerns et al. 2005). No bats have been found to have collided with the guyed met towers at KWP after five years of operation or with any cranes during the construction phase of that project. No downed bats have been found during the weekly searches of the one permanent met tower at the Kahuku Wind Power site.

Indirect Take

Hoary bats are thought to move to higher elevations during the months of January through March (Menard 2001), and so may be less prevalent in the project area during those months. However, given the lack of empirical data and for the purposes of the HCP, it is assumed that levels of bat activity on site remain constant throughout the year. Consequently, adult bats are considered to have equal potential to collide with turbines throughout the year and regardless of breeding status.

Hawaiian hoary bats breed between April and August (Menard 2001). Females are solely responsible for the care and feeding of young, and twin pups are typically born each year, although single pups sometimes occur. To date, no breeding records for Hawaiian hoary bat exist for Maui, however, any female bats directly taken from April through August will be examined and, if determined to be lactating, indirect take will be assessed. No indirect take will be assessed for female bats found at other times of year, or for male or immature bats found at any time of year. The rate at which indirect take will be assessed for lactating female bats found during the months of April through August is 1.8 juveniles per adult female as indicated in Table 4-11 below.

Table 4-11. Calculation of indirect take for the Hawaiian Hoary Bat.

Hawaiian hoary bat	Season	Average no. of juveniles per pair (A)	Likelihood of breeding (B)	Parental contribution (C)	Indirect take (A*B*C)
Female	Lactating	1.8	1.0	1.00	1.80
Female	Not Lactating	--	0.0	--	0.00
Male	All year	--	0.0	0.00	0.00
Immature	All year	--	0.0	--	0.00

Estimating Total Take

As indicated, the average rate of direct take of Hawaiian hoary bats as a result of project operations is expected to be 0.84 bats per year. The implementation of low wind speed curtailment is anticipated to further reduce take by an average of 70% (Arnett et al. 2009, 2010), thus the expected take is 0.25 bats/yr. Indirect take associated with this level of direct take would result in a maximum of 0.45 juveniles per year (0.25 x 1.8), resulting in a total adjusted take of 0.70 bats/year or essentially one bat per year (First Wind and KWP LLC 2010; SWCA 2011).

As with the other species addressed in this HCP, the DLNR and ESRC have recommended that annual take limits allow for at least one observed take a year. Again, because of assumptions concerning unobserved direct take, any one Hawaiian hoary bat found to have collided with a project component in a year will lead to an assessment of total direct take for that year of greater than one likely to be rounded up to four bats (based on expected results from take monitoring and subsequent adjustments for searcher efficiency and scavenging rates). Existing literature on adjusting total direct take for bats

suggest that a ratio of one observed take to three unobserved takes is not unreasonable and may be conservative (e.g., Arnett 2005; Jain et al. 2007; Fiedler et al. 2007).

For this project, it will be assumed that all Hawaiian hoary bats taken through "unobserved direct take" will be adults and will have a 50% chance of having been female (based on the sex ratio of males to females during the breeding season). In addition, because bats most likely would be flying through the project area from April through November, spanning a period of eight months, the likelihood of a female bat having dependent young is assumed to be 13%. This is based on the information that Hawaiian hoary bats have one brood a year, and are expected to have dependent young one month out of the eight months (parental care of one month after birth; NatureServe 2008) present on site. Further, parental care is limited to a period June through September. Consequently, indirect take will be assessed to bats lost through unobserved direct take at the rate of 0.1 juveniles/bat (0.5 x 0.13 x 1.8 = 0.12).

Indirect take assessed to a total direct take of 4 bats could range up to 2.1 juveniles (1 observed direct take + 3 unobserved direct takes). Consequently, KWP II LLC suggests the ITP and ITL should allow for a total direct take of up to 4 adult or volent juvenile bats and the indirect take of up to 2 dependent juvenile bats per year for the duration of the project. A 5-year and 20-year take limit based on the expected multi-year average rate of take are also proposed. This calculation does not use a multiple of the annual rate of take because the actual expected take will vary year to year. Expected rates of take and rates of take requested to be authorized by the ITP and ITL through the expected 20-year life of the project are summarized below, along with rates of take considered to qualify as "Tier 2".

Expected Rate of Take

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

Requested Tier ITP/ITL Authorization

One-year period	4 adults/immatures and 2 juveniles
5-year limit of take	6 adults/immatures and 3 juveniles
20-year limit	6 adults/immatures and 3 juveniles

Tier 2 Rate of Take

One-year period	Total direct take of 5-9 adults/immatures and 3-5 juveniles
5-year period	Total direct take of 7-9 adults/immatures and 3-5 juveniles
20-year limit	Total direct take of 7-9 adults/immatures and 3-5 juveniles

Population estimates for all islands in the state in the recent past have ranged from hundreds to a few thousand bats (Menard 2001). The Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998) states "since no accurate population estimates exist for this subspecies and because historical information regarding its past distribution is scant, the decline of the bat has been largely inferred." Because the abundance and distribution of the Hawaiian hoary bat throughout its range is not known, it is difficult to gauge the effect that take of Hawaiian hoary bat resulting from the proposed project may have on the population of this species.

The Tier 1 requested take is for 8 total bats over 20 years, resulting in an annual rate of take at 0.45 bats/yr. This low rate of take is unlikely to adversely affect the population on Maui and even less likely to impact the status of the species on other islands (such as Hawaii and Kauai) where populations are assumed to be more robust. Given that only a small population of bats is expected to be present on the island, it is very unlikely that all 8 bat mortalities will occur at once. If this occurs, it could impact the local resident population, but is unlikely to affect the population as a whole. However, the Applicant's proposed mitigation which will occur on Maui is expected to offset the anticipated take occurring on the island, and contribute to the species' recovery by increasing the productivity and survival rates of Hawaiian hoary bats utilizing the restored forest. For these reasons, no adverse impacts to the species' overall population are anticipated.

The Tier 2 rate of take (14 bats total or 0.7 bats/yr) is still unlikely to impact the local population given the low expected yearly rate of take of less than a bat a year. However, in the very unlikely event that all the mortality occurs at once, the take could impact the resident population on Maui, but is still unlikely to affect the population as a whole. However, the Applicant's proposed mitigation for the anticipated take (see below) which is being implemented on Maui is expected to offset the take at the required tier and ultimately contribute to the species' recovery by increasing the productivity and survival rates of Hawaiian hoary bats utilizing the restored forest. For these reasons, no adverse impacts to the species' overall population are anticipated.

Minimization and/or Mitigation Measures:

Because of the lack of life history information on the Hawaiian hoary bat, research is identified as one of the key components in achieving the recovery of this subspecies. The Recovery Plan for the Hawaiian hoary bat states that, "… Research is the key to reaching the ultimate goal of delisting the Hawaiian hoary bat because currently available information is so limited that even the most basic management actions cannot be undertaken with the certainty that such actions will benefit the subspecies …" (USFWS 1998). Recent research by Gorresen et al. (2008) on Hawaiian hoary bat detectability and occupancy has identified several key areas of research required to improve life history knowledge including: determining bat occupancy in different habitats; determining bat distribution across seasons on a local and regional scale; determining seasonal and daily peak bat activity periods; and determining whether bats are widely distributed on Hawaii, Maui and Kauai, with stable or increasing populations for at least 10 years. Development and implementation of a survey and monitoring program remains a high priority and a key recovery objective for the Hawaiian hoary bat (Gorresen et al. 2008; USFWS 1998).

<u>Tier 1 Mitigation</u>
KWP II LLC proposes, with the approval of DLNR and USFWS, to conduct the following:

1.) On-site surveys to add to the knowledge base of the species' status on West Maui: KWP II LLC will continue to survey for and monitor Hawaiian hoary bats within and in the vicinity of the KWP II project area. Surveys will be conducted during years when intensive fatality monitoring is conducted to allow observed activity levels to be correlated with any take that is observed. KWP II LLC will also join the Hawaii Bat Research Cooperative (HBRC). Survey protocols will be developed prior to start of project operations, in consultation with HBRC, with approval by USFWS and DLNR. Up to twelve Anabat detectors will be deployed at KWP II and the vicinity. The goal of this research will be to document bat occurrence, habitat use and habitat preferences on site, as well as identify any seasonal and temporal changes in Hawaiian hoary bat abundance.

2.) On-site research into bat interactions with the wind facility: In conjunction with the study to determine habitat utilization by bats at KWP II and its vicinity, KWP II proposes to conduct additional on-site surveys that will contribute to identifying areas of potential interactions and vulnerabilities of Hawaiian hoary bats at wind facilities. KWP II will survey for bat activity near turbine locations for the first two years of operation using acoustic bat detectors. Thermal imaging or night vision technology will be used to assist acoustic monitoring as trends are detected and would follow similar protocols developed during pre-construction monitoring. These data will be analyzed in an effort to determine seasonal and daily peak bat activity periods on-site, and comparison of data with pre-construction activity levels will help determine if bats are being attracted to the wind facility. Additionally, incidental bat observations will be recorded under the WEOP. These on-site surveys are expected to advance avoidance and minimization strategies that wind facilities in Hawaii and elsewhere can employ in the future to reduce bat fatalities.

3.) Implementation of management measures: Kahikinui Forest Reserve has been proposed by DOFAW as a potential site for restoring and providing additional foraging and roosting habitat for bats. Kahikinui Forest Reserve, located on the leeward flank of Haleakalā, encompasses approximately 8,000 ac of tropical dryland forest, with elevation ranging from 4,400 to 9,200 ft. The understory of the koa ohia montane mesic forest (3,500-6,500 ft elevation) is heavily degraded by ungulates and the ohia-mamane subalpine dry forest (6,500-8,000 ft elevation) is also severely damaged by ungulates. From 8,000-9,200 ft, a relatively intact pukiawe-ohelo *Vaccinium calycinum*) dry alpine shrubland still occurs. Fencing of the Kahikinui Forest Reserve to exclude ungulates will enable the

koa-ohia montane mesic forest to regenerate naturally and is expected to create additional habitat for the Hawaiian hoary bat.

KWP II will provide funding to DOFAW to fence and manage and monitor for bats at a distinct area within the Kahikinui Forest Reserve project. A 338 ac subunit at Kahikinui has been identified as a suitable mitigation site and is large enough to encompass the mitigation area requirement. However, if sufficient partnerships can be secured to ensure management of the whole of Kahikinui, KWP II will contribute to a portion of the cost for overall management. The fencing, ungulate removal and habitat restoration of Kahikinui is expected to take six years with a subsequent yearly maintenance of the habitat and fenceline throughout the remainder of the 20-year permit period. The monitoring of bats at Kahikinui and the implementation of restoration actions will be the responsibility of DOFAW. However, KWP II will remain responsible for ensuring that the mitigation actions are sufficient to offset the requested take and will result in a net benefit to the Hawaiian hoary bat. The location of the mitigation area may be modified with the approval of DOFAW and USFWS.

Potential Impacts: All of the mitigation measures proposed for KWP II would be implemented to provide net conservation benefits to the Covered Species (e.g., increase in adult survivorship or reproductive success); however, some short-term adverse impacts may occur as described below. Because Kahikinui Forest Reserve is situated on State land within a Conservation District, a State EA would be prepared prior to construction in accordance with Chapter 343 of HRS and that document would provide a more thorough assessment of impacts of the proposed fence, as well as specific minimization measure to be implemented by DOFAW.

Flora - Restoration activities at Kahikinui will have a positive effect on the native plants present at the site by removing invasive vegetation and replacing it with native species. Ungulate control will reduce the number of ungulates within the mitigation area, resulting in a positive impact on the flora due to the reduction of trampling, rooting and grazing by introduced ungulates.

Minor impacts to the flora at Kahikinui Forest Reserve may occur due to fence construction and other management measures. Fence construction and management at the Kahikinui Forest Reserve would result in the disturbance and removal of limited amounts of vegetation. The fenceline will be up to 3.4 mi in length and 12 feet of vegetation will be cleared along the fenceline resulting in temporary removal of up to 5.0 ac of vegetation. These narrow swaths of disturbance would be widely distributed over geography, and local impacts to the flora due to the constructing the fence would be minimal. Prior to construction, the final fence alignment would be surveyed by a qualified botanist to ensure the fence would be appropriately placed to avoid adverse impacts to sensitive plants. Flora disturbance as a result of fence construction is expected to be short-term with no significant impacts expected. Trampling by monitors during the monitoring or implementation of bat management measures (such as vegetation maintenance and restoration) may also result in minor impacts to botanical resources. Regular visits to the mitigation site will occur (daily, weekly, or monthly) and existing trails will be used whenever possible to reduce impacts to the flora.

Increased foot traffic, fence construction, and management activities (planting, ungulate control, weed control, monitoring) can create conditions that facilitate the establishment of non-native species, primarily due to soil and vegetation disturbance. Furthermore, the fencing crew has the potential to unintentionally introduce non-native species via equipment and field gear. To reduce the potential for introduction of non-native invasive species (e.g., plant seeds, propagules, arthropods) at the site, all gear, equipment and materials (including boots) will be stored in a weed-free area, and inspected and cleaned prior to entry into the area.

Various federally/state listed plant species have designated critical habitat in the Kahikinui Forest Reserve and the vicinity including mahoe (*Alectryon macrococcus*), ahinahina (*Argyroxiphium sandwicense* spp. *macrocephalum*), kookoolau (*Bidens micrantha* spp. *kalealaha*), oha wai (*Clermontia lindseyana*), *Diellia erecta*, *Diplazium molokaiense*, Hawaiian re-flowered geranium (*Geranium arboretum*), nohoanu (*Geranium multiflorum*), *Neraudia sericea*, wawaeiole (*Phlegmariurus mannii*), and *Phyllostegia mollis*. It is unknown whether

individuals of these plants actually occur in the area; however, fence construction, monitoring, and management activities have the potential to impact listed plants and their designated critical habitats. In order to avoid and minimize impacts to listed plants and critical habitat, a qualified botanist will fully survey the area prior to construction and implementation of management activities. Any listed or candidate plant species discovered in the area will be clearly flagged, and appropriate protocols will be used to avoid direct or indirect impacts to listed plants. Fence contractors will be trained regarding the sensitivity of this project including working in critical habitat. By implementing these measures, adverse effects to listed plant species and plant critical habitat will be insignificant. Moreover, construction of the fence has the potential to benefit listed plants and their designated critical habitats due to reducing grazing, browsing, and/or trampling by non-native species.

Wildlife - Approximately 990.86 ac of critical habitat for the *Manduca blackburni* (Blackburn's sphinx moth) occurs in the southwestern portion of the Kahikinui Forest Reserve. If mitigation measures are proposed within *M. blackburni* critical habitat, the area potentially affected by mitigation measures would be surveyed by a qualified specialist to avoid adverse impacts to the species. Potential larval host plants for the moth, including *Nicotiana glauca* (tree tobacco) and other plants in the Solanaceae family, would be carefully examined during the survey. If moth sign or larvae are found within areas to be affected by mitigation measures, a protocol similar to that developed by the USFWS would be implemented to avoid direct take of Blackburn's sphinx moths at Kahikinui. This includes measures such as checking *N. glauca* for sign of larvae, leaving trees with larvae or sign of larvae for 30 days, cutting trees without sign or larvae at ground level and leaving the root ball and soil in the surrounding 30 foot radius for a period of one year before ground disturbance (SWCA 2011). Any updated agency guidance on this protocol at the time of implementation will be incorporated. The fencing and restoration of native habitat at the Kahikinui Forest Reserve is expected to positively benefit the Blackburn's sphinx moth by protecting and enhancing potentially suitable habitat.

Prior to construction, the final fence alignment will be surveyed by a qualified biologist to document sensitive wildlife, particularly seabird burrows and the Hawaiian hoary bat. The fence will be appropriately placed to avoid adverse impacts to these resources and fence contractors will be trained to identify seabird nesting burrows.

Restoration of the Kahikinui Forest Reserve is expected to benefit Hawaiian petrel, as active petrel burrows that have been identified in the upper portion of the area (Tetra Tech EC, Inc. 2011b) would be protected from nonnative ungulates, cats, and mongooses.

Historical/Archaeological/Cultural Resources - Because all historical, archaeological and cultural resources will be avoided during the implementation of mitigation and management measures, no adverse impacts are expected.

Topography/Geology/Soils - Minor impacts to soil and topography will occur due to trampling by monitors during implementation or monitoring of bat mitigation measures such as fencing, vegetation maintenance and predator control. Regular visits to the mitigation site will occur (weekly or monthly) and existing trails will be used whenever possible to reduce impacts to soil and topography.

The removal of invasive vegetation may result in temporary impacts to soils and local topography, but the reestablishment of native vegetation will result in reduced erosion (Vitousek 1993). Fencing and subsequent ungulate control will reduce the number of ungulates within the mitigation area, thereby reducing impacts to soil and topography due to the reduction of trampling, rooting and grazing by introduced ungulates.

Water Resources - Monitoring, fencing, ungulate control, predator control and invasive plant control may affect hydrology and water resources. Some impacts to the hydrology or water resources may occur due to trampling when monitoring the success of mitigation measures or while implementing measures such as trapping. However, impacts will be kept to a minimum as existing trails will be used as much as possible. In the event that fencelines are constructed adjacent to surface waters, surrounding vegetation would remain in place to

prevent runoff from feral ungulates traversing the outside of the fenceline. Invasive plant control may include the use of herbicides. Only appropriate herbicides for the area will be used, in accordance with labeled instructions to ensure that no significant impacts to water resources are expected from the use of herbicides for plant control. Ungulate control can potentially improve the water quality at the site by decreasing the number of ungulates and reducing soil erosion.

Air Quality - Minor impacts to air quality are similarly expected to be primarily due to vehicular transport of staff and equipment to the site for research, restoration activities, monitoring or research activities. During the restoration period (two to three years), site visits may occur several times a week, but when the restoration is complete, regular visits (weekly or less) are expected.

Noise - Vehicles will be used to conduct regular site visits to the mitigation site during the monitoring or implementation of mitigation measures. Regular visits to the mitigation sites will occur (weekly or monthly) and the noise due to transportation is anticipated to be of short duration and of low intensity and is not anticipated to significantly increase the noise levels at the site.

Minor increases in noise are expected during fence construction and vegetation removal (may apply to seabird and bat mitigation) due to the possible use of machinery to accomplish the required work. However, the noise is expected to be during normal work hours and the mitigation sites are not near populated areas; thus, noise impacts from these activities are expected to be insignificant.

The transportation of equipment and employees by helicopter, if needed, will temporarily increase noise levels along the flight path. Because relatively few helicopter flights are expected to occur, and flights would occur during normal work hours, this not expected to substantially change the sound levels in the affected areas.

Scenic Resources - Fences constructed for mitigation will be constructed away from populated areas and will likely not be visible from most public vantage points due to screening by vegetation or other physical features in the landscape. If visible at all, the visual impact would be temporary until regrowth of the understory.

Hazardous Substances and Materials - Fuel (diesel or gasoline) will be used to operate vehicles to transport staff and equipment to the mitigation site and fuel may be used to run equipment to carry out mitigation measures. Herbicides may be used as part of vegetation control. Proper precautions will be taken when driving and operating equipment and the herbicide will only be applied according the labeled instructions. Therefore, monitoring and implementation of mitigation measures will not result in any significant impacts due to hazardous materials.

Land Use - The proposed seabird mitigation sites are located on state-owned conservation land. Thus, no mitigation measures are anticipated to have any effect on current or planned land uses.

Utilities/Public Services - The vehicles and vehicular trips required for monitoring and implementation of mitigation measures will involve too few vehicle trips (weekly to monthly trips) to significantly affect transportation and traffic.

Tier 2 Mitigation

The recommended mitigation for Tier 2 would consist of the additional restoration of 84.3 ac of forest at Kahikinui or at another location on Maui. If the acreage is required to be doubled because management is being conducted on State conservation land, KWP II will fund the management of 169 ac (84.3 x 2 = 169 ac) of land.

The Tier 2 mitigation site would be selected and a management plan would be completed for the site within the first five years of the permit term. Ungulate removal and forest restoration objectives used

in Tier 1 would be applied, as adapted, with the approval of DOFAW and USFWS, based on the best available information.

If, at the time the Tier 2 level of take is triggered, new scientific information may indicate mitigation measures other than habitat restoration are more important or pressing for recovery of the Hawaiian hoary bat, KWP II may revise the Tier 2 mitigation plans with the approval of USFWS and DLNR.

> Potential Impacts: The mitigation measures implemented for Tier 2 will be the same as Tier 1, except that the area to be fenced and managed will increase under Tier 2 mitigation. No more than an additional 169 acres will be required for Tier 2 mitigation (in addition to the 338 acres required under Tier 1). Therefore, the types of potential impacts of Tier 2 mitigation are similar to the impacts outlined for Tier 1 mitigation, but the spatial extent of the impacts under Tier 2 are anticipated to be larger.

4.11.1.3 Changed Circumstances

The HCP process allows for acknowledgement of, and planning for, reasonably anticipated changes in circumstances affecting the subject species, other species occurring in the project area, or in efforts expended towards mitigation. As discussed in Section 7.5 of the HCP, changed circumstances may include reasonably foreseeable circumstances, such as natural catastrophes, that can be anticipated. Reasonable anticipated changed circumstances for the project area include climate change, uluhe dieback, increased abundance of predators, disease outbreak, natural disasters, or deleterious change in relative abundance of non-native plants or ungulates (see Section 7.5 of the HCP). If any of these changed circumstances occur during the 20-year life of the HCP, they may change the condition of the mitigation site(s) so that the site is no longer considered suitable to carry out mitigation for the Covered Species. In that situation, KWP II LLC would consult with DLNR and USFWS to determine if measures to remediate those changes are available, practicable, and necessary.

Potential remediation measures to address changed circumstances at the mitigation site(s) may include: measures to prevent the further spread of non-native plants such as manual or chemical removal; measures to prevent incursion of ungulates such as hunting; measures to prevent uluhe dieback (currently unavailable, but will be evaluated using best available science and information at the time of occurrence); removal of predators though pesticides, trapping, or hunting; documenting and/or reducing the impact of disease in the event of an outbreak; removal of debris; revegetation and restoration efforts; rehabilitation of injured Covered Species and/or re-creation of nesting habitat in the aftermath of a natural disaster. If no such measures are available or practical, mitigation measures for the affected Covered Species may be implemented at another mitigation site as determined in consultation with DLNR and USFWS.

These potential remediation measures may adversely affect listed species and/or designated critical habitat within the mitigation site(s). Deploying and monitoring of traps or rodenticide stations, hunting, weed control, planting, and other remediation activities, as well as increased foot traffic, can facilitate erosion and disturb or remove vegetation through the area. These activities also have the potential to impact wildlife and their habitat present in the area due to noise, vegetation clearing and trampling, and disturbance of nesting and roosting sites. There is also some potential that non-target species can get caught in traps or consume rodenticides implemented as part of a predator control program. Furthermore, soil and vegetation disturbance can create conditions that facilitate the establishment of non-native species and contractors have the potential to unintentionally introduce non-native species via equipment and field gear.

In order to avoid and minimize impacts to listed species and critical habitat, KWP II LLC will hire qualified specialists to survey the area prior to implementing remediation measures. Any listed or candidate plant species will be clearly flagged, and appropriate protocols would be used to avoid direct or indirect impacts to listed species. All construction activities will be conducted outside of the nesting season of the two Covered seabird species and the Hawaiian hoary bat pupping season to minimize impacts. Contractors involved in the remediation measures will be educated regarding the sensitivity of working in critical habitat (if applicable). All restoration materials used during remediation measures will be certified weed-free and appropriate BMPs will be implemented by the contractor. Gear-cleaning procedures to reduce the introduction of noxious seeds, propagules, or arthropods will

be strongly enforced for biologists and/or contractors. Furthermore, all individuals involved in rehabilitation programs will be trained on how to appropriately handle and care for Covered Species.

Overall, the remediation measures are anticipated to improve the overall habitat quality and/or health of the Covered Species following recognition of a changed circumstance. Although remediation measures may result in short-term minor impacts to native habitat or species, disturbed areas are expected to regenerate. By implementing the minimization measures described above, adverse impacts to listed species and/or critical habitat as a result of activities undertaken to address changed circumstances listed in the HCP will be insignificant.

Any changes in the mitigation measures implemented for any of the Covered Species due to changed circumstances will be performed under the budget established for mitigation expenses in the HCP.

4.11.2 Alternative 2 – Downwind/Downstring Siting Area

Impacts to seabirds and the Hawaiian hoary bats due to turbine collisions are anticipated to be generally similar at the Downwind/Downstring Siting Area as the Downroad Siting Area (Alternative 1). However, the Downwind/Downstring Siting Area would require up to three permanent met towers, as opposed to one at the proposed site, which would create additional collision hazards for seabirds and nene. Additionally, nene are twice as likely to be found at the Downwind/Downstring Siting Area than at the lower elevation Downroad Siting Area. This is likely due to better habitat quality in these areas. While nesting has not been observed in the Alternative 2 area, its greater proximity to the existing KWP I WTGs and to suitable nesting habitat (where nene nesting has been observed) suggests that the probability of some nesting occurring in the Alternative 2 area may be greater than the Alternative 1 area. Consequently, the risk of collision with turbines is also greater at the Downwind/Downstring area (Alternative 2) than at the Downroad area (Alternative 1) as shown in Table 4-12. Impacts to the Hawaiian hoary bat due to turbine collisions are anticipated to be generally similar at the two sites.

Table 4-12. Estimated Tier 1 requested take for Downstring/Downwind Siting Area (Alternative 2).

Covered Species	Tier 1 Requested ITP Authorization	
	Annual Limit	20-Yr Limit
Hawaiian Petrel*	4 adults/ immatures and 3 chicks/eggs	10 adults/ immatures and 7 chicks/eggs
Newell's Shearwater*	4 adults/ immatures and 2 chicks/eggs	6 adults/ immatures and 3 chicks/eggs
Nene, Hawaiian Goose	4 adults/ immatures and 1 fledgling	24 adults/ immatures and 4 fledglings
Hawaiian Hoary Bat	4 adults/ immatures and 3 juveniles	6 adults/immatures and 4 juveniles
* The amount of requested take for seabirds was increased for the Downroad alternative as a conservative measure, based on a single year survey that suggested seabird passage rates could be higher in the Downroad siting area vs. the Downstring/ Downwind siting area.		

4.11.3 Alternative 3 – No Action Alternative

No impacts to non-listed wildlife would be expected under the No Action Alternative because there would be no construction or development within the project area and no loss of potential habitat for non-listed wildlife.

This no-build scenario would not cause any adverse impacts to the four Covered Species because no potential for collision with wind turbines or project infrastructure would be created. However, this

scenario also would not provide the benefits to the Covered Species expected under the Proposed Action because proposed beneficial measures outlined in the HCP would not be implemented. This scenario would not contribute to recovery efforts, research, or habitat protection for listed species.

4.12 Socioeconomic Characteristics

4.12.1 Alternative 1 (Proposed Action) – Downroad Siting Area

No significant adverse short-term or long-term impacts to the social or economic condition of the area will occur as a result of the Proposed Action. The Proposed Action will not result in new residents moving to the region or the Island of Maui. Energy generated from the facility will provide power "as available" and will be used to substitute other energy sources. The population of the area is not expected to increase due to higher energy availability or lower energy costs and will therefore not be considered growth inducing. The Proposed Action is not anticipated to impact housing costs or availability.

Construction and operation of the proposed facilities will have a number of socio-economic impacts. Direct socio-economic effects of the proposed facilities include: (1) construction employment and business activity; (2) ongoing employment of facility staff (relatively limited); (3) ongoing expenditures for materials and outside services; and (4) State revenues in the form of excise taxes, lease revenues, and other taxes. These are discussed below.

The project will generate construction employment and business activity. The total estimated construction cost for the Proposed Action of KWP II is $79 million. Of this total, approximately $30 million in expenditures will be in the State of Hawaii (Planning Solutions, Inc. 2009a). Following construction, KWP II LLC will likely employ between 10 and 12 people for ongoing operations. These employees will include biologists, road maintenance workers, a manager, and employees from General Electric (Planning Solutions, Inc. 2009a). Local residents may be employed during the general construction of the project, as well as during operation and maintenance. However, because the operations staff will be small, the project is not expected to generate significant new employment opportunities.

The proposed project will also produce ongoing expenditures for materials and outside services, as well as generate State revenues in the form of excise taxes, lease revenues, and other taxes. KWP II LLC will lease the property on which the proposed facilities will be constructed from the State of Hawaii. Although the exact terms of the lease have not yet been negotiated, the lease is estimated to produce a $6 million of revenue to the State for land use (Planning Solutions, Inc. 2009a).

The project also has the potential to stabilize a portion of the energy fuel cost incurred by MECO as it generates electricity for Maui Island residents and businesses under its fixed-price contract with MECO. KWP II LLC estimates that if fuel prices remained constant over the life of the project, the substitution of wind energy for fossil fuel energy will reduce the amount that MECO spends on imported fuel by approximately $100M (based on oil at $80/barrel). Together with an overall shift toward renewable energy, this has the long-term potential of lowering energy costs, as the State implements the Clean Energy Initiative (Planning Solutions, Inc. 2009a).

4.12.1.1 Environmental Justice

As stated in Section 1.3.1.5, Executive Order 12898 requires Federal agencies to take appropriate steps to identify and avoid disproportionately high and adverse effects of federal actions on the health and surrounding environment of minority and low-income persons and populations. The USEPA, working with the Enforcement Subcommittee of the National Environmental Justice Advisory Council, has developed technical guidance to ensure that environmental justice concerns are effectively identified and addressed throughout the NEPA process. Suggested measures include identifying areas as low-income if more than 20% of the affected area is below the poverty level (as defined by the U.S. Census Bureau) or identifying areas as minority areas if minority populations represent more than 15.72% of the total population. Typically, minorities are defined as individuals who are members of the following population groups: African Americans, American Indians, Alaskan Natives, Asians, Hispanics, Native Hawaiians, or Other Pacific Islanders.

As recognized in the Hawaii Environmental Justice Initiative Report (Kahihikolo 2008), the minority population distribution of Hawaii differs greatly from that of the continental U.S. In contrast to the continental U.S., where Caucasians account for the majority of the population, no racial group in Hawaii comprises even as much as half of the state population (OMPO and DPP 2004). The state is also unique in that 21.4% of the population reported multiple races; only 2.4 did so in the continental U.S. Thus, the minority definitions developed to determine environmental justice impacts on the mainland U.S. may not be applicable or appropriate for Hawaii (OMPO and DPP 2004). For this reason, the State of Hawaii has also developed its own legislation and guidance related to environmental justice. Act 294 was signed by Governor Lingle in July 2006 to define environmental justice in the unique context of Hawaii and to develop and adopt environmental justice guidance document that addresses environmental justice in all phases of the environmental review process (Kahihikolo 2008).

As stated in Section 3.12, the Maalaea CDP is primarily composed of Caucasians and there are few minority persons (U.S. Census Bureau 2000). Only a small percentage of the population living in the Maalaea CDP (less than 4%) has an income below poverty level (U.S. Census Bureau 2003). Thus, there are no concentrations of low income or minority populations in the vicinity of the project area.

The proposed project is not expected to result in significant environmental, human health, or economic impacts on surrounding populations. No persons or populations will be displaced as a result of this project. Furthermore, since the Proposed Action would benefit the local economy, including the low number of low-income and minority persons in Maalaea, these individuals will not experience a disproportionate share of the impacts of the project. Therefore, the proposed project complies with Executive Order 12898.

4.12.2 Alternative 2 – Downwind/Downstring Siting Area

Overall, socioeconomic impacts as a result of Alternative 2 would be expected to be generally similar to those described for the Proposed Action (Alternative 1). However, the total estimated construction cost for the Alternative 2 is $85 million, $6 million more than Alternative 1 (Planning Solutions, Inc. 2010).

4.12.3 Alternative 3 – No Action Alternative

No changes in existing social or economic conditions are expected under the No Action Alternative because the wind facility would not be constructed or operated. This alternative would result in continued reliance on petroleum-based energy generation and would not provide the social and economic benefits expected under the Proposed Action (i.e., construction and maintenance employment, expenditures for materials and outside services, and State revenues). There would be no changes or adverse impacts to low-income or minority populations under the No Action Alternative because the facility would not be constructed or operated.

4.13 Historical, Archaeological, and Cultural Resources

4.13.1 Alternative 1 (Proposed Action) – Downroad Siting Area

Construction of the Proposed Action has the potential to affect historic and archaeological resources directly if it physically disturbs remains at or near the ground surface. Indirect impacts are possible if construction or operation of the facilities adversely affect the ambience of remains or the context within which they are seen or used. Similarly, direct effects on cultural resources could occur if cultural uses of an area are displaced or disturbed by the proposed facilities.

The information available from all of the studies conducted in the project area, as well as the fact that no artifacts or burials were encountered during construction of KWP, indicates that the probability of encountering subsurface remains during construction is relatively low. However, it does not eliminate the potential entirely. In order to minimize the potential for KWP II construction to affect the existing heiau or other inadvertent archaeological finds, KWP II LLC proposes the measures described below. Once the project is in operation, the Proposed Action will not adversely impact archaeological or

historic sites, given continued compliance with the Heiau Preservation Plan (Planning Solutions, Inc. 2009a).

Impacts to traditional Hawaiian cultural resources and practices were analyzed based on the OEQC's "Guidelines for Assessing Cultural Impact." As mentioned in Section 3.13.3, one significant archaeological site meriting preservation was identified and the CIA has identified two potential traditional cultural properties (a koa and kulamanu). As recommended in the site preservation plan for the site, KWP II will ensure that an archaeological monitor will be present during any development activities (e.g., grading) that occur within 500 ft of the heiau (SIHP Site 5232). While the WTGs are quite noticeable, they do not obscure the koa, or natural navigation aid; hence, their impact can be considered negligible in that the ability to use this landscape feature is not diminished by their presence. The second potential traditional cultural property, kulamanu, a place where birds historically gathered, includes the project site and surrounding areas. Impacts to threatened and endangered bird species within the project area are addressed through the HCP prepared for these species, which is designed to minimize, mitigate, and monitor the incidental take of Covered Species.

Minimization and/or Mitigation Measures:

- Contracting for Archaeological Monitoring of Construction: Prior to commencing construction, KWP II LLC will contract with a qualified archaeologist for on-site/on-call monitoring of construction work. The construction contract will make the contractor responsible for halting work and reporting any archaeological or cultural materials encountered to the archaeological monitor. The monitoring contract will provide for on-call monitoring according to a SHPD approved monitoring plan.
- Pre-Construction Conference: Before construction, the consulting archaeologist will meet with the construction supervisors and all regular members of the construction crew to identify the location of the heiau, review guidelines for working in the vicinity of it, and explain what other kinds of cultural or archaeological materials might be encountered and the procedures they are to follow in the event they are uncovered during the course of construction.
- Treatment of Finds: If cultural deposits are discovered during monitoring, appropriate data will be collected (location, written descriptions, sampling, photographs, etc.). All cultural and historic remains other than burials will be treated in accordance with the current requirements and specifications contained in the SHPD HAR Title 13, Chapter 280. Any human skeletal remains would be treated in accordance with the current requirements and specifications contained in the SHPD HAR Title 13, Chapter 300:40.
- Preservation and enhancement of cultural properties and practices: KWP II LLC has agreed to implement the following, as recommended by the CIA: 1) Limit additional WTGs and related development to areas below (i.e., lower in elevation) the existing facilities to ensure that they do not intrude into the wao akua, or divine space; 2) continue and expand upon the education outreach programs conducted by the operators of the existing wind farm, particularly, malama aina (land and resource management), hookele waa (navigation and voyaging), and papahulilani (Hawaiian study of atmosphere); and 3) work with cultural practitioners and genealogical descendants of the area to establish a Kupa Aina Council as an advisory group for the project area to help with educational and resource conservation planning as well as community outreach.

4.13.2 Alternative 2 – Downwind/Downstring Siting Area

Impacts as a result of Alternative 2 are expected to be generally similar to those described for the Proposed Action (Alternative 1), except that this alternative is closer to the heiau and has no direct impact on the Maalaea branch of the Lahaina-Pali Trail. Cultural practitioners and kupuna have expressed a preference for Alternative 1 over Alternative 2 because it is further from the above mentioned cultural sites.

4.13.3 Alternative 3 – No Action Alternative

No impacts to cultural or archaeological resources are expected under the No Action Alternative because there would be no construction or development within the project area and no resources potentially present in the project area would be impacted.

4.14 Utilities and Public Services

4.14.1 Alternative 1 (Proposed Action) – Downroad Siting Area

4.14.1.1 Energy

With the approximately 70,000 MWh of renewable electricity potentially generated annually by the proposed facility, MECO will be able to eliminate the use of approximately 138,000 barrels of oil annually that will otherwise be used to produce conventional power. Reducing the proportion of its energy that comes from fossil fuel will decrease the amount of money that MECO spends on imported fuel and buffer the system from the energy cost fluctuations that accompany volatile oil prices. Moreover, because the power purchase contract with MECO will link the price paid for power from the proposed facility to the overall rate of inflation rather than to the cost of imported oil, the proposed project could allow island residents and businesses to pay less for electrical energy (Planning Solutions, Inc. 2010).

The Proposed Action will contribute to the goals outlined in the Hawaii's Renewable Portfolio Standards (HRS Chapters 269-91 to 269-95) and the Hawaii Clean Energy Initiative. It will also support recently passed State statutes designed to promote energy efficiency and renewable energy sources.

The proposed project will consume only small amounts of electrical power, and this will be delivered through the substation and power distribution equipment that are being installed as part of the project (Planning Solutions, Inc. 2010).

4.14.1.2 Hospitals

The KWP II facility will not place substantial additional demands upon the existing health care facilities in the area.

4.14.1.3 Police and Fire Protection Services

KWP II will not place substantial additional demands upon the existing police service. Similarly, construction and operation of the proposed project will not involve undue use of flammable material or cause undue fire hazards. The facility design includes fire water storage and other fire protection facilities, thus reducing the potential for additional burden on the Fire Department (Planning Solutions, Inc. 2010).

4.14.1.4 Water Supply

KWP II will not directly connect to Maui's municipal water supply. Potable water will be purchased from an off-site supplier and trucked up to the project area. KWP II LLC is considering installing a 60,000-gallon tank adjacent to the existing O&M building at KWP I. This water will be used for non-potable bathroom plumbing, dust control, irrigating re-introduced native plants, and emergency fire fighting. KWP II LLC estimates that daily water usage from the tank during normal operation will amount to about 250-450 gallons. If KWP II LLC does not install the tank, the proposed project will use bottled water and portable pumped toilets similar to the KWP I facility (Planning Solutions, Inc. 2010). The very low water usage associated with the project is not expected to adversely affect local water availability.

4.14.1.5 Wastewater and Solid Waste

The waste that accumulates in the portable toilets or septic tank will be collected by a private contractor and transported to the Kihei Wastewater Treatment Facility or other approved location for disposal. The small amount of sanitary wastewater that this represents can easily be accommodated in the existing treatment and disposal facilities (Planning Solutions, Inc. 2009a).

The project is not expected to result in adverse impacts on the solid waste disposal system because it will not generate a significant amount of waste. Although the exact amount is unknown, for other facilities of this kind, waste typically does not exceed one small dumpster per week (Planning Solutions, Inc. 2010). KWP II LLC will contract a private solid waste management company for the collection and disposal of this refuse at a permitted landfill. Some solid waste may be recycled and hauled to the appropriate recycling company (Planning Solutions, Inc. 2010). No hazardous solid waste is expected to be generated as a result of construction or operation of the proposed project.

4.14.1.6 Roadways

Under the Proposed Action, all of the equipment, employees, and materials needed for construction and operation of KWP II will access the site from the existing KWP access road. Honoapiilani Highway is the main highway serving West Maui, and it is designed and constructed to accommodate heavy vehicular traffic. The existing access road is owned by the State of Hawaii and was upgraded in conjunction with the development of KWP. Access is controlled by DLNR, which shares responsibility for the road's upkeep with KWP LLC.

Construction of the proposed facilities will generate vehicle traffic on area roadways throughout the construction period. This includes employee work trips, equipment delivery trips, and material delivery trips. Project-related vehicle-traffic will vary greatly over the course of construction. Employee work trips are expected to generate an average of 30 to 60 one-way vehicle trips per day to and from the highway/access road intersection typically between 6:30-7:00 a.m. and 3:30-4:00 p.m. (Planning Solutions, Inc. 2010). No work is planned in existing highway rights-of-ways, but the transport of large pieces of equipment may cause temporary traffic delays and will require traffic control measures to minimize disruption (see below). Although the project will result in a short-term increase in traffic during construction, the increase will not be sufficient to have a measurable effect on the level of service.

During operation, the majority of the vehicular-traffic associated with the proposed facilities will be employees reporting to or leaving the facility and service trips by MECO maintenance personnel. Approximately 20 one-way vehicle trips are estimated per day during operation (Planning Solutions, Inc. 2010). Because the amount of vehicular-traffic associated with the proposed facilities during operation will be minimal, the proposed project is not anticipated to increase traffic volumes on Honoapiilani Highway or roadways in the area in the long-term.

Minimization Measures:

- Police Escort: The trucking company that will transport the large WTG pieces now being stored in Kihei to the intersection of the site access road and Honoapiilani Highway will arrange for a police escort. The escort will ride ahead of the truck warning other traffic of the oncoming load and stopping other vehicles for the few turns that are required.
- Traffic Control at Honoapiilani Highway/Access Road Intersection: The entrance to the access road will be manned by two people during construction working hours. They will work as flagmen to stop other traffic for the 1-2 minutes that are needed for the large trucks to turn into and out of the site access road.
- Traffic Control on Site Access Road: Different trucks are used to carry heavy equipment up the hill than are used to deliver it to the staging area at the bottom. Trucks regularly using the road are equipped with radio communication equipment so that they can be contacted while in-route, and turn-out areas are provided along the side of the road so that passing can be coordinated.

4.14.2 Alternative 2 – Downwind/Downstring Siting Area

Overall, impacts to utilities and public services as a result of Alternative 2 would be expected to be generally similar to those described for the Proposed Action (Alternative 1).

4.14.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, the facility would not be built and operated so there were be no impacts to utilities and public services in the area. The benefits of reducing imported fossil fuel use would not occur. This no build scenario would not contribute to the goals outlined in the Hawaii's Renewable Portfolio Standards or the Hawaii Clean Energy Initiative. This alternative would result in the continued reliance on petroleum-based energy generation on the Island of Maui, assuming no other wind energy facilities are approved on the island.

4.15 Cumulative Impacts

This section considers projects in the past, present, and reasonably foreseeable future, authorized or under review, that are considered to contribute to the cumulative impacts not only on endangered, threatened, and other rare species, but also on society and the human environment in Kaheawa Pastures and the Island of Maui. "Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time" (40 CFR 1508.7). This discussion is limited to those past, present, and reasonably foreseeable future actions that involve impacts on a resource that overlaps with the Proposed Action impacts on that same resource.

Kaheawa Pastures encompasses a predominantly rural area. It is situated on State-owned conservation land; and comparatively few large-scale projects occur in the area. For this reason, cumulative impacts of the Proposed Action are evaluated for the regional area, defined as the Island of Maui. However, for impacts to resources that are essentially confined to the site (e.g., geology and soils), cumulative impacts are evaluated with respect to the Kaheawa Pastures area only.

Past development in the Kaheawa Pastures area is limited to the construction and operation of KWP. This action resulted in temporary impacts to air quality, soils, noise, and vegetation, and may cause on-going impacts to the Covered Species. Mitigation measures are being implemented for impacts to the four Covered Species, as well as native plants. No other projects are planned at Kaheawa Pastures at this time. The nearest large development to the project area is Ukumehame Subdivision, a low-density agricultural subdivision (Otani 2010). This 439-acre (178-ha) subdivision did not result in any significant environmental impacts (Chris Hart & Partners 2005).

The only other wind project that has been proposed on Maui is the Auwahi Wind Farm at Ulupalakua Ranch located on the leeward slope of Haleakala on the southern coast of East Maui. A Draft EIS was released for this project in February 2011 (Tetra Tech EC, Inc. 2011a). The proposed project would include up to 15 WTGs, a substation, operations and maintenance facility and related infrastructure, a transmission line, one permanent met tower, and construction of an access route (Tetra Tech EC, Inc. 2011a).

Four state and federally listed wildlife species have been identified as having the potential to be adversely impacted by construction or operation of the Auwahi project: the endangered Hawaiian hoary bat, Hawaiian petrel, nene, and Blackburn's sphinx moth (*Manduca blackburnii*). In compliance with Section 10 of the ESA and HRS 195D, Auwahi Wind Energy prepared a Draft HCP in June 2011 (Tetra Tech EC, Inc. 2011b) to obtain an ITP and ITL. Mitigation measures to compensate for the take of the Covered Species at the proposed Auwahi Wind Farm have been developed in cooperation with USFWS, DOFAW, and the ESRC. The ITP and ITL can only be issued if the application meets the criteria under HRS 195D and the ESA section 10. If approved, the mitigation for the proposed Auwahi Wind Farm would need to meet the same net benefit standard under state law, and thus cumulative adverse impacts would not be anticipated, nor permitted.

The proposed construction and operation of the Advanced Technology Solar Telescope (ATST) at the Haleakala High Altitude Observatory Site has the potential to impact the endangered Hawaiian petrel. The National Science Foundation (NSF) prepared a final HCP in October 2010 pursuant to the requirements of the ESA and HRS 195D that estimates incidental take of 35 Hawaiian petrel individuals (30 fledglings and 5 adults) over a six-year period. Although the ATST occurs within the vicinity of the largest known petrel breeding colony on Maui, the HCP includes measures to avoid, minimize, and mitigate impacts to petrels and if approved by the State, must result in a net

environmental benefit to the recovery of the species. An EA to address impacts of the ITL and associated conservation measures was also prepared (NSF 2011).

4.15.1 Alternative 1 (Proposed Action) – Downroad Siting Area

4.15.1.1 Climate and Topography

The Proposed Action would not adversely affect temperature, rainfall, humidity, wind regime, or other meteorological parameters; therefore, it would not contribute to climate impacts from other projects in the area.

4.15.1.2 Topography

Although grading would occur under the Proposed Action, ground disturbance would not alter any of the major topographic features. Thus, impacts from the Proposed Action would not contribute to the cumulative impacts on topography.

4.15.1.3 Geology, Soils, and Geologic Hazards

No significant impacts to geologic features or soils are expected from the Proposed Action. Because the soil on-site has largely been disturbed by agricultural and other activities, any disturbance of the soil would not contribute to loss of native soils or add to impacts resulting from other development activities on the regional area.

4.15.1.4 Water Resources

The proposed project will result in only slight increases in impervious surfaces and alterations to drainage patterns and stormwater runoff pathways. The proposed project has the potential to degrade the quality of surface water runoff leaving the project area. BMPs and general construction management techniques designed to minimize erosion will be implemented (see Table 4-1) to ensure no significant impacts to the water quality of receiving waters as a result of the proposed KWP II project. The project area would represent only a small percentage of the watershed that drains the area. However, when considered in combination with the adjacent KWP facility, the proposed project has the potential to cumulatively impact the water quality of receiving waters. Therefore, it is important to emphasize the design features that have been incorporated into KWP II, in addition to the revegetation plan in place for the facility, to ensure that the potential for erosion is minimized during construction and operation of the proposed facility.

4.15.1.5 Air Quality

The Proposed Action would contribute very low levels of air emissions to the air in the region during construction, operation, and monitoring of the project. However, the cumulative effect of emissions resulting from this and other projects occurring on the island is not expected to cause a significant change in regional air quality because impacts are minor and localized. Prevailing northeasterly trade winds help to maintain healthy air quality on the island.

Any potential change in electric rates resulting from the addition of new electrical power generation would not markedly promote or discourage economic activity or population growth. Consequently, it would not lead to increased residents or changes in the character of economic activity (e.g., opening of new industries not previously practical) that might have secondary air quality impacts.

4.15.1.6 Noise

Cumulative noise impacts from KWP and other sources are not expected due to the distance between the project and potential receptors. The nearest potential receptors are users of the Lahaina-Pali Trail; however, predicted sound levels during the day are lower than the Community Noise Control Rule limits. Other potential receptors are much farther away, at distances of over one mile to several miles, and thus well beyond the limit of potential adverse or cumulative impact.

4.15.1.7 Scenic Resources

Construction of KWP II would add to the amount of structural development within the visual landscape of Maui and specifically in the Kaheawa Pastures area. This would be in keeping with the current nature of development, and would not introduce different visual features into the viewshed. No other major developments are under consideration in the project area; therefore, the Proposed Action would not result in significant cumulative impacts to scenic resources.

4.15.1.8 Hazardous Substances and Materials

No other known developments are under review for the area; thus, there are no anticipated cumulative impacts of hazardous substances and materials.

4.15.1.9 Land Use

The Proposed Action is comparable and compatible with other long-standing land uses in the area. Therefore, the cumulative effect of the Proposed Action on land use is not considered to be significant.

4.15.1.10 Flora

The Proposed Action would result in a disturbance of existing flora at the project area and along the access roadway. In general, the project area is dominated by non-native species that are common and widespread regionally and throughout the State. Similar vegetation is known to be present at the existing KWP facility and is also likely present on other properties under development or planned for development on the island. KWP II LLC will mitigate for impacts to vegetation by re-introducing native plant species, minimizing the introduction of non-native plants during construction, and minimizing the risk of wildfire. Because the majority of the species on-site are common and regionally widespread and KWP II LLC would mitigate for impacts, the cumulative loss of this type of vegetation from projects currently underway or planned on Maui is not considered to be significant.

4.15.1.11 Wildlife

The Proposed Action would contribute to a cumulative reduction of habitat for some non-federally listed wildlife species when added to impacts resulting from other development and road construction projects on Maui. However, a large amount of similar habitat is available at other locations on the island. In general, non-federally listed wildlife species occurring in Kaheawa Pastures are common and widespread in the region. Therefore, cumulative effects to non-federally listed wildlife are not considered to be significant.

The proposed Auwahi Wind Farm has the potential to result in incidental take of Hawaiian hoary bats, Hawaiian goose, Newell's shearwaters, and Hawaiian petrels. Thus, there is a possibility of cumulative impacts to these species.

At a broader scale, KWP II represents one of many projects of various types that have occurred on Island of Maui and can be expected to occur on Maui. Some of the causes of decline of the Covered Species (such as mammal predation, bright light disorientation, and loss of nesting or roosting habitats) have occurred as a result of past and present projects throughout the island and may be on the increase due to continued real estate development on Maui, and will likely continue increasing in the future. In particular, fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997; Hays and Conant 2007) is expected to continue over time unless new lighting designs are adopted. Even when conducted in compliance with all applicable local, state, and federal environmental regulations, there is the potential for cumulative impacts to occur from these projects because many do not trigger review under endangered species provisions and thus are not required to meet the "net environmental benefit" standard. By implementing a HCP, KWP II will ensure that the net effects of this project will contribute to the recovery of the covered species, and thus not contribute to cumulative impacts that may occur as a result of these other developments.

Several federal ESA Section 10(a)(1)(B) permits and state HRS Chapter 195-D ITLs for the four Covered Species have been issued through an HCP on the Island of Maui or are pending permit

issuance (Table 4-12). Incidental take has also been authorized through two Safe Harbor Agreements (SHAs) on Maui (Table 4-13) according to Section 10(a)(1)(A) of the ESA. Under a SHA, property owners voluntarily undertake management activities on their property to enhance, restore, or maintain habitat that are anticipated to result in a net conservation benefit to species listed under the ESA. Accordingly, based on the net environmental benefit required for HCPs and net conservation benefit expected for SHAs, these past and future projects are not anticipated to result in a significant cumulative impact to the covered species.

Table 4-13. Take authorizations for the four Covered Species on Maui.

Permittee	Permit Duration	Location	Species Covered	Amount of Anticipated Take
Habitat Conservation Plan Permits				
Kaheawa Pastures Wind Energy Facility	01/30/2006-01/30/2026	Maalaea, Maui	Hawaiian hoary bat	20
			Hawaiian goose	60
			Hawaiian petrel	40
			Newell's shearwater	40
Advanced Technology Solar Telescope	2010 – 2020	Haleakala, Maui	Hawaiian petrel	35
Auwahi Wind Power[c]	Pending (25 yr duration)	Auwahi, Maui	Hawaiian hoary bat	22
			Hawaiian goose	5
			Hawaiian petrel	74
Safe Harbor Agreement Permits				
USDA Farm Bill Conservation Programs[a]	09/12/2007-09/12/2017	Statewide	Hawaiian goose	Various
Piiholo Ranch	09/21/2004-09/21/2054	Makawao, Maui	Hawaiian goose	>0 [b]

[a] Only a federal ESA Section 10(a)(1)(B) permit has been issued for this project; however, a state HRS Chapter 195-D ITL is still pending.
[b] The SHA is expected to result in a net conservation benefit. Incidental take is authorized for all covered activities on the property under the ESA Section 10(a)(1)(A) and an HRS Chapter 195-D ITL.
[c] Permit pending

No Covered Species were found downed or dead during the first year of construction and operation of the KWP project (Kaheawa Wind Power 2007a, 2007b). During the second through fourth years of monitoring, KWP documented observed direct take of three Covered species, including three adult Hawaiian petrels, nine full-grown nene, and two Hawaiian hoary bats (Spencer 2011). Other documented fatalities at KWP include three native bird species protected by the MBTA including: Hawaiian short-eared owls, great frigate bird, and white-tailed tropicbirds. Construction and operation of KWP II creates the potential for the Covered Species to collide with the WTGs, temporary and permanent met towers, overhead collection lines and cranes used for construction of the turbines. Native birds protected under MBTA birds, such as the great frigate bird, white-tailed tropicbird, and Hawaiian short-eared owl may also be at risk of collision with project associated structures.

4.15.1.11 (a) Hawaiian Petrel

Take of Hawaiian petrel on Maui has been authorized at the KWP facility. Since 2006, KWP LLC has documented three observed direct takes of adult Hawaiian petrels (KWP LLC 2008b; First Wind and KWP LLC 2011; Spencer 2011). No known take has occurred at the ATST site. Take authorization for this species has been requested by the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components.

KWP mitigation is being conducted jointly with KWP II and the mitigation measures and potential benefits are detailed in Section 4.11.1.2 (a). In order to mitigate impacts to Hawaiian petrels, ATST has proposed to fence and manage a 328-ac area adjacent to the western perimeter of Haleakala National Park. ATST mitigation measures include ungulate eradication, and predator trapping to protect the Hawaiian petrel burrows within their mitigation site. Social attraction will be implemented to encourage further recruitment to the mitigation site. These measures expected to increase adult

and juvenile numbers, increase their survival rates and improve the productivity of nesting pairs. These measures should compensate for their requested take and result in improvements to the seabird nesting habitat. Auwahi Wind Farm has proposed to conduct predator control and monitoring at the Kahikinui Forest Project (Tetra Tech EC, Inc. 2011b). Predator proof fencing may also be erected and predators within the enclosure subsequently eradicated. Similar to the ATST project, these measures expected to increase adult and juvenile survival rates and improve the productivity of nesting pairs. These measures should compensate for their requested take and result in improvements to the seabird nesting habitat.

Other developments on Maui with the potential to have cumulative impacts to the Hawaiian petrel include tall structures (communication towers, turbines, etc.), developments with unshielded lighting, and developments that decrease nesting habitat.

All projects (including KWP II) with pending or permitted take authorizations have mitigation measures that are expected to compensate for the requested take and result in long-term benefits to the species and their nesting habitats, thus no adverse cumulative impacts are expected.

4.15.1.11 (b) Newell's Shearwater

The only other authorized take of Newell's shearwater on Maui is at the KWP facility. To date, no take of Newell's shearwater have been observed at KWP. KWP mitigation is being conducted jointly with KWP II and the mitigation measures and potential benefits are detailed in Section 4.11.1.2 (b). Other developments on Maui with the potential to have cumulative impacts to the Newell's shearwater include tall structures (communication towers, turbines, etc.), developments with unshielded lighting, and developments that decrease nesting habitat. All projects (including KWP II) with pending or permitted take authorizations have mitigation measures that are expected to compensate for the requested take and result in long-term benefits to the species and their nesting habitats, thus no adverse cumulative impacts are expected.

4.15.1.11 (c) Nene

Authorized take of nene is documented at several locations on Maui (Table 4-13). Since 2006, KWP LLC has documented observed direct take of nine full-grown nene (KWP LLC 2008b, 2009; First Wind and KWP LLC 2011). Since 2005, two nene fatalities have been documented at Piiholo Ranch, while 48 nene have been released at this site (DOFAW 2008). Take authorization for this species is being requested for the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components. Mitigation for nene at KWP consisted of constructing a nene release pen at Haleakala ranch, releasing goslings or family units at the pen, conducting predator control and managing vegetation at the pen and surrounding area. These measures are expected to increase adult and juvenile survival rates and improve the productivity of nesting pairs sufficient to compensate for the take that is occurring at KWP. Long-term benefits include the establishment of another self-sustaining population on East Maui which will contribute to the recovery of the species. Auwahi Wind Power has proposed to contribute funding for the construction of a rescue pen and predator fence to support egg, gosling (and adult) rescue at Haleakala National Park. This will support the park in reducing the number of eggs and goslings lost due to predation and inclement weather. These measures are expected to increase fledging success at the park. Other developments on Maui with the potential to have cumulative impacts to nene include developments that decrease nesting and foraging habitat, as well as golf courses. All projects (including KWP II) with pending or permitted take authorizations have mitigation measures that are expected to compensate for the requested take and result in long-term benefits to the species and their nesting habitats, thus no adverse cumulative impacts are expected.

4.15.1.11 (d) Hawaiian Hoary Bat

The loss of available roost sites rather than food availability is believed to be the primary limitation in the distribution and abundance of many bat species (USFWS 1998). Although, the level of occupancy, distribution, and abundance of the bat on Maui is unknown, but because the decline of the Hawaiian hoary bat has been attributed to reduction in tree cover in historic times, it is possible to infer a potential decline in populations of the Hawaiian hoary bat on Maui due to past land use activities that have resulted in a loss of forested areas.

At this time, the only other authorized take of Hawaiian hoary bat on Maui is at the KWP facility. Since 2006, KWP LLC has documented two observed direct takes of Hawaiian hoary bats (KWP LLC 2008b; First Wind and KWP LLC 2011; Spencer 2011). Given that little was known about the ecology of the Hawaiian hoary bat at the time KWP was permitted, compensation for take at KWP consisted of contributing funds to conduct research to better understand the life-history requirements of the Hawaiian hoary bat which would in turn better inform management and recovery actions. These funds have been used to document the home range sizes of male and female bats, which have help to shape the basis of the current recommended management measures. Take authorization for this species is also being requested for the Auwahi Wind Farm due to the potential for colliding with WTGs and other project components. Mitigation for Auwahi Wind Power will consist of committing the mitigation area into a conservation easement and implementing bat habitat restoration measures including fencing, ungulate removal and outplanting. Also included are research components that entail estimating home range size, describing foraging and roosting habitat and collection of genetic samples of the Hawaiian hoary bat. Other developments on Maui with the potential to have cumulative impacts to the Hawaiian hoary bat include resort or recreational developments, farming, road construction, pesticide use, and other developments that decrease nesting and roosting habitat. All projects (including KWP II) with pending authorizations have mitigation measures that are expected to compensate for the requested take and result in long-term benefits to the species and their nesting habitats, thus no adverse cumulative impacts are expected.

4.15.1.12 Socioeconomic Characteristics

As mentioned in Section 4.12.1, the Proposed Action will not result in new residents moving to the region or the Island of Maui. Energy generated from the facility would provide power “as available” and would be used to substitute other energy sources. The population of the area is not growth inducing and would not impact housing costs or availability. When combined with past, present, and future projects, the Proposed Action would not result in adverse cumulative impacts to social or economic conditions in the area, including adverse or disproportionate impacts to minority or low income persons or populations.

Beneficial social and economic impacts include: increased employment opportunities during construction (short-term) and operation (long-term); generation of tax and lease revenues; production of ongoing expenditures for materials and outside services; and stabilization of imported fuel costs.

4.15.1.13 Historical, Archaeological, and Cultural Resources

The proposed project will not have a significant adverse effect on archaeological, historic, or cultural resources during construction or operation. Thus, cumulative impacts to these resources are not anticipated.

4.15.1.14 Utilities and Public Services

Wind energy is a critical component of the State’s renewable energy portfolio, and clearly fulfills the government mandate to increase renewable energy as a percentage of generation capability. The cumulative impact of these standards will be to considerably reduce Hawaii’s dependence on oil imports. The existing KWP facility is the only recent renewable energy project that has been approved on Maui. The Auwahi Wind Farm would also contribute to the State’s renewable energy portfolio.

The proposed KWP II project that would be constructed and operated under the Proposed Action would not significantly impact utilities and public services on the islands; thus, cumulative impacts of the utilities and public services are not anticipated.

Traffic impacts of the project under the Proposed Action would be short-term and restricted to the construction period. Long-term traffic during operations would be minimal, with little or no potential for cumulative effects. There are no other developments currently under review for the project area; consequently there are no cumulative impacts associated with roadways.

4.15.2 Alternative 2 – Downwind/Downstring Siting Area

Cumulative impacts are expected to be relatively similar to Alternative 1. Impacts to scenic resources would be less under Alternative 2 because the Downwind/Downstring Siting Area is less visible from most vantage points than Alternative 1, thus, cumulative impacts from past projects would be less. Nene are more likely to collide with WTGs in Alternative 2, however, proposed mitigation measures for KWP II are expected to offset the anticipated take and contribute to the species' recovery by providing a net conservation benefit, as required by State law.

4.15.3 Alternative 3 – No Action Alternative

The No Action Alternative would not cause any change to the existing environment (because the proposed project would not be constructed or operated) and therefore would not cumulatively contribute to a change in the status of any of the natural or human factors addressed in this EA. Under this scenario, KWP II LLC would not provide mitigation for potential impacts to the Covered Species, and there would be no cumulative contribution toward regional conservation and recovery of threatened and endangered species.

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CHAPTER 6: LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS CONTACTED

This list includes agencies, organizations, and persons contact during preparation of the State EISPN, State EIS, Draft HCP, and EA, as well as agencies, organizations, and persons on the State EISPN distribution list.

Federal Agencies

- U.S. Fish and Wildlife Service (USFWS)
- U.S. Environmental Protection Agency (EPA)
- National Marine Fisheries Service (NMFS)
- U.S. Army Corps of Engineers (USACE)
- U.S. Federal Aviation Administration (FAA)
- U.S. Geological Survey (USGS)

State Agencies

- Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW)
- Department of Land and Natural Resources (DLNR), Historic Preservation Division (SHPD)
- Department of Land and Natural Resources (DLNR), Land Division

- Department of Land and Natural Resources (DLNR), Office of Conservation and Coastal Lands (OCCL)
- Department of Land and Natural Resources (DLNR), Division of Conservation and Resource Enforcement
- Commission on Water Resource Management (CWRM)
- Department of Defense (DoD)
- Department of Hawaiian Homelands (DHHL)
- Hawaii State Civil Defense
- Office of Environmental Quality Control (OEQC)
- Office of Hawaiian Affairs (OHA)
- Department of Accounting and General Services
- Department of Agriculture (DOA)
- Department of Transportation (DOT)
- Department of Health (DOH), Environmental Planning Office
- Department of Health (DOH), Environmental Health Service Division (EHSD)
- Department of Business, Economic Development & Tourism (DBEDT), Office of Planning
- Department of Business, Economic Development & Tourism (DBEDT), Energy Resources, and Technology Division
- University of Hawaii Environmental Center

County Agencies
- Department of Planning and Permitting (DPP)
- Department of Public Works
- Department of Environmental Management
- Department of Water Supply (DWS)
- Department of Parks and Recreation
- Department of Transportation Services
- Department of Fire Control
- Police Department

Organizations
- Students from the Maui Community College Sustainability program
- Students from the Na Pua Noeau program
- Students from the Kamehameha Scholars Program
- Kilohana Ridge Home Owners Association
- American Institute of Architects
- Maui Sierra Club
- Kiwanis Club of Maui
- Maui Tomorrow
- Hokulani Holt Padilla
- Paolo Fujishiro
- Hawaiian Telcom (HECO)
- Maui Electric Company (MECO)
- Honolulu Advertiser
- Honolulu Star-Bulletin
- Maui News

CHAPTER 7: LITERATURE CITED

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Appendix 1

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BOTANICAL RESOURCES SURVEY

for the

KAHEAWA PASTURES ENERGY PROJECT

UKUMEHAME, MAUI, HAWAII

by

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August 2009

Prepared for:
First Wind Energy, LLC

BOTANICAL RESOURCES SURVEY
Kaheawa Pastures Wind Energy Project

INTRODUCTION

The Kaheawa Pastures Wind Energy Project area lies on lower Kealaloloa Ridge on the southern tip of West Maui between Manawainui Gulch on the west and Malalowaia'ole Gulch on the east. The project area is approximately 276 acres in size TMK (2) 3-6-01:14 (por.). This study has been initiated by First Wind Energy LLC to assess the botanical resources in the area in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

Kealaloloa Ridge is a very evenly sloping ridge descending from Hanaula Peak to the sea at a 16% grade. Vegetation is mostly open windblown grasslands with scattered shrubs and trees in gullies. Soils are exclusively characterized as Rocklands (rRK) by the National Resource Conservation Service (Foote et al, 1972). This substrate consists of thin soils formed from gray trachyte lavas of the Honolua Series which overlay the foundational lavas of the West Maui volcano. These lavas weather to platy gray blocks that extend across the entire ridge. This area is quite arid with annual rainfall totaling only about 12 to 20 inches per year (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times this part of the mountain slope was entirely covered with native vegetation of low stature with dry grass and shrub lands and with a few trees in the gullies. The Hawaiians made some uses of forest resources here and had a cross-island trail cresting the ridge at 1600 ft. elevation. This trail was upgraded during the mid-1800s and used as a horse trail to Lahaina. It was resurrected to use in recent years and is the present Lahaina Pali Trail.

Cattle ranching began in the late 1800s and continued for over 100 years. During this time the grazing animals consumed most of the native vegetation which was gradually replaced by hardy weed species.

During the 1950s high voltage power lines were installed across the mountain along with access roads through this area. Increased traffic brought more disturbances and weeds. Fires became more frequent, further eliminating remnant native vegetation.

With the cessation of cattle grazing a number of grass and weed species have proliferated, creating a heightened fire hazard. Large fires have swept across the mountain consuming thousands of acres including the entire project area several times.

DESCRIPTION OF THE VEGETATION

The vegetation within the project area is a diverse array of grasses and low shrubs with a scattering of small trees in gullies. The most abundant species is buffelgrass (*Cenchrus ciliaris*) which has proliferated following the fires. Also common are Natal redtop (*Melinis repens*), ‘ilima (*Sida fallax*), ‘uhaloa (*Waltheria indica*), lesser snapdragon (*Antirrhinum orontium*) and Jamaica vervain (*Stachytarpheta jamaicensis*). A total of 62 species were recorded during the survey.

Fifteen species of native plants were found on the project area: kumuniu (*Doryopteris decipiens*), (*Cyperus phleoides* var *phleoides*) no common name, kalamalö (*Eragrostis deflexa*), ‘äheahea (*Chenopodium oahuense*), nehe (*Lipochaeta lobata* var. *lobata*), nehe (*Melanthera lavarum*), puakala (*Argemone glauca*), ‘akia (*Wikstroemia oahuensis*), pili grass (*Heteropogon contortus*), koali awahia (*Ipomoea indica*), ‘ilima, ‘uhaloa, naio (*Myoporum sandwicense*), ‘ulei (*Osteomeles anthyllidifoli*a) and ‘a’ali’i (*Dodonaea viscosa*). The remaining 47 plant species were non-native grasses, shrubs and trees.

SURVEY OBJECTIVES

This report summarizes the findings of a botanical survey of the Kaheawa Pastures Wind Energy Project which was conducted in August, 2009.
The objectives of the survey were to:

1. Document what plant species occur on the property or may likely occur in the existing habitat.

2. Document the status and abundance of each species.

3. Determine the presence or likely occurrence of any native plant species, particularly any that are federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.

4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora in this part of the island.

5. Note which aspects of the proposed development pose significant concerns for plants and recommend measures that would mitigate or avoid these problems.

SURVEY METHODS

The entire project area was surveyed on foot. Areas on rocky gully slopes and the steep cliffs at the edges of the two large bordering gulches were examined more intensively as these were the places where the most native plants survived both the grazing of cattle and the effects of wildfires. Notes were made on plant species, distribution and abundance as well as on terrain and substrate.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within three groups: Ferns, Monocots and Dicots. Taxonomy and nomenclature of the ferns are in accordance with Palmer (2003) and the flowering plants are in accordance with Wagner et al. (1999) and Staples and Herbst (2005).

For each species, the following information is provided:

1. Scientific name with author citation

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:

   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   Polynesian introduction = plants introduced to Hawai'i in the course of Polynesian migrations and prior to western contact.
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:

   abundant = forming a major part of the vegetation within the project area.
   common = widely scattered throughout the area or locally abundant within a portion of it.
   uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
FERNS			
NEPHROLEPIDACEAE (Sword Fern Family)			
Nephrolepis brownii (Desv.) Hovencamp & Miyam.	Asian sword fern	non-native	rare
PTERIDACEAE (Brake Fern Family)			
Doryopteris decipiens (Hook.) J.Sm.	kumuniu	endemic	rare
Pityrogramma austroamericana Domin	gold fern	non-native	rare
MONOCOTS			
CYPERACEAE (Sedge Family)			
Cyperus phleoides Nees ex Kunth subsp. *phleoides*	----------	endemic	rare
POACEAE (Grass Family)			
Andropogon virginicus L.	broomsedge	non-native	rare
Cenchrus ciliaris L.	buffelgrass	non-native	abundant
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Eragrostis deflexa Hitchc.	kalamalö	endemic	rare
Heteropogon contortus (L.) P. Beauv. ex Roem & Schult.	pili grass	indigenous	uncommon
Melinis minutiflora P. Beauv.	molasses grass	non-native	rare
Melinis repens (Willd.) Zizka	Natal red-top	non-native	common
Panicum maximum Jacq.	Guinea grass	non-native	rare
Sporobolus africanus (Poir.) Robyns & Tournay	smutgrass	non-native	rare
DICOTS			
AMARANTHACEAE (Amaranth Family)			
Amaranthus spinosus L.	spiny amaranth	non-native	rare
Amaranthus viridis L.	slender amaranth	non-native	rare
Atriplex semibaccata R. Br.	Australian saltbush	non-native	rare
Chenopodium murale L.	'äheahea	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Chenopodium oahuense (Meyen) Aellen	'äheahea	endemic	rare
APOCYNACEAE (Dogbane Family)			
Calotropis procera (Aiton) W.T. Aiton	small crown flower	non-native	rare
ASTERACEAE (Sunflower Family)			
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	uncommon
Emilia fosbergii Nicolson	red pualele	non-native	uncommon
Lactuca sativa L.	prickly lettuce	non-native	rare
Lipochaeta lobata (Gaud.) DC. var. lobata	nehe	endemic	rare
Melanthera lavarum (Gaud.) Wagner & Rob.	nehe	endemic	uncommon
Senecio madagascariensis Poir.	fireweed	non-native	rare
Sonchus oleraceus L.	pualele	non-native	rare
Tridax procumbens L.	coat buttons	non-native	uncommon
Xanthium strumarium L.	kikania	non-native	rare
Zinnia peruviana L.	zinnia	non-native	rare
BRASSICACEAE (Mustard Family)			
Sisymbrium altissimum L.	tumble mustard	non-native	uncommon
CACTACEAE (Cactus Family)			
Opuntia ficus-indica (L.) Mill.	panini	non-native	rare
CONVOLVULACAE (Morning Glory Family)			
Ipomoea indica (J. Burm.) Merr.	koali awahia	indigenous	rare
EUPHORBIACEAE (Spurge Family)			
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	rare
FABACEAE (Pea Family)			
Acacia farnesiana (L.) Willd.	klu	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	uncommon
Crotalaria incana L.	fuzzy rattlepod	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	uncommon
Desmodium incanum DC.	kaimi clover	non-native	rare
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	non-native	rare
Indigofera suffruticosa Mill.	'inikö	non-native	uncommon
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	uncommon
Macroptilium lathryroides (L.) Urb.	wild bean	non-native	uncommon
Pithecellobium dulce (Roxb.) Benth.	'opiuma	non-native	rare
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	non-native	uncommon
GENTIANACEAE (Gentian Family)			
Centaurium erythraea Raf.	bitter herb	non-native	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R. Br.	lion's ear	non-native	rare
MALVACEAE (Mallow Family)			
Abutilon incanum (Link) Sweet	hoary abutilon	non-native	rare
Sida fallax Walp.	'ilima	indigenous	common
Waltheria indica L.	'uhaloa	indigenous	common
MYOPORACEAE (Myoporum Family)			
Myoporum sandwicense A. Gray	naio	indigenous	rare
PAPAVERACEAE (Poppy Family)			
Argemone glauca (Nutt. ex Prain) Pope	puakala	endemic	rare
PLANTAGINACEAE (Plantain Family)			
Antirrhinum orontium L.	lesser snapdragon	non-native	common
Plantago lanceolata L.	narrow-leaved plantain	non-native	uncommon
PORTULACACEAE (Purslane Family)			
Portulaca oleracea L.	pigweed	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Portulaca pilosa L.	----------	non-native	rare
PROTEACEAE (Protea Family)			
Grevillea robusta A. Cunn. ex R. Br.	silk oak	non-native	rare
ROSACEAE (Rose Family)			
Osteomeles anthyllidifolia	ūlei	indigenous	uncommon
SAPINDACEAE (Soapberry Family)			
Dodonaea viscosa Jacq.	'a'ali'i	indigenous	uncommon
SOLANACEAE (Nightshade Family)			
Solanum lycopersicum L.	cherry tomato	non-native	rare
THYMELAEACEAE ('Akia Family)			
Wikstroemia oahuensis (A. Gray) Rock	'akia	endemic	rare
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	uncommon
Stachytarpheta jamaicensis (L.) Vahl.	Jamaica vervain	non-native	common

DISCUSSION

The construction of additional wind turbines will require the development of additional access roads and the clearing and leveling of construction pads within the 276 acre project area. This will result in the loss of vegetation where these occur. The area in general has experienced a dramatic loss of native plant communities over the last century and there is concern that further losses of rare species and special habitats be avoided. The proposed project was analyzed with these concerns in mind.

Of the 15 native plant species identified on the property none were found to be federally listed as Threatened or Endangered species (USFWS, 2009), nor were any found that are candidates for such status. All but two are widespread and fairly common in Hawaii. (*Lipocheata lobata*) has one Endangered variety from Oahu and one commoner variety (L.I. *var lobata*) known from Niihau, O'ahu and West Maui. The one found in the project area is the commoner variety that has no federal status. (*Eragrostis deflexa*) is a native grass that was presumed to be extinct in the early 1990s. Recent collections, some quite extensive, from West Maui, Lana'i and Kaho'olawe, however, have been identified as (*Eragrostis deflexa*) and this species is not likely to be listed as Endangered. Six populations of this grass were found within the project area along the rocky edges of the two large gulches.

Of the 15 native plant species found in the project area were most prevalent in the rocky habitat bordering Manawainui and Malalowaia'ole Gulches. This is due to the fact that these area were less accessible to grazing cattle over the years, and to the fact that these rather barren, rocky area are less susceptible to the effects of fires. The three hardiest native species 'ilima, 'uhaloa and 'a'ali'i that are more prevalent on the flatter grassy ridge tops, are the most likely to be impacted by road construction and the leveling of tower pads. These are three of the commonest native dryland plants in all of Hawaii.

It is likely that periodic fires will continue to be a problem into the forseeable future. The area has been nearly completely overtaken by buffelgrass, a highly flammable, fire-adapted species that is quick to recover following wildfires. Meanwhile, each fire destroys more and more of even the hardiest native plants. Unless land management practices change dramatically across this dry mountain slope, little improvement in this prognosis is likely.

Previous botanical surveys on this southern tip for West Maui have identified a few Endangered species growing in gulches about two miles upslope of this project area. This area is remote from these populations and is in a habitat completely unsuitable for their growth and survival. This project is not expected to negatively impact any of these species.

Due to the general condition of the habitat and the specific lack of any environmentally sensitive native plant species or habitats on or near the project area, the proposed development work is not expected to result in any significant negative impact on the botanical resources in this part of Maui.

RECOMMENDATIONS

The quality of the roads created will have a long term effect on surrounding habitat. Poorly engineered roads in this entire project area quickly erode causing downslope disturbances from moving water and road materials. They have the added effect of necessitating frequent maintenance work resulting in further disturbances. It is recommended that the road surfaces be crowned and rolled with stable material, and that swales, drains and culverts be engineered to channel water from the roadway quickly and effectively.

It is desirable that the incidence of wildfires be minimized because of their devastating long term effects on native plant resources. Fuels in this area are highly flammable. One way to minimize fire here is to limit human access along the road corridor to only those with management or other legitimate functions.

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BIOLOGICAL RESOURCES SURVEY

KAHEAWA WIND ENERGY PROJECT 2 (KWP2)

KAHEAWA, MAUI, HAWAII

by

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January 2010

Prepared for: FIRST WIND ENERGY, LLC

INTRODUCTION

Kaheawa Wind Energy Project 2 (KWP2) lies on Kaheawa Ridge on the southern tip of West Maui just west of Manawainui Gulch between the elevations of 1,800 feet and 2,700 feet. This project consists of one approximately 1,500 ft. long corridor for the installation of an underground cable system and two small areas where project related structures are planned. This study has been intiated by First Wind Energy LLC to assess the botanical resources of the project area in fulfillment of environmental requirements of the planning process.

SITE DESCRIPTION

Kaheawa Ridge has moderately sloping terrain that descends to the sea at a roughly 16% grade. Vegetation is mostly grasslands and low shrubby cover with a few small scattered trees. Soils are characterized as Oli Silty Clay Loam, 10 – 30% slopes (OMB), which is a moderately deep soil formed from volcanic ash, as well as Rocklands (rRK) which are broken and uneven and with some eroded areas (Foote et al, 1972). This area is often windy, and has an annual rainfall that averages 30 inches to 40 inches with the bulk falling during the winter months (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times this part of the mountain slope was entirely covered with native vegetation of low stature with dry grass and shrub lands and with a few trees in the gullies. The Hawaiians made some uses of forest resources here and had a cross-island trail cresting the ridge at 1600 ft. elevation. This trail was upgraded during the mid-1800s and used as a horse trail to Lahaina. It was resurrected to use in recent years and is the present Lahaina Pali Trail.

Cattle ranching began in the late 1800s and continued for over 100 years. During this time the grazing animals consumed much of the native vegetation which was gradually replaced by hardy weed species.

During the 1950s high voltage power lines were installed across the mountain along with access roads through this area. Increased traffic brought more disturbances and weeds. Fires became more frequent, further eliminating remnant native vegetation.

With the cessation of cattle grazing a number of grass and weed species have proliferated, creating a heightened fire hazard. Large fires have swept across the mountain consuming thousands of acres including the entire project area several times.

DESCRIPTION OF VEGETATION

The vegetation within the project area is a diverse array of grasses and low shrubs with a scattering of small trees. Five species are common throughout: molasses grass (*Melinis minutiflora*), Natal redtop (*Melinis repens*), u'ulei (*Osteomeles anthyllidifolia*), 'a'ali'i (*Dodonaea viscosa*) and lantana (*Lantana camara*). A total of 57 species were recorded during the survey.

Sixteen species of native plants were found in the project area: they include the u'ulei and 'a'ali'i as well as (*Carex wahuensis* subsp. *wahuensis*) no common name, ko'oko'olau (*Bidens micrantha* subsp. *micrantha*), naupaka kuahiwi (*Scaevola gaudichaudii*), 'akoko (*Chamaesyce celastroides* var. *amplectens*), 'öhi'a (*Metrosideros polymorpha* vars. *Glaberrima* and *incana*), 'iliahi alo'e (*Santalum ellipticum*), kilau (*Pteridium aquilinum* var. *decompositum*), koali awahia (*Ipomoea indica*), pükiawe (*Leptecophylla tameiameiae*), 'ilima (*Sida fallax*), 'uhaloa (*Waltheria indica*) and huehue (*Osteomeles anthyllidifolia*). The remaining 41 plant species were non-native grasses, shrubs and trees.

SURVEY OBJECTIVES

This report summarizes the findings of a botanical survey of the Kaheawa Pastures Wind Energy Project which was conducted in January 2010.
The objectives of the survey were to:

1. Document what plant species occur on the property or may likely occur in the existing habitat.

2. Document the status and abundance of each species.

3. Determine the presence or likely occurrence of any native plant species, particularly any that are federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.

4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora in this part of the island.

5. Note which aspects of the proposed development pose significant concerns for plants and recommend measures that would mitigate or avoid these problems.

SURVEY METHODS

The entire project area was surveyed on foot. Areas on rocky gully slopes were examined more intensively as these were the places where the most native plants survived both the grazing of cattle and the effects of wildfires. Notes were made on plant species, distribution and abundance as well as on terrain and substrate.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within three groups: Ferns, Monocots and Dicots. Taxonomy and nomenclature of the ferns are in accordance with Palmer (2003) and the flowering plants are in accordance with Wagner et al. (1999) and Staples and Herbst (2005).

For each species, the following information is provided:

1. Scientific name with author citation

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:

   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.

   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).

   Polynesian introduction = plants introduced to Hawai'i in the course of Polynesian migrations and prior to western contact.

   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:

   abundant = forming a major part of the vegetation within the project area.

   common = widely scattered throughout the area or locally abundant within a portion of it.

   uncommon = scattered sparsely throughout the area or occurring in a few small patches.

   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
FERNS			
DENNSTAEDTIACEAE (Bracken Family)			
Pteridium aquilinum (L.) Kuhn var. *decompositum* (Gaud.) R.M. Tryon	*kilau*	endemic	rare
MONOCOTS			
CYPERACEAE (Sedge Family)			
Carex wahuensis C.A. Meyen subsp. *wahuensis*	----------	endemic	uncommon
POACEAE (Grass Family)			
Bothriochloa barbinodis (Lag.) Herter	fuzzy top	non-native	rare
Bothriochloa pertusa (L.) A. Camus	pitted beardgrass	non-native	uncommon
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	rare
Hyparrhenia rufa (Nees) Stapf	thatching grass	non-native	uncommon
Melinis minutiflora P. Beauv.	molasses grass	non-native	common
Melinis repens (Willd.) Zizka	Natal red top	non-native	common
Panicum maximum Jacq.	Guinea grass	non-native	rare
Paspalum dilalatum Poir.	Dallis grass	non-native	rare
Pennisetum clandestinum Chiov.	Kikuyu grass	non-native	rare
Sprorobolus africanus (Poir.) Robyns & Tournay	smutgrass	non-native	uncommon
DICOTS			
ANACARDIACEAE (Mango Family)			
Schinus terebinthifolius Raddi	Christmas berry	non-native	uncommon
ASTERACEAE (Sunflower Family)			
Acanthospermum australe (Loefl.) Kuntze	spiny bur	non-native	rare
Bidens micrantha Gaud.	*ko'oko'olau*	endemic	uncommon
Cirsium vulgare (Savi) Ten.	bull thistle	non-native	rare
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	uncommon
Emilia fosbergii Nicolson	red pualele	non-native	rare
Heterotheca grandiflora Nutt.	telegraph weed	non-native	rare
Hypochoeris radicata L.	gosmore	non-native	rare
Senecio madagascariensis Poir.	fireweed	non-native	uncommon
BRASSICACEAE (Mustard Family)			
Lepidium virginicum L.	pepperwort	non-native	rare
Sisymbrium altissimum L.	tumble mustard	non-native	rare
CACTACEAE (Cactus Family)			
Opuntia ficus-indica (L.) Mill.	*panini*	non-native	rare
CASUARINACEAE (She-oak Family)			
Casuarina equisetifolia L.	common ironwood	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Casuarina glauca Sieber ex Spreng	longleaf ironwood	non-native	uncommon
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea indica (J. Burm.) Merr.	*koali awahia*	inidgenous	rare
ERICACEAE (Heath Family)			
Leptecophylla tameiameiae (Cham. & Schlect.) C.M. Weiller	*pükiawe*	indigenous	uncommon
EUPHORBIACEAE (Spurge Family)			
Chamaesyce celastroides (Boiss.) Croizat & Degener var. *amplectens* (Sherff) Degner & I. Degener	*'akoko*	endemic	uncommon
FABACEAE (Pea Family)			
Acacia farnesiana (L.) Willd.	klu	non-native	rare
Chamaecrista nictitans (L.) Willd.	partridge pea	non-native	uncommon
Indigofera suffruticosa Mill.	*'inikö*	non-native	rare
Leucaena leucocephala (Lam.) de Wit	*koa haole*	non-native	rare
Macroptilium lathyroides (L.) Urb.	wild bean	non-native	rare
Neonotonia wightii (Wight & Arnott) Lackey	glycine	non-native	rare
GOODENIACEAE (Goodenia Family)			
Scaevola gaudichaudii Hooker & Arnott	*naupaka kuahiwi*	endemic	rare
MALVACEAE (Mallow Family)			
Malvastrum cormandelianum (L.) Garcke	false mallow	non-native	rare
Sida fallax Walp.	*'ilima*	indigenous	uncommon
Triumfetta semitriloba Jacq.	Sacramento bur	non-native	uncommon
Waltheria indica L.	*'uhaloa*	indigenous	uncommon
MENISPERMACEAE (Moonseed Family)			
Cocculus orbiculatus (L.) DC.	*huehue*	indgenous	rare
MYRTACEAE (Myrtle Family)			
Metrosideros polymorpha Gaud. var. *glaberrima* (H.Lev.) St. John	*'öhi'a*	endemic	uncommon
Metrosideros polymorpha Gaud. var. *incana* (H. Lev.) St. John	*'öhi'a*	endemic	rare
Psidium guajava L.	common guava	non-native	rare
OXALIDACEAE (Wood Sorrel Family)			
Oxalis corniculata L.	yellow wood sorrel	Polynesian	rare
PLANTAGINACEAE (Plantain Family)			
Plantago lanceolata L.	narrow-leaved plantain	non-native	uncommon
POLYGALACEAE (Milkwort Family)			
Polygala paniculata L.	milkwort	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
PROTEACEAE (Protea Family)			
Grevillea robusta A. Cunn. ex R. Br.	silk oak	non-native	rare
ROSACEAE (Rose Family)			
Osteomeles anthyllidifolia (Sm.) Lindl.	u'ulei	indigenous	common
SANTALACEAE (Sandalwood Family)			
Santalum ellipticum Gaud.	'iliahialo'e	endemic	rare
SAPINDACEAE (Soapberry Family)			
Dodonaea viscosa Jacq.	'a'ali'i	indigenous	common
SOLANACEAE (Nightshade Family)			
Solanum linnaeanum Hepper & P. Jaeger	apple of Sodom	non-native	rare
THYMELAEACEAE ('Akia Family)			
Wikstroemia oahuensis (A.Gray) Rock	'akia	endemic	uncommon
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	common
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain	non-native	uncommon
Verbena littoralis Kunth	ha'uöwi	non-native	rare

DISCUSSION

The excavation of a 1,500 foot long trench in which to install an underground electrical transmission cable will result in the loss of some native vegetation within a narrow corridor between turbines 12 through 20. Much less native vegetation will be impacted by the construction of additional project structures at a proposed substation near turbine 12 and an extension to the office building at the project baseyard, as these two sites are nearly entirely covered with non-native grasses. None-the-less, the area in general has experienced a dramatic loss of native plant communities over the last century and there is concern that further losses of rare species and special habitats be avoided. The proposed project was analyzed with these concerns in mind.

Of the 16 native plant species identified within the project area none were found to be federally listed as Threatened or Endangered species (USFWS, 2009), nor were any found that are candidates for such status. All but one of these native species are common throughout the state. One, *Bidens micrantha*, is found only on Maui and Lanai but is quite common in West Maui.

Most of these native plants are in low shrubland communities that are most prevalent on rocky slopes on the West side of Manawainui Gulch. This is due to the fact that these areas were less accessible to grazing cattle over the years and because these rather barren, rocky slopes are less susceptible to fires. While a few of the native shrubland communities within the project corridor have a variety of native species, none can be considered special habitats or associated with a rare or protected species.

It is likely that periodic fires will continue to be a problem into the forseeable future. The area has been nearly completely overtaken by molasses grass, a highly flammable, fire-adapted species that is quick to recover following wildfires. Meanwhile, each fire destroys more and more of even the hardiest native plants. Unless land management practices change dramatically across this dry mountain slope, little improvement in this prognosis is likely.

Previous botanical surveys on this southern tip for West Maui have identified a few Endangered species growing in gulches about a mile upslope of this project area. This area is remote from these populations and is in a habitat completely unsuitable for their growth and survival. This project is not expected to negatively impact any of these species.

Due to the general condition of the habitat and the specific lack of any environmentally sensitive native plant species or habitats on or near the project area, the proposed development work is not expected to result in any significant negative impact on the botanical resources in this part of Maui.

RECOMMENDATIONS

Sensitivity toward the remnant native plant communities on the steeper slopes should be exercised in selecting the route for the underground cable. The gentler slope near the edge of the ridgetop would be preferable.

It is recommended that some of the native plant species found in this area be used to revegetate berms and banks resulting from construction activities.

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Appendix 2

An Assessment of Hawaiian Native Molluscan Fauna
Kaheawa Pastures, West Maui, Hawaii

TMK 4-8-001:001 and 3-6-001:014

Prepared for

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January, 2009

Introduction:

The terrestrial mollscan fauna of Hawai‘i is in a state of catastrophic decline in which hundreds of species and an endemic family are in danger of extinction. Hawai‘i's mollusks evolved in isolation with an ecological naivety that has left them extremely vulnerable to environmental change, and a low fecundity that has not allowed them to recover from the pressures exerted by introduced predators. During the late 20th century perhaps as many as two-thirds of the living species described in the 19th and early 20th centuries have become rare or extinct.

This survey was commissioned by First Wind to determine if any species of native Hawaiian snails, particularly those species federally and state listed as threatened, endangered, or of substantial conservation concern, remain within or along the borders of the Kaheawa Pasture, and if so what steps could be taken to insure their continued survival. The survey area was restricted to former pasture south and west of the present First Wind facility at Kaheawa Wind Power (KWP) and turbine access road, several small ravines and the upper edge of Papalaua Gulch along the upper pasture.

During the survey tree leaves and bark were examined and rock talus was searched for living snails. Soil, mosses and leaf litter samples were screened for living and dead snails to 1 mm in diameter, and exposed ground in gulches and road cuts was searched for fresh and dead shells. No evidence of snails, fossil or extant, native or introduced, was found.

Site Description:

Kaheawa Pasture lies in the Lahaina District in the ahupua‘a of Ukumehame and is defined by the upper reaches of Papalaua Gulch and its tributaries on the west and by Manawainui Gulch to the east and south. The upper elevation of the survey area was approximately 2,700 ft and the lower elevation approximately 1,800 ft. Much of the pasture was burned in 2006 in the most recent of many wind-driven fires to pass through the area. The fire was contained by a firebreak road across the pasture creating two biogeographically distinct areas – the lower pasture which had burned and the upper which had not. There are small stands of ironwood trees throughout the area which have recovered, and in fact benefited, from the fire by spreading.

Water flowing from the pasture into Papalaua Gulch on the west and its tributary gulches on the southwest has exposed the underlying stratigraphy of the pasture in the banks of the gulches. Much of the stratigraphy is relatively constant in appearance with a brown layer of recent soil resting on several layers of hard packed reddish-brown soil-like material, which in turn rests on a cream-colored layer of volcanic grit formed by decaying rock and cinder. The upper two layers are of particular interest because they are the most likely to contain semi-fossil shells of recent species.

The topography of the lower elevations of the survey area consists of low ridges which fan out downhill to the south defining the southern end of the survey area. The ridges and shallow gulches are strewn with large rocks and boulders and the vegetation consists of

low grasses and several species of native shrubs and trees about a meter tall. There was virtually no leaf liter accumulation and fire-blackened woody plants could still be seen among the grasses. In this area the search focused on protected places beneath and among boulders where snail shells may have escaped incineration during the fire.

The southwestern edge of the pasture is bordered by a saw-toothed pattern of small gulches and ravines with steep banks devoid of vegetation. These banks were searched exhaustively for semi-fossil shell deposits that might be eroding out of the bare sides of the gulch and for fresh dead shells that may have fallen down from the pasture grasses above. The longest of these gulches bisects the pasture from the southwest to the turbine access road providing a potential catch for snail shells, but none were found.

A couple hundred meters above this bisecting gulch a road had been cut across the pasture in 2006 to form a firebreak from the turbine access road to the edge of Papalaua Gulch. The road formed a convenient transect of the deep grasses of the unburned pasture. When combined, the road and the gulch below provided an unusually complete cross section of the survey area.

The western edge of the pasture is defined by the precipitous Papalaua Gulch, which abruptly terminates the gently sloped upper pasture. In the pasture along the edge of Papalaua Gulch large shrubs and small trees are numerous with some having moist leaf liter beneath them, which was sampled and screened. The unburned grass is nearly chest high and small ‘ohia trees, which are good snail habitat, stand above the grasses and can be found well into the pasture.

Biological History:

Prior to European contact much of the pasture area was probably blanketed by the horizontally growing uluhe fern with scattered trees, predominantly ‘ohia, as on nearby ridges today.

Uluhe fern often acts as a fringe forest plant on mountain slopes and ridge tops. It is intermediate between the forest and the lowland vegetation and is often the dominant plant in that role. Because of the steep inclination of the ridges of West Maui's lee side, uluhe forms an obvious broken line of bright green on the ridge backs beneath the forest. Its regularity in elevation and growth patterns permits a reasonable expectancy from one ridge to the next at the same elevation. Thus by comparing nearby ridges of similar elevation to the Kaheawa Pasture survey area it is possible to imagine what the vegetation of the pasture may have looked like in the past.

It has been my experience that ground-dwelling snails are found in this fringe forest habitat living in the moist leaf liter beneath the uluhe fern, diminishing in numbers with the loss of elevation in the drier, lower portion of the uluhe coverage. Arboreal species are still found today in the higher elevations of the uluhe belt, in geographically well-defined populations on the neighboring ridge on the Wailuku side of Manawainui Gulch.

Since West Maui is heavily eroded into distinct ridges separated by deep valleys, populations of a species living on the ridge tops are isolated and develop characteristics in shape and color unique to each population. Thus if snails had existed in the Kaheawa Pasture they would have had distinct characteristics and would have been interesting to early collectors as subspecies. An intensive search of the collecting data showed that all of the collected variations of the arboreal snail species I would have expected to find in the survey area had data indicating their origin, but none of that data mentions Kaheawa Pasture or Ukumehame.

The nearest location for which there is data for the collection of a snail species is along the ridge overlooking Ukumehame Valley on the trail leading to the reservoirs at Hana‘ula, at a higher elevation, but parallel to the Kaheawa Pasture. There *Partulina fusoidea* was collected and still exists today. It was described in 1855 by Newcomb.

Knowing that collections were made on an adjacent and parallel ridge on the Wailuku side of the survey area in 1855, and that in 1978 semi-fossil *Partulina* were found in the soil along the Wailuku edge of that adjacent pasture at the elevation of the upper survey area, I would expect a subspecies or variation of that species to have lived in the area that the Kaheawa Pasture occupies today. Having no collecting data nor specimens whose location is unaccounted for and could be attributed to the Kaheawa Pasture suggests that the Kaheawa Pasture was unproductive for snail hunters before 1855.

One explanation for the lack of specimens is that the pastoral history of the pasture predates the study of snails in the area. The snail fauna of the pasture can be inferred from surrounding areas, but without living snails or fossil snail deposits it will not be

possible to know what the pasture was like prior to what is known historically and what is there today.

Survey Objectives:

This survey and report were initiated out of concern that there may be native snail populations within or reasonably close to the Kaheawa Pastures region and proposed Kaheawa Wind Power II facility. The objectives were to determine if any native land snail species were present in the survey area, to identify them and to try to determine their habitat. Another objective was to look for semi-fossil shells protected beneath rocks or buried in the soil, which could indicate what species might have been present in the area. In the absence of empirical data for the pasture, a list of potential species that may have existed at one time – or through extraordinary circumstances still exist – in the pasture area, has been created for this report.

Species Analysis for Ukumehame

A total of 201 taxa of endemic Hawaiian snails are described from Maui. Of these, 71 taxa are described specifically from West Maui. In addition 27 of the total 201 Maui taxa have data, which does not specifically place them in either East or West Maui and therefore should be included in a list of West Maui taxa. Thus there are a possible 98 taxa of Hawaiian snails, which were or may have been described from West Maui.

Of these 98 taxa, 57 are arboreal and not expected to be represented in the Kaheawa Pasture survey area simply for lack of suitable habitat. Of the remaining 41 taxa of ground-dwelling snails three are known only from fossils.

Of the remaining 38 ground-dwelling taxa I have selected the most likely to have been present in the area of the Kaheawa Pasture before European contact and listed them below. None of the taxa listed below has been recorded in recent years from Ukumehame, collected as fossils near Ukumehame nor found in beach drift between the mouth of Ukumehame Valley and Hekili Point at Olowalu.

The most likely species are the dryland species and subspecies listed in Group One. Those in Group Two are more likely to have been found in more damp situations than exist today, and thus may have been found in the pasture area if it had been covered with uluhe fern as I surmise. Group Three list species found on nearby ridges and valleys and thus may have had a greater range than is known. These are the least likely to have occurred in the surveyed area. In addition, members of the family Endodontidae were probably present and may still exist in talus in the deeper gulches below the pasture, and two species of the genus *Partulina*, one species of *Perdicella* and one species of *Auriculella* still exist on the adjacent ridge discussed above but at a higher elevation than the surveyed area.

Group One:
Amastra (Heteramastra) soror soror (Newcomb, 1854)
Amastra (Heteramastra) soror interjecta Hyatt & Pilsbry, 1911
Amastra (Heteramastra) soror olowaluensis Cooke (?)
Amastra (Heteramastra) subsoror subsoror Hyatt & Pilsbry, 1911

Group Two:
Leptachatina (Leptachatina) fulgida Cooke, 1910
Leptachatina (Leptachatina) praestabilis Cooke, 1910

Group Three:
Amastra (Amastra) lahainana Pilsbry & Cooke, 1914
Amastra (Cycloamastra) metamorpha Pilsbry & Cooke, 1914
Amastra (Cycloamastra) metamorpha debilis Pilsbry & Cooke, 1914
Amastra (Heteramastra) pilsbryi Cooke, 1913

Habitat Requirements

The habitats preferred by the taxa listed above are a moist environment beneath rocks and talus in gulches at lower elevations; in the leaf litter beneath trees and shrubs; in mosses growing on trees and rocks; and beneath thick understory such as uluhe fern at mid-elevations.

Conservation Relevance:

It is highly unlikely that living native snails, including those which receive protection under state or federal endangered species laws will be found in the Kaheawa Pasture. However, all of the native Hawaiian land snails should be considered rare and treated as such if discovered.

Discussion:

There were approximately 1,308 species and subspecies of endemic land snails described from Hawai‘i. They represent 7 widespread Indo-Pacific families. In addition there is one endemic family which reflects a spectacular divergence from its ancestor over millions of years of evolution in an isolated environment. This family containns 499 taxa representing 38.5% of all known species and subspecies of Hawai‘i's endemic snail fauna.

Polynesians colonized the islands approximately 2,000 years ago and they appear to have had very little effect on the land snail fauna. It was not until Europeans introduced ranching, large-scale agriculture and global commerce during the past 230 years that the Hawaiian snail fauna began to collapse under the pressure of a new biota that displaced their habitat, and predators that decimated their populations. Today perhaps 90% of the known Hawaiian snail fauna is extinct or is in imminent danger of extinction. Sensitivity to this situation is essential in planning developments anywhere in Hawai‘i.

The attention First Wind has given to this important but devastated aspect of Hawaiian biology is commendable, but it appears that years of abuse of the land, along with tell-tale hints of pastoral use pointing back to before the 1850's, seem to have reduced the area to a molluscan desert.

Conclusions:

I am confident there are no living native snails within the area surveyed. Without evidence, not even one fragment of a shell, and with no historic description of the area or collecting data from a snail species within the survey area, there is nothing to do but speculate on what might have existed in the survey area in the past. I have done this using fossils collected from several sites on Maui and Lana‘i, by examining sorted beach drift taken over 15 years and by examining collecting data taken from the data slips of specimens held in several museums worldwide.

Relavant Citations:

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An Assessment of Hawaiian Native Molluscan Fauna of the lower Kaheawa Pasture, West Maui, Hawai‘i

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September, 2009

Introduction:

The terrestrial molluscan fauna of Hawai‘i is in a state of catastrophic decline in which hundreds of species and an endemic family are in danger of extinction. Hawai‘i’s molluscs evolved in isolation with an ecological naivety that has left them extremely vulnerable to environmental change, and a low fecundity that has not allowed them to recover from the pressures exerted by introduced predators. During the late 20th century perhaps as many as two-thirds of the living species described in the 19th and early 20th centuries became rare or extinct.

This survey was commissioned by First Wind to determine if any species of native Hawaiian snails, particularly those species listed by federal or state agencies as threatened, endangered, or of substantial conservation concern, remain within or along the borders of the lower Kaheawa Pasture, and if so what steps should be taken to insure their continued survival.

During the survey rock talus and grasses were searched for living snails, and soil samples were screened for living and dead snails to 1 mm in diameter. Two species of extant snails were located representing two families – one, an undescribed species of Vertiginidae, the other a species of Succinidae.

Site Description:

The lower Kaheawa Pasture lies in the Lahaina District in the ahupua‘a of Ukumehame and is defined by the upper reaches of Manawainui Gulch on the southwest and by Malalowaia‘ole Gulch on the north. The area surveyed was located between these two gulches and consisted of a gently undulating pasture with a slight slope of 17 degrees and the upper edges of the gulches themselves. The elevation range was approximately 258 - 577 meters. Much of the pasture was burned in 2006 in the most recent of many wind-driven fires that consumed the vegetation on the gulch slopes and the flat, grass-covered pasture.

Remnants of an old road snake up the pasture on the southwest side of the First Wind access road which lies to the north of the approximate center of much of the survey area. Along the upper edges of the gulches that define the survey area are periodic rock outcroppings, low rock cliffs and rock talus, the latter being generally overgrown with taller grass than that seen in the pasture. These talus areas are of particular interest because they form good dryland snail habitat as well as offer the potential to find semi-fossil snail shells, which might indicate the presence of species not encountered alive during the survey or species that may have existed in the survey area prior to the activity of First Wind.

At the time of the survey the top of the pasture was covered with a knee-high grass and sporadic woody shrubs, many of which were blackened and appeared to be recovering from the last fire in 2006. The substrate is a hard packed sun-dried soil covered with

loose rocks. Occasional rock outcroppings are scattered throughout the pasture and appear to be remnants of the volcanic flows that cap what is now the ridge.

Biological History and Potential:

Prior to European contact much of the pasture was probably covered in woody shrubs and trees of the Hawaiian low elevation dryland forest; grasses; and occasional ferns, with the horizontally growing uluhe fern probably being found in the highest elevation surveyed. Little or no habitat would have been available for arboreal snails; however, ground-dwelling snails were found in similar dryland habitats statewide and some are still extant in other such areas on Maui.

There is no record of land snails having been found in the area of the survey; however, based on previous collections of Hawaiian dryland snails, species of the following four families might have been present at one time.

Species of the family Succinidae are known from similar dryland habitat on the lower western slopes of Haleakala; a species of Endodontidae is known from fresh dead shells collected in a small gulch on the Lahaina side of West Maui several miles from the survey area; species of ground-dwelling Achatinellidae are known to exist at the base of grasses on some of the dry, remnant islands of the northwestern Hawaiian chain and were no doubt found in similar habitat throughout the Hawaiian Islands; and species of Vertiginidae are known to have inhabited grass and leaf litter in dryland areas throughout the island chain.

An extensive search of the literature, however, showed no indication that species from these families have ever been collected from the survey area. If snails had been collected in the survey area they were probably species already known to early collectors from other areas and thus were not considered of interest.

Survey Objectives:

This survey and report were initiated out of concern that there may be native snail populations within, or reasonably close to, the lower Kaheawa Pasture region and proposed Kaheawa Wind Power facility. The objectives were to determine if any native land snail species were present in the survey area, to identify them and to try to determine their habitat. Another objective was to look for semi-fossil shells protected beneath rocks or buried in the soil, which could indicate what species might have been present in the area at one time.

Habitat Requirements:

The habitats preferred by the Hawaiian lowland molluscan fauna are determined by available vegetation and moisture. Considering the sparse vegetation and dry conditions of the survey area the search for living land snails was restricted to rock talus, rock cliffs and other rocky features scattered in the pasture where the roots of grasses help maintain

moisture beneath the rocks and deep in cracks. This kind of habitat is common along the upper edges of the defining gulches but uncommon in the open pasture.

Method:

A preliminary examination and initial survey of the area showed that the best habitat existed along the edge of the gulch on the windward side of the survey area. A series of stations was established based on available habitat along the upper edge of the gulch and a transect determined by the elevational contour of each station was followed horizontally across the pasture, as Hawaiian snails are known to be sensitive to elevation on the steep slopes of West Maui.

Species Discovered:

Of the four potential families expected to be found in the survey area, two families had living representatives and two families did not. As expected, both species were found in protected, moist habitat beneath rocks.

The Succinid, ***Succinea mauiensis*** Ancey, 1889, is present throughout the pasture within undisturbed rock outcroppings where it attaches to the moist undersides of closely-packed rocks or in the root mat of grasses beneath the rocks. It was not found beneath the loose surface rocks which litter the pasture but have no root mat.

This species is known to have a wide range in dry habitat on East and West Maui. The *S. mauiensis* present in the survey area were uncommon in the pasture compared to the upper edges of the gulches. One live specimen was collected and preserved in an RNA/Later solution for further study, and dead specimens were collected when encountered for identification purposes.

In addition to the Succinid, an undescribed species of Vertiginidae of the genus ***Nesopupa*** was discovered in similar habitat. This new species was seen in only one location along the upper edge of Malalowaia‘ole Gulch at an elevation of 446 meters and represents a fifth species of the genus to be found on Maui.

After the initial discovery of the first specimen a one-square-meter area was examined closely on two occasions. A total of 9 *Nesopupa* specimens were collected including four fresh fragments, four intact dead shells and one live specimen. The live specimen was collected for descriptive purposes. One other live specimen was noted and left.

Conservation Relevance:

In general dryland species appear to have an advantage in surviving the introduced predatory snails which have devastated the native molluscan fauna because their preferred habitat is too dry for these predators to survive. In addition, the habitat of the two living species found within the survey area has proven to be resilient, as it has apparently survived 100 years of grazing cattle and periodic fires.

Discussion:

Finding lowland snails in the survey area was not a surprise, though finding an undescribed species of ***Nesopupa*** was, and indicated that the area has never been thoroughly explored for Hawaiian snails.

The two species found in the survey area are numerous when located. Thus, there is reason to believe that both species may exist in similar habitats beyond the boundaries of the property surveyed on neighboring ridges and in neighboring gulches.

Of the two species located during the survey, only ***Succinea mauiensis*** is found in the area proposed to be developed, and then only in several rock outcroppings associated with small ravines scattered within the pasture. The undescribed ***Nesopupa sp.*** is found in an area not scheduled to be developed.

For these reasons careful planning and caution should suffice to protect these species. In fact, they may eventually prosper as the use of the pasture becomes stabilized, is protected more vigorously from fires and is regulated by First Wind.

The attention First Wind has given to this important but devastated aspect of Hawaiian biology is commendable, but it appears that years of abuse of the land prior to First Wind has destroyed much of the habitat available to these snails, reducing the potential habitat for living snails to islands of rock outcroppings. More than 99% of the land within the survey area is now completely devoid of snails and their habitat.

Conclusion:

First Wind has shown by this survey that the degradation of an area through decades of grazing and periodic fires was no reason to ignore the possibility that endemic Hawaiian snails and their micro-habitat might yet survive. This prudence has not only demonstrated snails can and do survive in extreme conditions, but that new species may yet be discovered where least expected, adding more to our knowledge of this fragile fauna.

GPS Coordinates:

GPS coordinates are given here for the five stations along Malalowaia‘ole Gulch and the species found at each.

20˚48.224 – 156˚32.409 No snails present. Elevation 577 meters.
20˚47.706 – 156˚32.145 ***Nesopupa n. sp.*** and ***Succinea mauiensis*** Ancey, 1889. Elevation 446 meters.
20˚47.537 – 156˚31.996 ***Succinea mauiensis*** Ancey, 1889. Elevation 350 meters.
20˚47.335 – 156˚31.855 No snails present. Elevation 282 meters.
20˚47.275 – 156˚31.832 meters. ***Succinea mauiensis*** Ancey, 1889. Elevation 256 meters.

Species Analysis:

Family Succinidae
Succinea mauiensis Ancey, 1889 was compared with an image of a specimen from the Museum of Comparative Zoology at Harvard, MCZ# 039616 (possible lectotype).

Family Vertiginidae
Nesopupa n. sp. was compared with the following Nesopupa which represent all the known species from Maui, Kaho‘olawe, Lana‘i and Moloka‘i.

Nesopupa (Nesopupilla) baldwini Ancey, 1904
1.2 mm. Maui. MCZ 078790 Paratype.

Nesopupa (Nesopupilla) baldwini lanaiensis Pilsbry & Cooke, 1920
1.6 mm. Lana‘i. MCZ 078778 Paratype.

Nesopupa (Nesopupilla) baldwini subcostata Pilsbry & Cooke, 1920
1.5 mm. Moloka‘i. MCZ 180174.

Nesopupa (Infranesopupa) bishopi Cooke & Pilsbry, 1920
2.15 mm. Maui. BPBM 12465 Holotype.

Nesopupa (Nesopupilla) dispersa Cooke & Pilsbry, 1920
1.4 mm. Kaho‘olawe. MCZ 078785 Paratype.

Nesopupa (Infranesopupa) dubitabilis Cooke & Pilsbry, 1920
1.2 mm. Moloka‘i. MCZ 078797 Paratype.

Nesopupa (Limbatipupa) newcombi (Pfeiffer, 1853)
1.3 mm. Lana‘i. MCZ 045244 Lectotype.

Nesopupa (Limbatipupa) newcombi seminulum (Boettger, 1881)
1.2 mm. Moloka‘i. MCZ 180179.

Nesopupa (Infranesopupa) limatula Cooke & Pilsbry, 1920
1 mm. Maui. ANSP 44692 Paratype.

Nesopupa (Limbatipupa) singularis Cooke & Pilsbry, 1920
1.0 mm. Maui. ANSP 44697.

Nesopupa (Nesodagys) wesleyana rhadina Cooke & Pilsbry, 1920
2 mm. Moloka‘i. MCZ 078793 Paratype.

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Severns, Mike. In press. *An Illustrated Catalog of the Shelled Molluscan Fauna of the Hawaiian Islands, Marine and Land*. Conchbooks Publishers. Maizer Str. 25, D-55546, Hackenheim, Germany. Estimated 800 pages in two volumes. Estimated publication November 2009.

An Assessment of Native Hawaiian Molluscan Fauna
Kaheawa Pastures, West Maui, Hawaii

Kaheawa Wind Power II: Part 2

TMK 4-8-001:001 and 3-6-001:014

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January, 2010

Introduction:

The terrestrial molluscan fauna of Hawai‘i is in a state of catastrophic decline in which hundreds of species and an endemic family are in danger of extinction. Hawai‘i’s molluscs evolved in isolation with an ecological naivety that has left them extremely vulnerable to environmental change, and a low fecundity that has not allowed them to recover from the pressures exerted by introduced predators. During the late 20th century perhaps as many as two-thirds of the living species described in the 19th and early 20th centuries became rare or extinct.

This survey was commissioned by Kaheawa Wind Power II (KWP II) to determine if any species of native Hawaiian snails, particularly those species federally and state listed as threatened, endangered or of substantial conservation concern occur within the proposed underground collection system routing, BESS and sub-station enclosures, expanded Operations and Maintenance facilities, and proposed water storage tank, and if so what steps could be taken to ensure their continued survival.

Survey Objectives:

This survey and report were initiated out of concern that there may be native snail populations within the proposed KWP II underground collection system routing, BESS and sub-station enclosures, expanded Operations and Maintenance, and water storage tank facilities. The objectives were to determine if any native land snail species were present in these proposed project areas, to identify them and to determine their habitat. Another objective was to look for semi-fossil shells protected beneath rocks or buried in the soil, which could indicate what species might have been present in the area in recent years, and thus may still be present.

Site Description:

The survey area was restricted to the eastern side of the lower portion of the Kaheawa Pastures within the existing Kaheawa Wind Power (KWP) leased area. The survey encompassed a 750-meter-long by 50-meter-wide corridor beginning at turbine number 20 at approximately 546 meters and extending uphill parallel to the western edge of Manawainui Gulch and bordering the existing KWP string road to turbine 12. It also included a proposed building expansion site measuring 18 by 24 meters which is beside an existing structure housing offices and equipment (Operations and Maintenance facility) and a section of pasture to the east of the present Operations and Maintenance facility where a water storage tank is proposed.

Kaheawa Pasture lies in the Lahaina District in the ahupua‘a of Ukumehame. It is defined by the upper reaches of Papalaua Gulch and its tributaries on the west and by Manawainui Gulch to the east and south. Much of the pasture was burned in 2006 in the most recent of many wind-driven fires to pass through the area.

Within the survey area there are areas of fire-stunted, native shrubs and some native and introduced grasses. A very shallow layer of leaf litter was found beneath the shrubs which rested on a layer of burnt plant material presumably from the last fire. A couple of small stands of ironwood trees found within the survey area blanket the ground with their needles preventing the growth of other plants resulting in very poor snail habitat.

When exposed, much of the stratigraphy is relatively constant in appearance with a brown layer of recent soil resting on a layer of hard-packed reddish-brown soil-like material. The upper layer was the most likely to contain evidence of snails in the form of semi-fossil shells of recent species; however none were found.

Though naturally occurring rock formations were abundant, they rested on the hard-packed ground mentioned above with pockets of ash in the cracks between the rocks. Very seldom did grass root-mats of any substantial depth form around or beneath the rocks. This grass root-mat and rock combination provides good snail habitat and can protect small snails living deep in the grass root-mat from fast-moving fires which sweep across the rocks burning exposed grass leaves, but not the root-mat.

Biological History:

[The following paragraphs are copied from my first assessment of the Kaheawa Pastures in January 2009. They are repeated here because the area of this survey is adjacent to and part of the original Kaheawa Pastures which was surveyed in January, 2009.]

Prior to European contact much of the pasture was probably blanketed by the horizontally-growing uluhe fern with scattered trees, predominantly ohia (*Metrosideros polymorpha*), as on the nearby ridges today.

Uluhe fern often acts as a fringe forest plant on mountain slopes and ridge tops. It is intermediate between the forest and the lowland vegetation and is often the dominant plant in that role. Because of the steep inclination of the ridges of West Maui's lee side, uluhe forms an obvious broken line of bright green on the ridge backs beneath the forest. Its regularity in elevation and growth patterns permits a reasonable expectancy from one ridge to the next at the same elevation. Thus by comparing nearby ridges of similar elevation to the Kaheawa Pastures survey area it is possible to imagine what the vegetation of the pasture may have looked like in the past.

Since West Maui is heavily eroded into distinct ridges separated by deep valleys, populations of species living on the ridge tops are isolated and develop characteristics in shape and color that are unique to each population. Thus, if snails had existed in the Kaheawa Pastures they would have had distinct characteristics and would have been interesting to early collectors as subspecies. An intensive search of the collecting data showed that all of the collected variations of arboreal snail species that I would have expected to find in the survey area had data indicating their origin, but none of that data mentions Kaheawa Pastures or Ukumehame.

The nearest location for which snail collecting data exist is along the ridge overlooking Ukumehame Valley on the trail leading to the reservoir at Hana‘ula, parallel to but at a higher elevation than the Kaheawa Pastures. There, *Partulina fusoidea* was collected and still exists today. It was described in 1855 by Newcomb.

Knowing that collections were made on an adjacent and parallel ridge on the Wailuku side of the survey area in 1855, and that in 1978 semi-fossil *Partulina* were found in the soil along the Wailuku edge of that adjacent pasture at the elevation of the upper survey area, I would expect a subspecies or variation of that species to have lived in the area that the Kaheawa Pastures occupies today. Having no collecting data nor specimens whose location is unaccounted for and could be attributed to the Kaheawa Pastures suggests that the Kaheawa Pastures was unproductive for snail hunters before 1855.

One explanation for the lack of specimens is that the pastoral history of the pasture predates the study of snails in the area. The snail fauna of the pasture can be inferred from surrounding areas, but without living snails or fossil snail deposits it will not be possible to know what the pasture was like prior to what is known historically and what is there today.

Habitat Requirements for Ground dwelling Snails:

The habitats preferred by ground-dwelling snails are a moist environment beneath rocks and rock talus, often associated with the root-mats of grasses; in the leaf litter beneath trees and shrubs, and in thick mosses growing on the ground, on trees and among rocks.

Conservation Relevance:

It is highly unlikely that native snails, including those which receive protection under state or federal endangered species laws will be found in the Kaheawa Pastures. However, all of the native Hawaiian land snails should be considered rare and treated as such if discovered, with particular attention given to their habitat.

Discussion:

Since all of the habitats expected to be occupied by ground-dwelling snails are seriously degraded or non-existent within the surveyed area and since there is no habitat for arboreal snails, it is highly unlikely that living snails exist within the surveyed area.

The attention First Wind and Kaheawa Wind Power II has given to this important but devastated aspect of Hawaiian biology is commendable, but it appears that years of abuse of the land, along with tell-tale hints of pastoral use pointing back to before the 1850’s, seem to have reduced the capacity of the area to support living snails.

Conclusion:

During the survey the leaves, bark and leaf litter beneath shrubs were searched. In addition, grass root-mats among and beneath rock talus and other naturally occurring rock formations were also searched for evidence of snails. The limited amount of moss was examined, and exposed ground was searched for fresh and dead shells. No snail shells, fossil or extant, native or introduced, were found.

After the meticulous search described, my assessment is that there are no living snails, native or introduced, within the area surveyed.

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Appendix 3

FINAL REPORT

RADAR AND VISUAL STUDIES OF SEABIRDS AT THE PROPOSED KWP II DOWN-ROAD ALTERNATIVE WIND ENERGY FACILITY, MAUI ISLAND, HAWAII, SUMMER 2009

BRIAN A. COOPER AND ROBERT H. DAY

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RADAR AND VISUAL STUDIES OF SEABIRDS AT THE PROPOSED KWP II DOWN-ROAD ALTERNATIVE WIND ENERGY FACILITY, MAUI ISLAND, HAWAII, SUMMER 2009

FINAL REPORT

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EXECUTIVE SUMMARY

- We used radar and audiovisual methods to collect data on movements of endangered Hawaiian Petrels (*Pterodroma sandwichensis*) and threatened Newell's (Townsend's) Shearwaters (*Puffinus auricularis newelli*) at the proposed Kaheawa Wind Power II Down-road Alternative wind energy generation facility, on Maui Island during summer 2009. We conducted evening and morning surveys during 20–24 July 2009.
- The objectives of the study were to: (1) document movement rates of Hawaiian Petrels and Newell's Shearwaters at the proposed KWP II Down-road Alternative facility; (2) estimate the daily number of petrels/ shearwaters that fly within areas that would be occupied by wind turbines at the proposed facility; and (3) estimate annual fatality rates of petrels/shearwaters at proposed turbines and meteorological (met) tower.
- We recorded 37 radar targets that fit our criteria for petrels and shearwaters.
- The mean movement rate across all nights was 1.78 ± 0.14 targets/h. After adjusting our sampling results for hours of the night that we did not sample (i.e., non-peak periods), we estimated a mean movement rate of 10.0 petrel-like/shearwater-like targets/night during summer 2009.
- We recorded one Hawaiian Petrel during visual sampling. This bird was heading east (i.e., toward Haleakala) at 40 m agl at 2126 on 24 July.
- To determine the risk of collision-caused mortality, we used petrel/shearwater movement rates observed on radar in summer 2009, petrel/shearwater flight altitudes from previous studies, and dimensions and characteristics of the proposed turbines and met towers to generate an estimate of exposure risk. We then applied estimates of the fatality probability (i.e., the probability of collision with a portion of the turbine or tower and dying while in the airspace occupied by the structure) and a range of estimated avoidance probabilities (i.e., the probability that a bird will detect and avoid entering the airspace containing the turbine or tower) to this estimate of exposure to calculate annual fatality rates that could be expected at the proposed turbines and met tower.
- We estimate that ~1,607 Hawaiian Petrels and 882 Newell's Shearwaters pass over the 1.5-km-radius radar sampling area in an average year (including birds at all altitudes).
- We estimated annual fatality rates at wind turbines and met towers by assuming that 90%, 95%, or 99% of all petrels/shearwaters flying near a turbine/tower will see and avoid the structure. Based on these scenarios, annual fatality rates for wind turbines ranged from 0.016–0.217 Hawaiian Petrel/turbine/yr and 0.009–0.119 Newell's Shearwaters/turbine/yr. For the 65-m met tower, we estimated a fatality of 0.008–0.081 Hawaiian Petrel/tower/yr and 0.004–0.044 Newell's Shearwaters/tower/year. Although the range of assumed avoidance rates of wind turbines and met towers (90–99%) is not fully supported by empirical data at this time we speculate that avoidance rates of petrels and shearwaters at wind farm structures (e.g., wind turbines and met towers) potentially are ≥95%, based upon fatality rates at existing windfarms and avoidance behavior of petrels observed at other structures (e.g., powerlines and communication towers); thus, we believe that fatality rates will be within the lower half of the range of estimates.

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We thank FirstWind for funding this study and for providing the ornithological radar used for sampling. We thank Greg Spencer and Dave Cowan (FirstWind) for help with logistics and thank Greg Spencer and Ian Bordenave (FirstWind) for their assistance with the visual sampling. At ABR, Rich Blaha and Dorte Dissing produced study figures and Alice Stickney and Pam Odom assisted with report production.

INTRODUCTION

First Wind, LLC, formerly UPC Wind Management, LLC, operates the 30-MW Kaheawa Pastures Wind Energy Generation Facility, referred to as Kaheawa Wind Power I (KWP I), on the island of Maui (Figure 1). A new wind project adjacent to the existing facility is being considered for development by FirstWind and will be operated as Kaheawa Wind Power II (i.e., the KWP II Down-road Alternative). Two federally-listed seabird species occur on Maui: the endangered Hawaiian Petrel (*Pterodroma sandwichensis*; Hawaiian name 'Ua'u) and the threatened Newell's (Townsend's) Shearwater (*Puffinus auricularis newelli*; Hawaiian name 'A'o). Ornithological radar and night-vision techniques have been shown to be successful in assessing numbers and movement rates of these petrels and shearwaters on the Hawaiian Islands (e.g., Kaua'i [Cooper and Day 1995, 1998; Day and Cooper 1995, Day et al. 2003b], Maui [Cooper and Day 2003], Moloka'i [Day and Cooper 2002], and Hawai'i [Day et al. 2003a]). Previous radar and visual studies documented the presence of petrel/shearwater targets, including visual observations of Hawaiian Petrels, in the vicinity of the existing KWP I project site (Day and Cooper 1999, Cooper and Day 2004a). These data were used to model the potential number of annual fatalities at the KWP I development (Cooper and Day 2004b). In addition, radar studies were conducted in 2008 (Sanzenbacher and Cooper 2008, 2009) to model the potential number of fatalities in a nearby portion of an alternate KWP II site that was located just upslope of the KWP II Down-road Alternative.

The currently operational KWP I wind-energy facility consists of an articulated row of 20 1.5-MW turbines (GE 1.5se) with a hub height of ~55 m and a rotor diameter of 70.5 m, plus one 30-m-high, guyed NRG monopole meteorological (met) tower and two 55-m-high, guyed lattice met towers (Figure 2). The proposed KWP II Down-road Alternative project would consist of ~14 additional 1.5-MW turbines (GE 1.5se), each with a hub height of ~65 m and a rotor diameter of 70.5 m, plus one 65-m-high, free-standing met tower.

ABR conducted additional radar and visual studies on Maui in July 2009 with a specific focus on an area proposed for the KWP II Down-road Alternative. The objectives of the study were to: (1) document movement rates of Hawaiian Petrels and Newell's Shearwaters at the proposed KWP II Down-road Alternative facility; (2) estimate the daily number of petrels/shearwaters that fly within areas that would be occupied by wind turbines or met towers at the proposed facility; and (3) estimate annual fatality rates of petrels/shearwaters at proposed turbines and meteorological (met) tower.

Background

Two seabird species that are protected under the Endangered Species Act (ESA) are likely and/or known to occur in the KWP II Down-road Alternative project area: the endangered Hawaiian Petrel and the threatened Newell's (Townsend's) Shearwater. The Hawaiian Petrel and the Newell's Shearwater are forms of tropical Pacific species that nest only on the Hawaiian Islands (American Ornithologists' Union 1998). Both species are Hawaiian endemics whose populations have declined significantly in historical times: they formerly nested widely over all of the Main Islands but now are restricted in most cases to scattered colonies in more inaccessible locations (Ainley et al. 1997b, Simons and Hodges 1998). The one exception is Kaua'i Island, where colonies still are widespread and populations are substantial in size. Of note, Kaua'i (along with Lana'i) also has no introduced Indian Mongooses (*Herpestes auropunctatus*) which prey on these seabirds.

The Hawaiian Petrel nests primarily on Maui (Richardson and Woodside 1954, Banko 1980a; Simons 1984, 1985; Simons and Hodges 1998, Cooper and Day 2003), Kaua'i (Telfer et al. 1987, Gon 1988, Day and Cooper 1995; Ainley et al. 1995, 1997a, 1997b; Day et al. 2003a), Hawai'i (Banko 1980a, Conant 1980, Hu et al. 2001, Day et al. 2003a), Lana'i (Shallenberger 1974; Hirai 1978a, 1978b; Conant 1980; G. Spencer and J. Penniman, pers. comm.), and Moloka'i (Simons and Hodges 1998, Day and Cooper 2002). On Maui, these petrels are known to nest on Haleakala Crater (Brandt et al. 1995, Simons and Hodges 1998) and are believed to nest in West Maui (Cooper and Day 2003), with recent observations of birds calling and exhibiting aerial displays consistent with breeding behavior, despite the

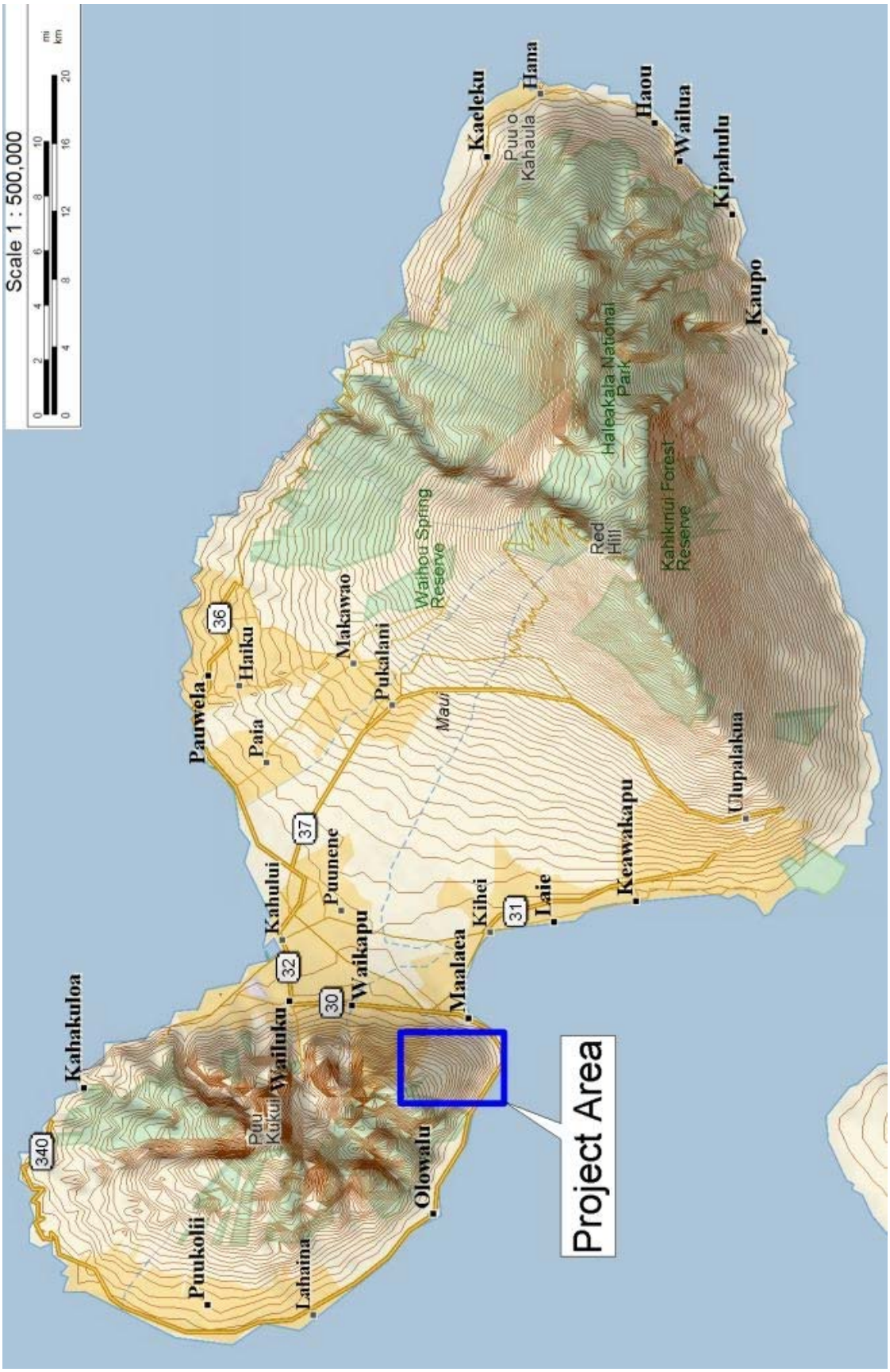

Figure 1. Maui Island, Hawaii, with approximate location of the Kaheawa Pastures Wind Energy Facilities (KWP I and KWP II).

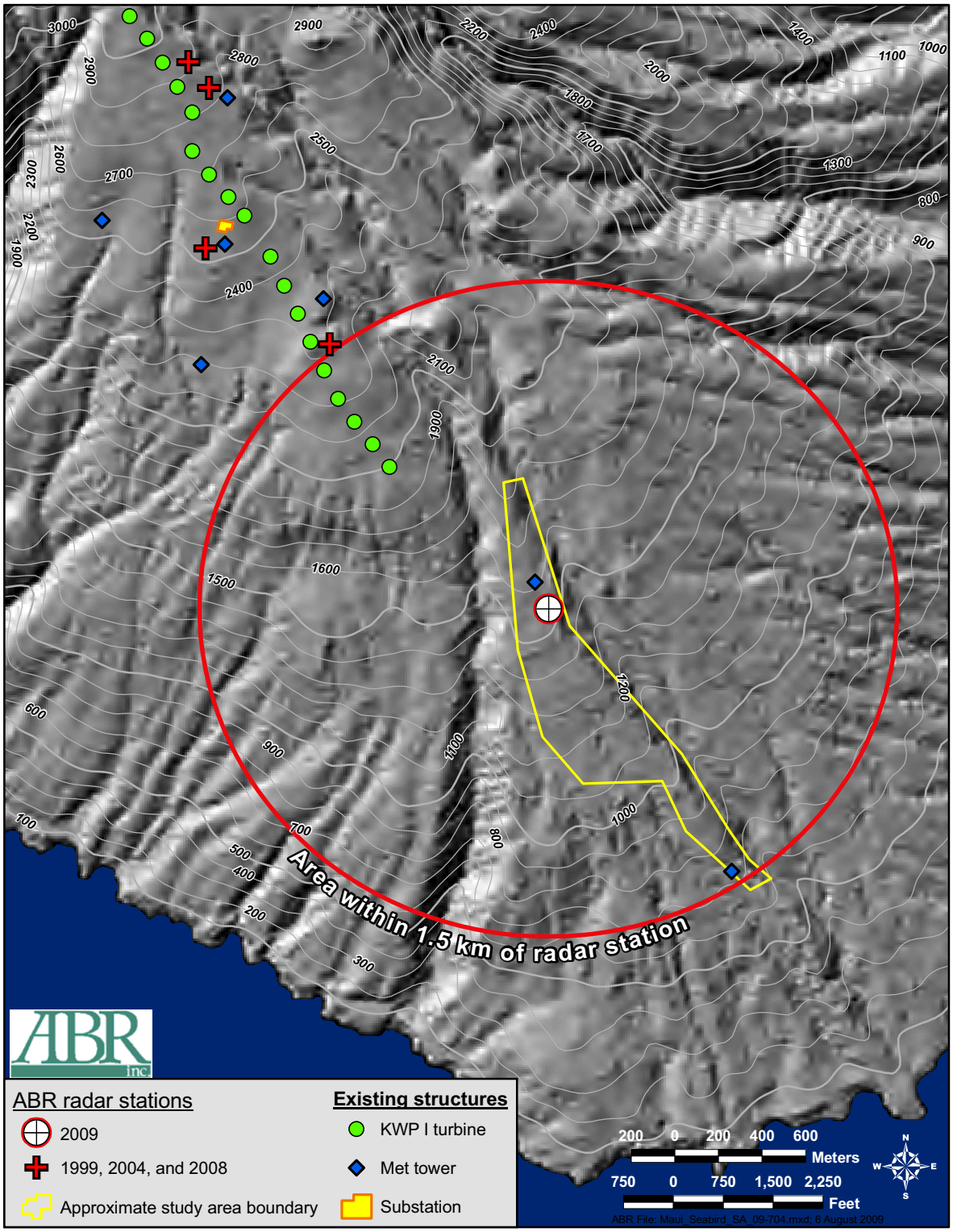

Figure 2. Location of 2009 radar sampling stations relative to sampling stations from previous studies (Day and Cooper 1999, Cooper and Day 2004a; Sanzenbacher and Cooper 2008, 2009) and areas under consideration for siting of wind turbines at the proposed KWP II Down-road Alternative wind energy facility, Maui, Hawaii.

minimal historical evidence and introduction of Indian Mongoose on Maui. For example, on 16 June 1999, a Hawaiian Petrel was heard calling from a bed of uluhe ferns (*Dicranopteris linearis*) at 3,300 ft (~1,000 m) elevation in the Kapunakea Preserve, which lies on the northwestern slope of the West Maui Natural Area Reserve (A. Lyons, *fide* C. Bailey). In addition, recent observations of consistent calling from a single location suggests that there is another small colony of Hawaiian Petrels in the West Maui Mountains ~14 km north of the KWP project areas (G. Spencer, FirstWind, pers. comm.). On the other hand, daily movement rates of Hawaiian Petrels near KWP I and II (i.e., on the southern slope of West Maui Mountain; Day and Cooper 1999, Cooper and Day 2004a, Sanzenbacher and Cooper 2008 and 2009) are much lower than those over the eastern and northern sides of Maui (Cooper and Day 2003), suggesting that few birds use that area.

Newell's Shearwaters nest on several of the main Hawaiian Islands, with the largest numbers clearly occurring on Kaua'i (Telfer et al. 1987, Day and Cooper 1995; Ainley et al. 1995, 1997b; Day et al. 2003b). These birds also nest on Hawai'i (Reynolds and Richotte 1997, Reynolds et al. 1997, Day et al. 2003a), almost certainly nest on Moloka'i (Pratt 1988, Day and Cooper 2002), and may still nest on Oahu (Sincock and Swedberg 1969, Banko 1980b, Conant 1980, Pyle 1983; but see Ainley et al. 1997b). On Maui, recent auditory observations suggest that a small colony of Newell's Shearwaters is present in the west Maui Mountains ~14 km north of the KWP project areas (G. Spencer, FirstWind, pers. comm.), matching a prediction of their occurrence there by Cooper and Day (2003). Newell's Shearwaters typically nest on steep slopes that are vegetated by uluhe fern (*Dicranopteris linearis*) undergrowth and scattered o'hia trees (*Metrosideros polymorpha*).

There is interest in studying these two species because of concerns regarding collisions with structures such as met towers and turbines. To date, there is documented mortality of only one Hawaiian Petrel at a wind turbine and zero Newell's Shearwaters at wind-energy facilities (wind turbines or met towers) within the Hawaiian Islands (G. Spencer, FirstWind, pers. comm.). Note, however, that fatality studies have been conducted only for 3.5 yr at one wind-energy location in the Hawaiian Islands (KWP I, Maui) and 3 mo at six met towers at the same site prior to operation. Hence, there have not been enough studies of adequate duration or geographic scope to answer the question definitively of whether these species are prone to collisions at these types of structures. There has, however, been well-documented petrel and shearwater mortality because of collisions with other human-made objects (e.g., transmission lines, communication towers) on Kaua'i (Telfer et al. 1987, Cooper and Day 1998, Podolsky et al. 1998) and Maui (Hodges 1992), and there have been collision-caused fatalities of other seabirds at other Hawaiian Islands (Fisher 1966).

STUDY AREA

The operational KWP I windfarm and proposed KWP II Down-road Alternative expansion are located on the southern slope of West Maui Mountain, in an area called Kaheawa Pastures (Figure 1). These sites lie on a moderately sloping portion of West Maui Mountain, ~1–6 km inland from McGregor Point. Vegetation at the site consists of non-native grasslands at lower elevations and a mixture of grasslands and scattered shrubs at moderate to higher elevations. Although the KWP II Down-road Alternative area consists of a dry Mediterranean habitat, vegetation becomes much wetter upland, toward the summit of West Maui Mountain. Presumably, vegetation communities also are dominated by native species in these higher, wetter areas. These upland habitats may provide suitable nesting habitat for Newell's Shearwaters, based on our experience on Kaua'i and other sites. In addition to the vegetation, the steepness of the land at higher elevations on West Maui Mountain also suggests that suitable nesting habitat exists for Hawaiian Petrels, as it does on Haleakala (Brandt et al. 1995), Kaua'i (Telfer, pers. comm.), and Lana'i (Hirai 1978b).

In previous studies at the KWP I and KWP II sites (Day and Cooper 1999, Cooper and Day 2004a; Sanzenbacher and Cooper 2008, 2009), sampling was conducted at four other stations; however, for the current study, we established a new sampling station with a focus on providing maximal radar coverage of potential siting areas for the proposed KWP II Down-road Alternative

development (Figure 2). The study area is situated in lower elevations slightly to the east and south of the existing KWP I turbine string, and our 2009 sampling station was located adjacent to the existing KWP I access road, just south of the Lahaina Pali trail (20° 47'52.6" N, 156° 32'16.5" W; elevation ~490 m).

METHODS

We used marine radar and visual equipment to collect data on the movements, flight behaviors, and flight altitudes of petrels and shearwaters at a single sampling station during summer (20–24 July) 2009 (Table 1). The daily sampling effort consisted of 3 h each evening (1900–2200 h) and 2 h each morning (0400–0600 h). These sampling periods were selected to correspond to the evening and morning peaks of movement of petrels and shearwaters, as described near breeding colonies on Kaua'i (Day and Cooper 1995). During sampling, we collected radar and audiovisual data concurrently so the radar operator could help the audiovisual observer locate birds for species identification and data collection. In return, the audiovisual observer provided information to the radar operator on the identity and flight altitude of individual targets (whenever possible). For the purpose of recording data, a calendar day began at 0700 and ended at 0659 the following morning; that way, an evening and the following morning were classified as occurring on the same day.

The ornithological radar used in this study was a Furuno (Model FCR-1510) X-band radar transmitting at 9.410 GHz through a slotted wave guide with a peak power output of 12 kW; a similar radar unit is described in Cooper et al. (1991) and Mabee et al. (2006). The antenna face was tilted upward by ~10°, and we operated the radar at a range setting of 1.5 km and a pulse-length of 0.07 μsec.

Issues associated with radar sampling include ground clutter and shadow zones. Whenever energy is reflected from the ground, surrounding vegetation, and other objects around the radar unit, a ground-clutter echo that can obscure targets of interest (i.e., birds) appears on the radar's display screen. Shadow zones are areas of the screen where birds can fly at an altitude that potentially would

Table 1. Sampling dates and number of inbound and outbound seabird radar targets and number of audio-visual observations of species of interest at the proposed KWP II Down-road Alternative wind-energy site, Maui, Hawaii, July 2009.

			Number of radar targets			Number of audio-visual
Date	Site	Period	Inbound[1]	Outbound[1]	Total	detections[2]
20 July	Lower	Eve	0	7	7	0
		Morn	0	1	1	0
21 July	Lower	Eve	0	5	5	0
		Morn	1	2	3	0
22 July	Lower	Eve	4	0	4	3 SEOW
		Morn	1	0	1	1 TROP
23 July	Lower	Eve	6	1	7	3 SEOW
		Morn	1	0	1	2 SEOW, 1 BAOW, 1 UNOW
24 July	Lower	Eve	6	0	6	1 HAPE, 1 BAOW, 1 UNOW
		Morn	1	1	2	1 SEOW

[1] Flight direction categories for landward and seaward categories included all birds flying toward and away, respectively, from either the colonies located on the opposite end of west Maui to the north of the study site or colonies on Haleakala.
[2] HAPE = Hawaiian Petrel; HOBA = Hoary Bat; NESH = Newell's Shearwater; SEOW = Short-eared Owl; BAOW = Barn Owl: TROP = unidentified Tropicbird; UNOW = Unidentified owl.

put them behind a hill or row of vegetation where they could not be detected because the radar operates only on line-of-sight. We attempted to minimize ground clutter and shadow zones during the selection of radar sampling stations; various structures and landscape features visible on radar indicated that our sampling stations provided good coverage of the study area.

We sampled for six 25-min sessions during each evening and for four 25-min sessions each morning (Table 1). Each 25-min sampling session was separated by a 5-min break for collecting weather data. To help eliminate non-target species, we collected data only for those targets that met a suite of selection criteria, following methods developed by Day and Cooper (1995), that included appropriate flight characteristics and flight speeds (≥30 mi/h [≥50 km/h]). We also removed radar targets identified by flight characteristics or visual observers as being of other bird species.

We conducted audiovisual sampling for birds and bats concurrently with the radar sampling to help identify targets observed on radar and to obtain flight-altitude information. During this sampling, we used 10X binoculars during crepuscular periods and Generation 3 night-vision goggles (Model ATN-PVS7; American Technologies Network Corporation, San Francisco, CA) during nocturnal periods. The magnification of the night-vision goggles was 1X, and their performance was enhanced with the use of a 3-million-Cp floodlight that was fitted with an IR filter to avoid blinding and/or attracting birds. Audiovisual observations were conducted within 25 m of the radar to facilitate coordination between observers, and we also listened for petrel and shearwater vocalizations.

Before each 25-min sampling session, we also collected environmental and weather data, including:

- wind speed (to the nearest 1.6 km/h [1 mi/h]);
- wind direction (to the nearest 1°);
- percent cloud cover (to the nearest 5%);
- cloud ceiling height, in meters above ground level (agl; in several height categories);
- visibility (maximal distance we could see, in categories);
- light condition (daylight, crepuscular, or nocturnal, and with or without precipitation)
- precipitation type; and
- moon phase/position (lunar phase and whether the moon was above or below the horizon in the night sky).

For each appropriate radar target, we recorded the following data:

- species (if identified by visual observer);
- number of birds (if identified by visual observer);
- time;
- direction of flight (to the nearest 1°);
- cardinal transect crossed (000°, 090°, 180°, or 270°);
- tangential range (the minimal perpendicular distance to the target when it passed closest to the radar; used in reconstructing actual flight paths, if necessary);
- flight behavior (straight, erratic, circling);
- velocity (to the nearest 5 mi/h [8 km/h]); and
- flight altitude (meters agl, if identified by visual observer).

For each bird (or bat) recorded during audiovisual sampling, we recorded:

- time;
- species (to the lowest practical taxonomic unit [e.g., Hawaiian Petrel, unidentified petrel/shearwater]);
- number of individuals composing each target;
- ordinal flight direction (000°, 045°, 090°, 135°, 180°, 225°, 270°, 315°); and
- flight altitude (meters agl).

For any birds heard but not observed, we recorded species, number of calls, direction of calls, and approximate distance.

DATA ANALYSIS

We entered all radar and visual data into Microsoft Excel databases. Data files were checked visually for errors after each night's sampling, then were checked electronically for irregularities at the end of the field season, prior to data analyses. In addition, radar data were filtered to remove non-target species, and only known petrel/shearwater targets or unknown targets with appropriate characteristics (i.e., target size, flight characteristics, and airspeeds ≥30 mi/h) were included in data analyses. Airspeeds were calculated by correcting observed target flight speeds (groundspeeds) for speed and relative direction of wind, as measured each half-hour at the radar station (Mabee et al. 2006).

We tabulated counts of numbers of radar targets of petrels and shearwaters recorded during each sampling session, then converted those counts to estimates of movement rates of birds (radar targets/h), based on the number of minutes sampled. No sampling time was lost to rain or other factors; we standardized estimates by actual minutes of sampling effort each half hour. We used all of the estimated movement rates across sampling sessions at a station to calculate the mean ± 1 standard error (SE) nightly movement rate of petrels and shearwaters by station and pooled data across nights to derive an overall hourly movement rate for the study.

We also classified general flight directions of each radar target as landward or seaward and summarized those directional categories by station, date, and time period. To categorize the general flight direction of each target, we defined a landward flight as a radar target flying toward the West Maui Mountains or Haleakala (on East Maui) and classified targets flying in the opposite directions as seaward targets.

MODELING FATALITY RATES

The risk-assessment technique that we have developed involves the use of radar data for estimating the fatality rates for petrels and shearwaters near structures in the Hawaiian Islands. This modeling technique uses the radar data on seasonal movement rates to estimate numbers of birds flying over the area of interest (sampling station) across a 255-d year (for Hawaiian Petrels) or a 210-d year (for Newell's Shearwater) when breeding birds are present on the island. The model then uses information on the physical characteristics of the structures (e.g., wind turbines or met towers) themselves to estimate horizontal and vertical interaction probabilities and combines these interaction probabilities with the movement rates to generate exposure rates (Figure 3). These rates represent the estimated numbers of petrels/shearwaters that pass within the airspace occupied by a proposed wind turbine or within the airspace occupied by a met tower and its associated guy wires each year. We then combine these exposure rates with (1) the probability that an interaction results in fatality, and (2) the probability that birds detect structures and avoid interactions, to estimate fatality rates.

We calculate an exposure rate by multiplying the seabird movement rate observed on radar by horizontal- and vertical-interaction probabilities. The movement rate is an estimate of the average number of birds passing in the vicinity of the proposed turbines/towers in a day, as indicated by numbers of targets on the radar screen and the mean flock size/target. It is generated from the radar data by: (1) multiplying the average movement rates by 5.0 h to estimate the number of targets moving over the radar site in the first 3 h and last 2 h of the night (i.e., during the peak movement periods of petrel/shearwaters); (2) adjusting the sum of those evening and morning counts to account for the estimated percentage of movement that occurs during the middle of the night (when we did not sample); and (3) multiplying that total number of targets/night by the mean number of seabirds/target to generate an estimate of the number of petrel/shearwaters passing in the vicinity of the proposed met towers/turbines during an average day.

We used the radar-based movement data from our current study at the proposed KWP II Down-road Alternative development to estimate seabird movement-rates in summer and assumed that those rates represented average rates observed in an average year. We used data from all-night sampling sessions on Kaua'i (Day and Cooper 1995) to estimate movement rates occurring during the hours between our evening and morning sampling periods. These data suggested that an additional 12.6% of the total combined evening

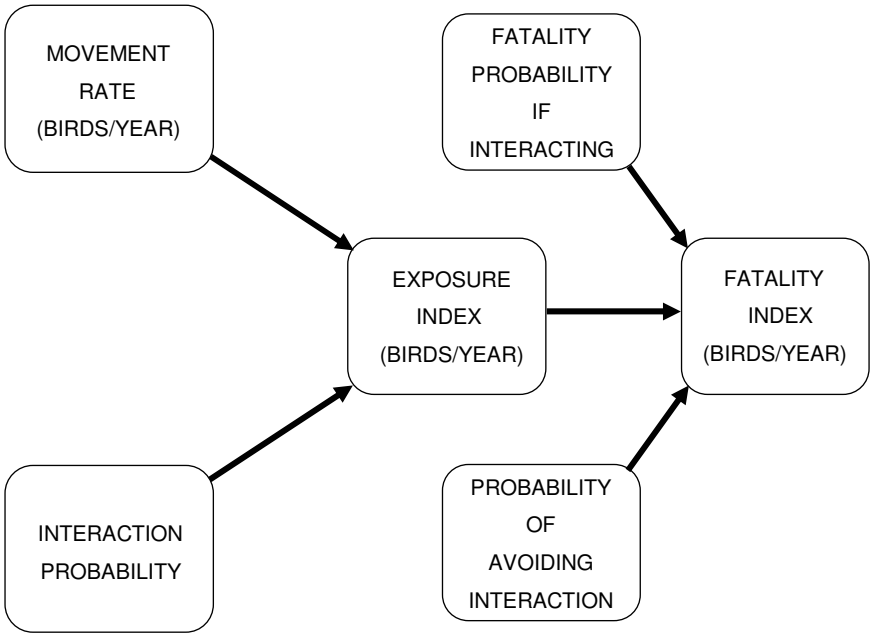

Figure 3. Major variables used in estimating possible fatalities of Hawaiian Petrels and Newell's Shearwaters at wind turbines at the proposed KWP II Down-wind Alternative wind energy facility, Maui, Hawaii. See Tables 2 and 3 for details on calculations.

landward movements and seaward morning movements occurred between the evening and morning peak-movement periods (Day and Cooper, unpubl. data). We also corrected the number of targets for flock size: mean flock sizes of petrels and shearwaters combined in Hawai'i are 1.05 ± SE 0.01 birds/flock (n = 2,062 flocks; Day and Cooper, unpubl. data). In addition, we used the timing of inland flights at the nearby Ukumehame site from Cooper and Day (2003) to correct for proportions of targets that were Hawaiian Petrels and those that were Newell's Shearwaters; those data suggested that 60% of the targets were Hawaiian Petrels and 40% of the targets were Newell's Shearwaters.

The number of petrels visiting breeding colonies tends to decline from summer to fall because attendance at colonies by nonbreeders and failed breeders declines as chick-rearing progresses (Serventy et al. 1971, Warham 1990, Ainley et al. 1997b, Simons and Hodges 1998). Although we do not yet have fall data for the site, we split the 255-d breeding season for Hawaiian Petrels (Simons and Hodges 1998) and 210-d breeding season for Newell's Shearwaters (Ainley et al. 1997b) into a spring/summer period of 180 days and 150 days for petrels and shearwaters, respectively, and a fall period of 75 days and 60 days for petrels and shearwaters, respectively. We corrected the seasonal estimates of nightly movement rates by the numbers of days for the spring/summer and fall seasons to generate estimates of movements for each season and species. We assume that the sum of these two estimates represents estimated movement rates for an entire breeding season (i.e., an average year).

Because the resulting estimate of the number of birds/yr is not an integer, we then round it upward to the next whole number to generate an estimate of the average number of birds passing within 1.5 km of the radar site during a year. This rounding technique results in slightly-inflated fatality estimates, but we choose to take a conservative approach in these studies associated with endangered species.

INTERACTION PROBABILITIES

Horizontal

Interaction probabilities consist of horizontal and vertical components. The horizontal-interaction probability is the probability that a bird seen on radar will pass through or over the airspace occupied by a met tower or turbine located somewhere on the radar screen. This probability is calculated from information on the two-dimensional area (side view) of the tower/turbine and the two-dimensional area sampled by the radar screen to determine the interaction probability. The 65-m, free-standing met-tower system consists of a central lattice tower without any supporting guy wires. The tower is 65 m high with a width at the base of ~6 m and a width at the top of ~0.5 m. The proposed wind turbines have ~65-m monopole towers and 35.25-m-long blades. Two calculations of area were made for turbines because of the large differences in area of the structure that depended on the orientation of the blades relative to the flight path of an approaching bird: a minimal area occupied by each proposed turbine if a bird approaches it from the side (i.e., side profile) and a maximal area occupied by each turbine if a bird approaches it from the front (i.e., front profile, including the rotor-swept area). The ensuing ratio of cross-sectional area of the proposed tower/turbine to the cross-sectional area sampled by the radar (1.5 km) indicates the probability of interacting with (i.e., flying over or through the airspace occupied by) the proposed tower or turbine.

Vertical

The vertical-interaction probability is the probability that a bird seen on radar will be flying at an altitude low enough that it might pass through the airspace occupied by a proposed met tower/turbine located somewhere on the radar screen. This probability is calculated from data on flight altitudes and from information on the proposed turbine heights. We used data from throughout the Hawaiian Islands (n = 2,010 birds; Cooper and Day, unpubl. data) to calculate the percentage of petrels/shearwaters with flight altitudes at or below the maximal height of the turbines (i.e., 51.0% ≤100 m agl) and met towers (i.e., 33.0% ≤65 m agl). We would have preferred to use flight-altitude data from the project area for the flight-altitude computations, but adequate sample sizes do not currently exist to do so.

FATALITY RATES

The annual estimated fatality rate is calculated as the product of: (1) the exposure rate (i.e., the number of birds that might fly within the airspace occupied by a tower/turbine); (2) the fatality probability (i.e., the probability of collision with a portion of the tower/turbine and dying while in the airspace occupied by the structure); and (3) the avoidance probability (i.e., the probability that a bird will detect and avoid entering the airspace containing the tower/turbine). The annual fatality rate is generated as an estimate of the number of birds killed/yr as a result of collisions with the tower/turbine, based on a 255-d breeding season for Hawaiian Petrels and a 210-d breeding season for Newell's Shearwaters.

Fatality Probability

The estimate of the fatality-probability portion of the fatality rate formula is derived as the product of: (1) the probability of dying if a bird collides with a tower/turbine; and (2) the probability of colliding with a turbine if the bird enters the airspace occupied by the structure (i.e., are there gaps big enough for birds to fly through the structure without hitting any part of it). Because any collision with a wind turbine or tower falls under the ESA definition of "take" we used an estimate of 100% for the first fatality-probability parameter. Note that the actual probability of fatality resulting from a collision is less than 100% because of the potential for a bird to hit a turbine component and not die (e.g., a bird could brush a wingtip but avoid injury/death). The second probability (i.e., striking the structure) needs to be calculated differently for met towers and turbines. In the met-tower design, the tower frame is a lattice structure, so we conservatively estimated the probability of hitting the tower if the bird enters the airspace at 100%. Similarly, a bird approaching a wind turbine from the side has essentially a 100% probability of getting hit by a blade; in contrast, a bird approaching from the back or front of a turbine may pass through the rotor-swept area without colliding with a blade, if it is flying fast enough. We calculated the probability of collision

for the "frontal" bird approach based upon the length of a petrel (43 cm; Simons and Hodges 1998); the average groundspeed of petrels on Maui (mean velocity = 42.5 mi/h; *n* = 347 probable petrel targets; Cooper and Day, unpubl. data) and the time that it would take a 43-cm-long petrel to travel completely through a 2-m-wide turbine blade spinning at its maximal rotor speed (22 revolutions/min); also see Tucker (1996). These calculations indicated that 19.5% of the disk of the rotor-swept area would be occupied by a blade sometime during the length of time (i.e., 0.13 sec) that it would take a petrel to fly completely past a rotor blade (i.e., to fly 2.43 m).

Avoidance Probability

The final parameter is the avoidance probability, which is the probability that a bird will see the turbine and change flight direction, flight altitude, or both, so that it completely avoids flying through the space occupied by a met tower/turbine. Because avoidance probabilities are largely unknown, we present fatality estimates for a range of probabilities of collision avoidance by these birds by assuming that 90%, 95%, or 99% of all petrels or shearwaters flying near a tower/turbine structure will detect and avoid it. See discussion for explanation of avoidance rates used.

RESULTS

VISUAL OBSERVATIONS

One Hawaiian Petrel was detected by visual observers (Table 1). This bird was heading eastward toward Haleakala at 40 m agl at 2126 on 24 July. That bird also was observed on radar. In addition, we had numerous observations of Short-eared Owls (*Asio flammeus sandwichensis;* Pueo), plus a few Barn Owls (*Tyto alba*), and one unidentified tropicbird (at 0542 on 22 July). No Hawaiian Hoary Bats (*Lasiurus cinereus semotus*; 'Ope'ape'a) were recorded.

MOVEMENT RATES

We recorded 37 radar targets during 25.0 h of sampling in summer 2009 that fit our criteria for petrels and shearwaters (Table 1). Passage rates tended to be higher in the evening than in the morning: only 8 (21.6%) of the 37 targets were recorded during the morning sampling period. Mean nightly movement rates during summer 2009 were 1.78 ± 0.14 targets/h. After adjusting our sampling results for hours of the night that we did not sample (i.e., non-peak periods), we estimated a mean movement rate of 10.0 petrel-like targets/ night during summer 2009 (Table 2).

We observed two different patterns of movement that depended on wind strength. During 20 and 21 July, there were strong Trade Winds (i.e., with average wind speeds mostly 20–35 mi/h), and we observed a pattern of 5–7 outbound targets in the evening followed by lower numbers of outbound targets in the morning (Table 1; Figure 4). During the final three nights of sampling, the winds were light (i.e., with average wind speeds mostly 0–5 mi/h [i.e., below turbine cut-in speed, since the KWP I turbine blades were not spinning]) and we observed a pattern of 4–6 inbound targets in the evening and lower numbers of targets in the morning (Table 1; Figure 5). Further, there appeared to be a shift in the spatial distribution of birds during low wind conditions that was not seen during strong winds: during the low winds, the majority of the inbound targets flew over the lower half of the proposed turbine string, and all were heading in the general direction of breeding colonies on Haleakala—not West Maui Mountain.

EXPOSURE RATES

The exposure rate is calculated as the product of three variables: annual movement rate, horizontal-interaction probability, and vertical-interaction probability. As such, it is an estimate of the number of birds flying in the vicinity of the wind turbine/met tower (i.e., crossing the radar screen) that could fly in a horizontal location and at a low-enough altitude that they could interact with a tower/turbine. Based on our summer 2009 movement rate data, we estimate that ~1,607 Hawaiian Petrels and 882 Newell's Shearwaters pass over the 1.5-km-radius radar sampling area in an average year (including birds at all altitudes; Tables 2 and 3). To generate annual exposure rates of birds exposed to each turbine or met tower (e.g., birds/tower/yr), we then multiplied the annual movement rate by the horizontal-interaction probability and the vertical-interaction probability. By applying those proportions to our data (and

Table 2. Estimated average exposure rates and fatality rates of Hawaiian Petrels (HAPE) and Newell's Shearwaters (NESH) at GE 1.5se wind turbines at the proposed KWP II Down-road Alternative wind-energy site, Maui, Hawaii, based on radar data collected in July 2009. Values of particular importance are in boxes.

Variable/parameter	HAPE		NESH	
	Minimum	Maximum	Minimum	Maximum
MOVEMENT RATE (MVR)				
A) Mean movement rate (targets/h)				
A1) Mean rate during nightly peak movement periods in spring/summer based on July 2009 data (targets/h)	1.776	1.776	1.776	1.776
A2) Mean rate during nightly peak movement periods in fall based on July 2009 data (targets/h)	1.776	1.776	1.776	1.776
B) Number of hours of evening and morning peak-period sampling	5	5	5	5
C) Mean number of targets during evening and morning peak-movement periods				
C1) Spring/summer (A1 * B)	8.88	8.88	8.88	8.88
C2) Fall (A2 * B)	8.88	8.88	8.88	8.88
D) Mean proportion of birds moving during off-peak h of night	0.126	0.126	0.126	0.126
E) Seasonal movement rate (targets/night) = ([C * D] + C)				
e1) Spring/summer	10.0	10.0	10.0	10.0
e2) Fall	10.0	10.0	10.0	10.0
F) Mean number of birds/target	1.05	1.05	1.05	1.05
G) Estimated proportion of each species	0.60	0.60	0.40	0.40
H) Daily movement rate (birds/day; = E * F * G)				
H1) Spring/summer	6.30	6.30	4.20	4.20
H2) Fall	6.30	6.30	4.20	4.20
I) Fatality domain (days/year)				
I1) Spring/summer	180	180	150	150
I2) Fall	75	75	60	60
J) Annual movement rate (birds/year; = ([H1 * I1] + [H2 * I2]), rounded to next whole number)	1,607	1,607	882	882
HORIZONTAL INTERACTION PROBABILITY (IPH)				
K) Turbine height (m)	100	100	100	100
L) Blade radius (m)	35.25	35.25	35.25	35.25
M) Height below blade (m)	29.5	29.5	29.5	29.5
N) Front-to-back width (m)	6	6	6	6
O) Minimal side profile area (m^2; = K * N)	600		600	
P) Maximal front profile area (m^2; = [M * N] + [π * L^2])		4,081		4,081
Q) Cross-sectional sampling area of radar at or below 100 m turbine height (= 3000 m * 100 m = 300,000 m^2)	300,000	300,000	300,000	300,000
R) Minimal horizontal interaction probability (= O/Q)	0.00200000		0.00200000	
S) Maximal horizontal interaction probability (= P/Q)		0.01360211		0.01360211
VERTICAL INTERACTION PROBABILITY (IPV)				
T) Proportion of petrels flying ≤ turbine height)	0.51	0.51	0.51	0.51

Table 2. Continued.

Variable/parameter	HAPE Minimum	HAPE Maximum	NESH Minimum	NESH Maximum
EXPOSURE INDEX (ER = MVR * IPH * IPV)				
U) Daily exposure index (birds/turbine/day; = H * (R or S) * T; rounded to 8 decimal places)				
U1) Spring/summer	0.00642528	0.04369870	0.00428352	0.02913247
U2) Fall	0.00642528	0.04369870	0.00428352	0.02913247
V) Annual exposure index (birds/turbine/year; = J * (R or S) * T; rounded to 8 decimal places	1.63914000	11.14788498	0.89964000	6.11850314
FATALITY PROBABILITY (MP)				
W) Probability of striking turbine if in airspace on side approach	1.00	1.00	1.00	1.00
X) Probability of striking turbine if in airspace on frontal approach	0.20	0.20	0.20	0.20
Y) Probability of fatality if striking turbine[1]	1.00	1.00	1.00	1.00
Z1) Probability of fatality if an interaction on side approach (= W * Y)	1.00000		1.00000	
Z2) Probability of fatality if an interaction on frontal approach (= X * Y)		0.19500		0.19500
FATALITY INDEX (= ER * MP)				
Annual fatality rate with 90% exhibiting collision avoidance (birds/turbine/year; = V * (Z1 or Z2) * 0.1)	0.16391	0.21738	0.08996	0.11931
Annual fatality rate with 95% exhibiting collision avoidance (birds/turbine/year; = V * (Z1 or Z2) * 0.05)	0.08196	0.10869	0.04498	0.05966
Annual fatality rate with 99% exhibiting collision avoidance (birds/turbine/year; = V *(Z1 or Z2) * 0.01)	0.01639	0.02174	0.00900	0.01193

[1] Used 100% fatality probability due to ESA definition of "take"; however, actual probability of fatality with collision <100% (see methods).

rounding up to the nearest whole number), we estimate that 2–12 Hawaiian Petrels and 1–7 Newell's Shearwater fly within the space occupied by each wind turbine in an average year (Tables 2 and 4) and estimate that 1 Hawaiian Petrel and 1 Newell's Shearwater fly within the space occupied by the 65-m-high met tower in an average year (Tables 3 and 4). Note that all these calculations are exposure rates and, thus, include an unknown proportion of birds that would detect and avoid the turbines and met towers. Hence, exposure rates estimate how many times/year a petrel or shearwater would be exposed to wind turbines or met towers and not necessarily the number that actually would collide with those structures.

FATALITY MODELING

The individual steps and estimates involved in calculating fatality rates are shown in Table 2 (turbines) and Table 3 (met tower). We speculate that the proportions of birds that detect and avoid turbines and towers is substantial (see Discussion), but limited petrel- or shearwater-specific data are available to use for an estimate of the avoidance rates for those types of structures. Because it is necessary to estimate the fatality of petrels and shearwaters at the proposed project, however, we assumed that 90%, 95%, or 99% of all birds will be able to detect and avoid the towers and turbines. If we also assume that 100% of the birds colliding with a turbine/tower die (although see above), the ranges of annual fatalities are 0.016–0.217 Hawaiian Petrel/turbine/yr and 0.009–0.119 Newell's Shearwaters/turbine/year (Table 2). For the 65-m met tower, we estimate a fatality rate of 0.008–0.081 Hawaiian Petrel/tower/yr and 0.004–0.044 Newell's Shearwaters/tower/year (Table 3). For cumulative annual fatalities, the

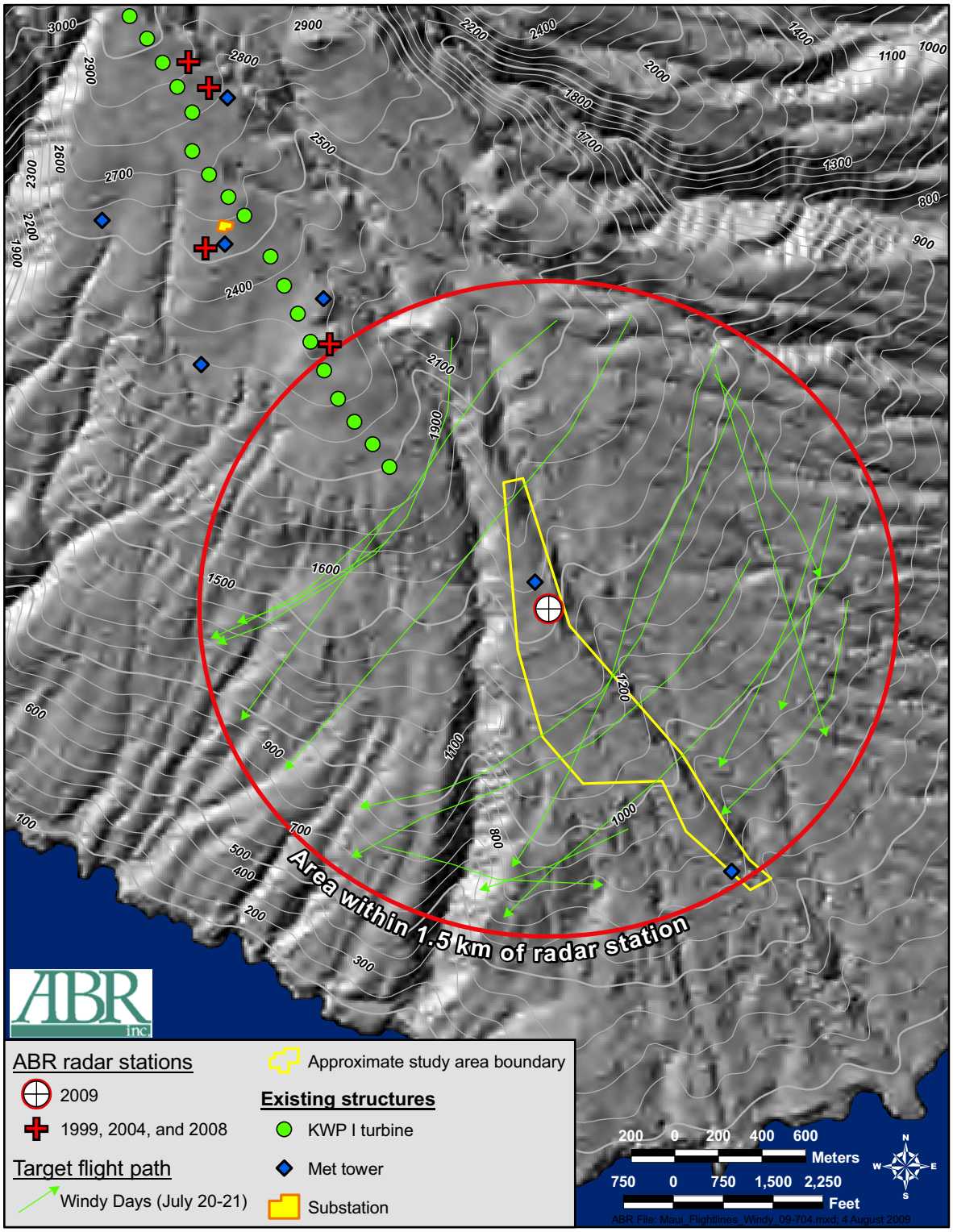

Figure 4. Location of flight paths of petrel-like radar targets observed during the strong wind conditions of 20–21 July 2009, at the KWP II Down-road Alternative wind energy facility, Maui, Hawaii.

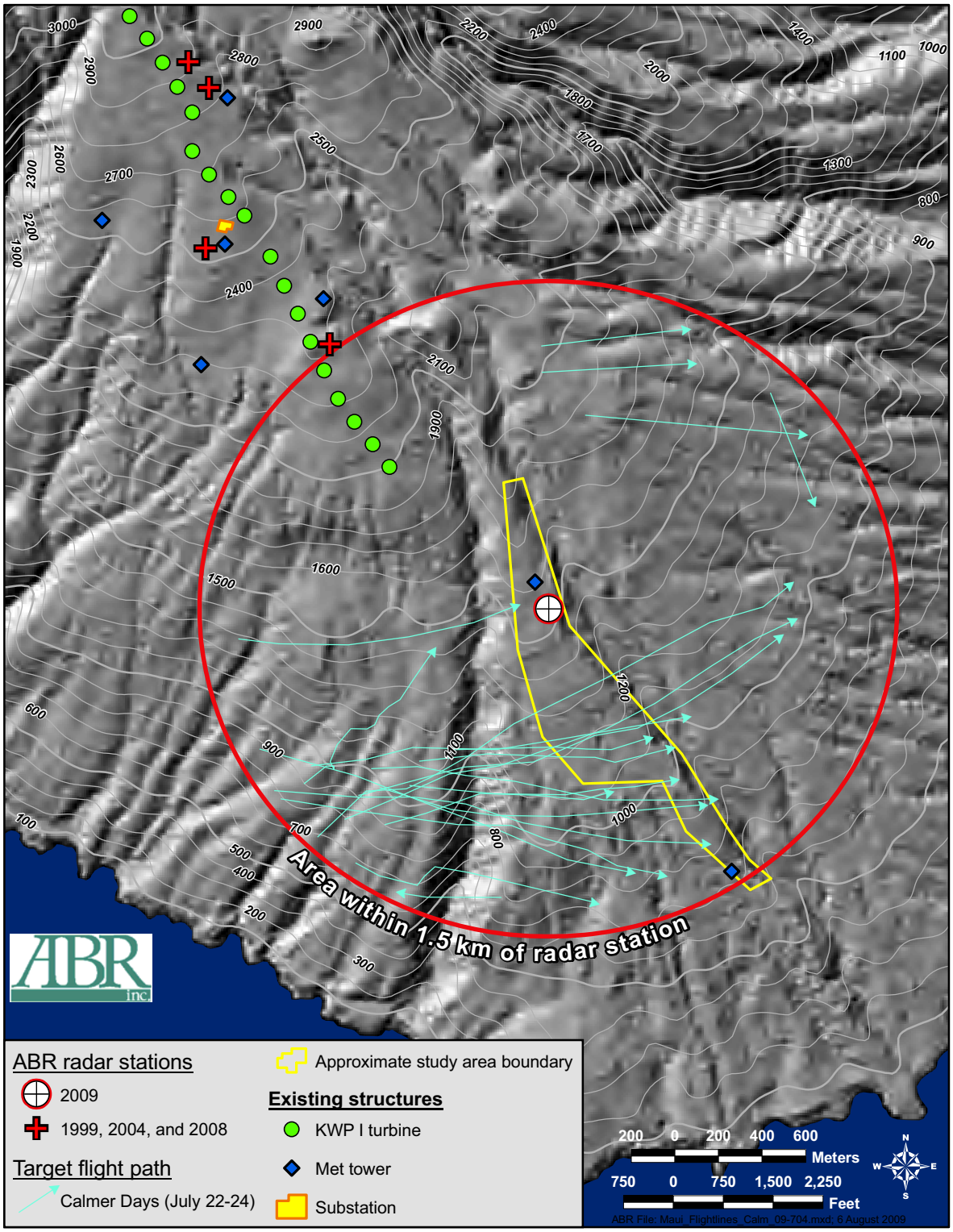

Figure 5. Location of flight paths of petrel-like radar targets observed during the light and variable wind conditions of 22–24 July 2009, at the KWP II Down-road Alternative wind energy facility, Maui, Hawaii.

Table 3. Estimated average exposure rates and fatality rates of Hawaiian Petrels (HAPE) and Newell's Shearwaters (NESH) at the proposed free-standing 65-m-tall met tower at the KWP II Down-road alternative wind-energy site, Maui, Hawaii, based on radar data collected in July 2009. Values of particular importance are in boxes.

Variable/parameter	HAPE	NESH
MOVEMENT RATE (MVR)		
A) Mean movement rate (targets/h)		
A1) Mean rate during nightly peak movement periods in spring/summer based on July 2009 data (targets/h)	1.776	1.776
A2) Mean rate during nightly peak movement periods in fall based on July 2009 data (targets/h)	1.776	1.776
B) Number of hours of evening and morning peak-period sampling	5	5
C) Mean number of targets during evening and morning peak-movement periods		
C1) Spring/summer (A1 * B)	8.88	8.88
C2) Fall (A2 * B)	8.88	8.88
D) Mean proportion of birds moving during off-peak h of night	0.126	0.126
E) Seasonal movement rate (targets/night) = ((C * D)+ C)		
e1) Spring/summer	10.0	10.0
e2) Fall	10.0	10.0
F) Mean number of birds/target	1.05	1.05
G) Estimated proportion of each species	0.60	0.40
H) Daily movement rate (birds/day =E*F*G)		
h1) Spring/summer	6.30	4.20
h2) Fall	6.30	4.20
I) Fatality domain (days/year)		
i1) Spring/summer	180	150
i2) Fall	75	60
J) Annual movement rate (birds/year; = ((H1*I1) + (H2*I2)), rounded to next whole number)	1,607	882
HORIZONTAL INTERACTION PROBABILITY (IPH)		
K) Maximal cross-sectional area of tower (side view =297 m²)	297.0	297.0
L) Cross-sectional sampling area of radar at or below 50 m tower height (= 3000 m * 65 m = 195,000 m²)	195000.000	195000.000
M) Average probability of radar target intersecting the met tower (= K/L, rounded to 8 decimal places)	0.00152308	0.00152308
VERTICAL INTERACTION PROBABILITY (IPV)		
N) Proportion of petrels flying ≤ tower height)	0.33	0.33
EXPOSURE INDEX (ER = MVR*IPH*IPV)		
O) Daily exposure index (birds/tower/day = H*M*N, rounded to 8 decimal places)		
O1) Spring/summer	0.00316612	0.00211075
O2) Fall	0.00316612	0.00211075
P) Annual exposure index (birds/tower/year = J*M*N, rounded to 8 decimal places)	0.80770292	0.44330677
FATALITY PROBABILITY (MP)		
Q) Probability of striking tower if in airspace	1.00	1.00
R) Probability of fatality if striking tower[1]	1.00	1.00
S) Probability of fatality if an interaction (= Q*R)	1.00000	1.00000
FATALITY INDEX (= ER*MP)		
T) Annual fatality rate with 90% exhibiting collision avoidance (birds/tower/year = P*S*0.1)	0.08077	0.04433
U) Annual fatality rate with 95% exhibiting collision avoidance (birds/tower/year = P*S*0.05)	0.04039	0.02217
V) Annual fatality rate with 99% exhibiting collision avoidance (birds/tower/year = P*S*0.01)	0.00808	0.00443

[1] Used 100% fatality probability due to ESA definition of "take", however actual probability of fatality with collision <100% (see methods).

annual fatality rate would be 0.229–3.043 Hawaiian Petrels/yr and 0.126–1.670 Newell's Shearwaters/yr for all 14 proposed wind turbines combined (Table 4). The cumulative annual fatalities at the one proposed met tower would be 0.008–0.081 Hawaiian Petrels/yr and 0.004–0.044 Newell's Shearwaters/yr (Table 4). We caution again, however, that the range of assumed avoidance rates of seabirds and turbines/towers (90–99%) is not fully supported by empirical data at this time.

DISCUSSION

MOVEMENT RATES AND FLIGHT BEHAVIOR

Within KWP, there has been some variation in mean movement rates among years and studies (Table 5), but all estimated rates have been low (i.e., between 0.5 and 1.8 targets/h). Thus, mean movement rates of Hawaiian Petrels recorded in the KWP study areas (i.e., ~1–2 targets/h; this study; Day and Cooper 1999, Cooper and Day 2004; Sanzenbacher and Cooper 2008, 2009) are much lower than those over the eastern and northern sides of Maui (Cooper and Day 2003).

Our limited data (i.e., five sampling nights) from the current study suggest that patterns of movement may have been affected by the wind regime. We found that shearwater/petrels mostly flew in an outbound movement towards the southwest during strong Trade Winds and flew inbound toward the east during light and variable winds (i.e., at wind speeds that apparently were below the cut-in speed of the KWP I turbines that were not spinning at the time). Our limited data also suggested that the passage rates might be higher over the lower (southern) end of the study area than elsewhere during calm conditions, though, again note that we only had two nights of sampling during strong winds and three nights during light winds. The flight directions of the targets observed during light winds suggest that they were birds approaching Maui from the west and "cutting the corner" of West Maui on their way to breeding colonies on Haleakala.

VISUAL OBSERVATIONS OF PETRELS AND SHEARWATERS

In total, we have had three visual observations of Hawaiian Petrels and two observations of unidentified shearwaters/petrels over the KWP study areas during 1999–2009 (Table 6; Day and Cooper 1999, Cooper and Day 2004a; Sanzenbacher and Cooper 2008, 2009; this study). The birds observed in the evening period were headed easterly or northeasterly, and the birds observed in the morning were heading southeasterly or southwesterly. These directions fit a pattern of inbound movements toward Haleakala in the evening and outbound movements from Haleakala and/or West Maui in the morning.

Flight altitudes of the two birds that we observed over the proposed turbine-string ridges were within turbine heights (i.e., one was at 40 m agl and the other was at 65 m agl; Table 6). The flight altitudes of the other three birds were much higher (i.e., 300–500 m agl), but they were measured over the valley to the east; hence, we not know what their flight altitudes were as they flew over the ridges on which the turbine strings lie. Thus, it is possible that visual altitude data is biased to detecting lower-flying birds, the very limited data that we have for known flight altitudes (n = 2) suggest that a substantial proportion of petrels may have flown within the turbine-height zone.

In our fatality models, we used the timing of inland flights at the nearby Ukumehame site from Cooper and Day (2003) to correct for proportions of targets that were Hawaiian Petrels and those that were Newell's Shearwaters; those data suggested that 60% of the targets were Hawaiian Petrels and 40% of the targets were Newell's Shearwaters. However, the timing of two of the three Hawaiian Petrels that we saw over the site (Table 6) occurred during the late evening, a period when Cooper and Day (2003) assumed that only Newell's Shearwaters would occur. Thus, these visual observations suggest the possibility that more than 60% of the radar targets we observed in the current study could have been Hawaiian Petrels. We do not recommend changing the relative proportions of Hawaiian Petrels vs. Newell's Shearwaters in the fatality model, however, unless further data are collected to confirm this pattern.

Table 4. Summary of exposure rates, fatality rates, and cumulative fatality rates for Hawaiian Petrels (HAPE) and Newell's Shearwaters (NESH) at wind turbines and meteorological (met) towers at the proposed KWP II Down-road Alternative wind-energy site, Maui, Hawaii, based on radar data collected in July 2009.

	Exposure rate/structure (birds/structure/yr)			Fatality rate/structure (birds/structure/yr)			Cumulative fatality rate (birds/yr)	
Structure type	HAPE	NESH	Avoidance rate	HAPE	NESH	No. structures	HAPE	NESH
GE 1.5 MW turbine	1.639 (min)	0.900 (min)	0.90 (min)	0.164	0.090	14.00	2.295	1.259
	11.148 (max)	6.119 (max)	0.90 (max)	0.217	0.119	14.00	3.043	1.670
			0.95 (min)	0.082	0.045	14.00	1.147	0.630
			0.95 (max)	0.109	0.060	14.00	1.522	0.835
			0.99 (min)	0.016	0.009	14.00	0.229	0.126
			0.99 (max)	0.022	0.012	14.00	0.304	0.167
65-m free-standing met tower	0.808	0.443	0.90	0.081	0.044	1.00	0.081	0.044
			0.95	0.040	0.022	1.00	0.040	0.022
			0.99	0.008	0.004	1.00	0.008	0.004

Table 5. Mean (± SE) movement rates of petrel-like targets measured with radar at the KWP wind-energy site and proposed KWP II wind-energy sites, Maui, Hawaii, during 1999–2009 studies.

		Movement rate (targets/h)		
Year	Site	Summer	Fall	Source
1999	KWP I	1.2 ± 0.3	–	Day and Cooper (1999)
2004	KWP I	–	1.0 ± 0.2	Cooper and Day (2004)
2008	KWP II	0.46 ± 0.15	0.09 ± 0.07	Sanzenbacher and Cooper (2008. 2009)
2009	KWP II Alternate	1.78 ± 0.14	–	current study

Table 6. Records of Hawaiian Petrels and unidentified shearwaters/petrels at the proposed KWP II wind-energy site and nearby KWP I wind-energy site, Maui, Hawaii, during 1999–2009 studies.

Date	Time	Species[1]	Number	Altitude (m agl)	Flight direction
28 May 1999	2150	HAPE	1	300[2]	NE
28 May 1999	0608	UNSP	2	500[2]	SE
12 October 2004	0608	HAPE	1	500[2]	SE
15 October 2004	0454	UNSP	1	65	SW
24 July 2009	2126	HAPE	1	40	E

[1] HAPE = Hawaiian Petrel; UNSP = unidentified shearwater/petrel.
[2] Flight altitude measured over the valley to east of the proposed turbine string ridge, not over the proposed turbine string ridge itself; measurements were done that way because that is where birds were first seen.

EXPOSURE RATES AND FATALITY ESTIMATES

We estimated that 2–12 Hawaiian Petrels and 1–7 Newell's Shearwater would fly within the space occupied by each wind turbine in an average year and estimated that 1 Hawaiian Petrel and 1 Newell's Shearwater would fly within the space occupied by the 65-m-high met tower in an average year (Table 4). We used these estimated exposure rates as a starting point for developing a complete avian risk assessment; however, we emphasize that it currently is unknown whether bird use (i.e., exposure) and fatality at windfarm structures are strongly correlated. For example, Cooper and Day (1998) found no relationship between movement rates and fatality rates of Hawaiian Petrels and Newell's Shearwaters at powerlines on Kaua'i, indicating that other factors had a much greater effect on causing fatality than movement rates did. For example, other factors such as proximity to the ocean or poor weather could be more highly correlated with fatality rates than is bird abundance. As an example, collisions of Laysan Albatross with a large array of communication-tower antenna wires and guy wires adjacent to large, high-density albatross breeding colonies on Midway Atoll occurred at a far higher rate during periods of high winds, rain, and poor visibility than during periods of better weather: 838 (>25%) of the 2,901 birds killed during the study were killed during two storms (Fisher 1966). To determine which factors are most relevant, future studies that collect concurrent data on movement rates, weather, and fatality rates would be useful to begin to determine whether movement rates and/or weather conditions can be used to predict the

likelihood of petrel fatalities at wind turbines and other structures across the entire proposed windfarm.

In addition, few data are available on the proportion of petrels and shearwaters that do not collide with wind turbines or met towers because of collision-avoidance behavior (i.e., birds that completely alter their flight paths horizontally and/or vertically to avoid flying through the space occupied by a turbine/tower). Clearly, the detection of wind turbines or other structures could result in collision-avoidance behavior by these birds and reduce the likelihood of collision. There also appear to be differences between petrels and shearwaters in their ability to avoid obstacles. For example, Cooper and Day (1998) indicated that Hawaiian Petrels have flight characteristics that make them more adept at avoiding powerlines than Newell's Shearwaters, suggesting that Hawaiian Petrels might also be more likely to avoid collisions with other structures such as wind turbines. These authors also suggested that the tendency for Hawaiian Petrels to approach and leave nesting colonies primarily during crepuscular periods enables these birds to see and avoid structures (e.g., wind turbines) more easily than do Newell's Shearwaters that approach and leave nesting colonies primarily during nocturnal periods.

Some collision-avoidance information is available on petrels and shearwaters from earlier work that we conducted on Kaua'i (Cooper and Day 1998; Day et al., *In review*). In summary, those data suggest that the behavioral-avoidance rate of Hawaiian Petrels and Newell's Shearwaters near powerlines is high. For example, across all 207 Hawaiian Petrels observed flying within 150 m of transmission lines on Kauai, 40 exhibited behavioral responses; of those 40 birds that exhibited collision-avoidance responses, none (0%) collided with a transmission line. Thus, the collision-avoidance rate for Hawaiian Petrels was 100% (i.e., 40 of 40 interactions). Across all 392 Newell's Shearwaters observed flying within 150 m of transmission lines, 29 exhibited behavioral responses; of those 29 birds that exhibited collision-avoidance responses, none (0%) collided with a transmission line. However, one Newell's Shearwater that did not exhibit a collision-avoidance response hit a transmission line. Thus, the collision-avoidance rate for Newell's Shearwaters was 97% (i.e., 29 of 30 interactions).

There also is some information available on collision-avoidance of Hawaiian Petrels on Lana'i, where the behavior of petrels was studied as they approached large communication towers near the breeding colony (TetraTech 2008; Day et al., *In review*). In that study, all 20 (100%) of the Hawaiian Petrels seen on a collision-course toward communication towers exhibited avoidance behavior and avoided collision.

Additional data that provides some insight on collision-avoidance behavior of petrels and shearwaters at windfarm structures (e.g., wind turbines and met towers) are available from other studies associated with the operational KWP I wind facility. There was 1 Hawaiian Petrel fatality and 0 Newell's Shearwater fatalities observed at the 20-turbines and three met towers in the first 3.5 years of operation (G. Spencer, FirstWind, pers. comm.). Calculations using data for scavenging bias and searcher efficiency collected at the KWP I wind facility indicate that the one observed fatality equates to a corrected direct take of 0.5 Hawaiian Petrels/yr and 0 Newell's Shearwaters/yr (Kaheawa Wind Power LLC 2009, *in prep*). Cooper and Day (2004b) modeled seabird fatality for the KWP I wind turbines, based on movement rates from radar studies at the site (Day and Cooper 1999; Cooper and Day 2004a, 2004b), and estimated that the combined annual fatality of Hawaiian Petrels and Newell's Shearwaters at the KWP I turbines would be ~3–18 birds/yr with a 50% avoidance rate, ~1–2 birds/yr with a 95% avoidance rate, and <1 bird/yr with a 99% avoidance rate. Thus, the fatality model that used a 99% avoidance value was a closer fit with the measured fatality rates than was the fatality models that used a 50% or 95% avoidance rate.

In summary, currently available data from Kaua'i, Lana'i, and Maui suggest that the avoidance rate of petrels and shearwaters at transmission lines and communications towers is high and approaches 100% (Day et al., *in review*). Data from the fatality searches at turbines and met towers on Maui are more difficult to interpret because they suggest high avoidance but are not a direct measure of avoidance; however those data also suggest that avoidance of those structures must be occurring because only one Hawaiian

Petrel has been found during regular fatality searches of those structures over a 3.5-year period. Thus, the overall body of evidence, while incomplete, is consistent with the hypothesis that the average avoidance rate of wind turbines and met towers is substantial and potentially is ≥95%. The ability of Hawaiian Petrels and Newell's Shearwater to detect and avoid most objects under low-light conditions makes sense from a life-history standpoint, in that they forage extensively at night and are adept at flying through forests near their nests during low light conditions.

In addition to the limited data available for Hawaiian Petrels and Newell's Shearwaters, there is evidence that many other species of birds detect and avoid structures (e.g., wind turbines, met towers) during low-light conditions (Winkelman 1995, Dirksen et al. 1998, Desholm and Kahlert 2005, Desholm et al. 2006). For example, seaducks in Europe have been found to detect and avoid wind turbines >95% of the time (Desholm 2006). Further, natural anti-collision behavior (especially alteration of flight directions) is seen in migrating Common and King eiders (*Somateria mollissima* and *S. fischeri*) approaching human-made structures in the Beaufort Sea off of Alaska (Day et al. 2005) and in diving ducks approaching offshore windfarms in Europe (Dirksen et al. 1998). Collision-avoidance rates around wind turbines are high for Common Eiders in the daytime (Desholm and Kahlert 2005), gulls (*Larus* spp.) in the daytime (>99%; Painter et al. 1999, cited in Chamberlain et al. 2006), Golden Eagles (*Aquila chrysaetos*) in the daytime (>99%; Madders 2004, cited in Chamberlain et al. 2006), American Kestrels (*Falco sparverius*) in the daytime (87%, Whitfield and Band [in prep.], cited in Chamberlain et al. 2005), and passerines during both the day and night (>99%; Winkelman 1992, cited in Chamberlain et al. 2006).

We agree with others (Chamberlain et al. 2006, Fox et al. 2006) that species-specific, weather-specific, and site-specific avoidance data are needed in models to estimate fatality rates accurately. However, the currently available avoidance data from Kaua'i and Lana'i for Hawaiian Petrels and Newell's Shearwaters and the petrel fatality data at KWP I wind turbines and met towers while incomplete, is consistent with the notion that a substantial proportion of petrels detect and avoid wind turbines, marked met towers, communication towers, and powerlines under normal ranges of weather conditions and visibility (but note that avoidance rates could be lower under inclement conditions). Until further petrel- and shearwater-specific data on the relationship between exposure and fatality rates are available for structures at windfarms, we continue to provide a range of assumptions for avoidance rates in our fatality models (i.e., 90%, 95%, and 99% avoidance), along with a discussion of the body of evidence that, while incomplete at this time, is consistent with the notion that the average avoidance-rate value is substantial and potentially is ≥95%. With an assumption of a 95% avoidance rate, the estimated average annual take at the KWP II Downroad Alternative would be ≤0.1 Hawaiian Petrel/turbine/yr and ≤0.06 Newell's Shearwaters/ turbine/yr and, for met towers, fatality would be 0.04 Hawaiian Petrel/tower/yr and 0.02 Newell's Shearwaters/tower/yr.

Other factors could affect our estimates of fatality in either a positive or a negative direction. One factor that would have created a positive bias was the inclusion of targets that were not petrels or shearwaters. Our visual observations of several other species with similar target characteristics to petrels (especially during crepuscular periods, when we could use binoculars) helped to minimize the inclusion of these non-target species, but it is possible (especially during nocturnal conditions) that some of our radar targets were other fast-flying species that were active during the sampling period (e.g., Pacific Golden-Plover [*Pluvialis fulva*]). A second positive bias in our fatality model is our simplistic assumption that movement rates of seabirds do not fall as individual fatalities occurred (i.e., we assumed sampling with replacement for fatalities). Given the low movement rates observed in this study, it is likely that the fatality of just a single bird would substantially reduce the average nightly movement rates. A third positive bias is the assumption that turbines are operating at maximal rotor speed; this assumption clearly is incorrect because of variability in winds, but using it results in maximal estimates of collision rates for birds flying through the turbine rotors.

There also are factors that could create a negative bias in our fatality estimates. One example would be if targets were missed because

they flew within radar shadows. Because the sampling stations provided good coverage of the surrounding area, we believe that the proportion of targets that was missed because they passed through the entire area of coverage of the study area within a radar shadow was minimal.

A factor that could affect the predictive value of our fatality estimates in either direction is interannual variation in the number of birds visiting nesting colonies on Maui. Average hourly movement rates for the current study (= ~1.8 targets/h), from 2004 (summer = ~0.5 targets/h; fall = ~0.1 targets/h; Sanzenbacher and Cooper 2008, 2009), from summer 1999 (1.2 targets/h; Day and Cooper 1999), and from fall 2004 (1.0 targets/h; Cooper and Day 2004a) all suggest that rates are consistently low at the KWP project areas relative to other areas on Mauai, and that interannual variation in that overall level of bird use of the area is minimal. Some caution in extrapolation of movement rates across years is still warranted, however, because there are examples of other sites with high interannual variation in counts, such as the three sites on Kaua'i where counts were ~100–300 birds/hr lower (~four times lower) in fall 1992 than in fall 1993; the lower counts in 1992 were attributed to the effects of Hurricane Iniki (Day and Cooper 1995). Oceanographic factors (e.g., El Niño–Southern Oscillation events) also vary among years and are known to affect the distribution, abundance, and reproduction of seabirds (e.g., Ainley et al. 1994, Oedekoven et al. 2001). Another factor that could cause interannual variation in counts in either direction is overall population increases or declines. For example, there was a ~60% decline in radar counts on Kaua'i between 1993 and 1999–2001 that was attributed to population declines of Newell's Shearwaters (Day et al. 2003b).

CONCLUSIONS

We used our risk-assessment model to estimate the number of Hawaiian Petrels and Newell's Shearwaters that might be killed by collisions with wind turbines and met towers at the proposed KWP II Down-road Alternative facility. The model is affected by several input variables, including the collision-avoidance rate. The absence behavioral studies to fully quantify avoidance rates at wind turbines and met towers precludes determination of actual avoidance rates; however, a growing body of evidence suggests that a high percentage of petrels and shearwaters detect and avoid structures such as communication towers, transmission lines, and wind turbines (see above). We also suspect high rates of anti-collision behaviors because petrels must rely upon acute nocturnal vision for foraging and other flight activities under varying weather conditions. In conclusion, we believe that the proportion of petrels that would see and avoid proposed wind turbines at the KWP II Down-road Alternative will be high, but until studies are conducted to quantify avoidance behavior at wind turbines and met towers, we provide a range of assumptions for avoidance rates in our fatality models (i.e., 90%, 95%, and 99% avoidance rates) along with a discussion of the body of evidence that is consistent with the hypothesis that the average avoidance-rate value is substantial and potentially ≥95%. With an assumption of 95% avoidance, the estimated average annual take at the proposed KWP II Down-road Alternative wind turbines would be ≤0.1 Hawaiian Petrel/turbine/yr and ≤0.06 Newell's Shearwaters/turbine/yr. The estimated average annual take at the proposed KWP II Down-road Alternative met tower (with an assumption of 95% avoidance) would be 0.04 Hawaiian Petrel/tower/yr and 0.02 Newell's Shearwaters/tower/yr.

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Appendix 4

RC-0438B

An Archaeological Inventory Survey for the Kaheawa Wind Power (KWP) Phase 2 Project Area

(TMK:2-3-6-001:por. 014 and 2-4-8-001: por. 001)

Ukumehame Ahupua‘a
Wailuku and Lahaina Districts
Island of Maui

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ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL STUDIES

An Archaeological Inventory Survey for the Kaheawa Wind Power (KWP) Phase 2 Project Area

(TMK: 2-3-6-001:por. 014 and 2-4-8-01:por. 001)

Ukumehame Ahupua‘a
Wailuku and Lahaina Districts
Island of Maui

RECHTMAN CONSULTING

EXECUTIVE SUMMARY

At the request of Kelly Bronson of First Wind, Rechtman Consulting, LLC conducted an archaeological inventory survey of a roughly 175-acre project area in Ukumehame Ahupuaʻa, Wailuku and Lahaina Districts, Island of Maui (TMK:2-3-6-001:por. 014 and TMK:2-4-8-001:por. 001). The objective of the survey was to record the locations of all archaeological sites and features present within the study area and to provide preliminary significance evaluations for any recorded sites. First Wind would like to expand their existing wind farm operation (KWP Phase 1) by erecting fourteen new power generating wind turbines (KWP Phase 2) within the current study area. The current project was undertaken in support of all necessary permit approvals and in compliance with both the historic preservation review process requirements (HAR 13§13-275-5) of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) and the County of Maui Planning Department.

The current project area is located on the southern slopes of the West Maui Mountains and stretches from an elevation of approximately 400 feet above sea level to a maximum elevation of approximately 2,000 feet above sea level. The project area is accessed through a gate along the northern edge of Honoapiliʻilani Highway that leads to the existing access road that runs to the upper portions of the area, commonly referred to a Kaheawa Pastures. The land encompassed by the current project area is owned by the State of Hawaiʻi and is administered through the Department of Land and Natural Resources; it is designated as conservation land, and aside from the access road is currently not being used. Cattle were formerly grazed on the property, but a lease to Perreira Ranch was cancelled in the mid-1990s (Tomonari-Tuggle 1998:1). The project area terrain consists of what is commonly referred to as tableland. Typical of the south rift of the West Maui volcano, this land consists of high, inter-valley ridges separated by steep-sided, dry gulches that descend the steep, southwest facing slope to the ocean (Tomonari-Tuggle 1998:1). The two largest gulches that cross the current project area are Malalowaiaole Gulch and Manawainui Gulch; the latter marks the boundary between the Lahaina and Wailuku Districts. Owing to the former use as ranch land, grass is the dominant vegetation over most of the project area.

Nine previous archaeological studies were conducted for the KWP Phase 1 project area. These studies included a reconnaissance survey of twenty-seven wind turbine locations (Tomonari-Tuggle 1998), a study of an upland *heiau* site (Site 5232; Athens 2002) and a preservation plan for that *heiau* (Tomonari-Tuggle and Rasmussen 2005), a supplemental survey of the wind turbine pad alignments (Magnuson 2003), a supplemental survey for a proposed access road (Athens 2004), a reconnaissance survey of the southern portion of a new low impact road (Rasmussen 2005a), a supplemental reconnaissance survey within the SMA zone for a proposed staging area (Rasmussen 2005b), and an inventory survey of the entire proposed development area (Clark and Rechtman 2005). Three of these studies included portions of the current project area (Clark and Rechtman 2005; Rasmussen 2005a; Tomonari-Tuggle 1998). In addition to these studies, an archaeological survey report (Tomonari-Tuggle and Tuggle 1991) and a cultural resource management plan (Tomonari-Tuggle 1995) were prepared for the Lahaina Pali Trail, a portion of which crosses through the current project area; an inventory survey was conducted for MECO transmission lines that mark the *mauka* terminus of the *makai* portion of the current project area (Hammatt et al. 1996; Robins et al. 1994); and an inventory survey of 333 acres for the alternative proposed location for KWP Phase 2 (Clark and Rechtman 2006).

As a result of the current inventory survey the Lahaina Pali Trail and a possible remnant section of its Māʻalaea branch were identified as was the previously recorded Site 5648, along with a concrete water trough (Site 6665). The Lahaina Pali Trail and the Māʻalaea branch of this trail were constructed in 1841 and remained in use until 1891. It seems reasonable to assume that during earlier times other trails accessed this area; however, the physical evidence of such trails is no longer observable on the surface having been superseded by either the historic trails or the Jeep roads. At Site 5648, twenty new features were documented; bringing the total number of features at this site to thirty. The features are indicative of temporary habitation and may represent recurrent use shelters associated with trail routes. The use of these features likely dates from both Precontact and Historic times. The most intensive habitation may have occurred between 1841 and 1891 when the Lahaina Pali Trail and its Māʻalaea branch were still in use. Site 6665 is a concrete water trough that was built on December 14, 1943. This water trough is part of a water system developed by Honoula Ranch in Ukumehame in the 1940s. This system provided drinking water for cattle in the once extensive, but arid pastures of this upland area. Cattle ranching continued within the project area until the 1990s.

The Lahaina Pali Trail and the remnant of the Mā‘alaea branch of this trail are considered significant under Criterion D for the information yielded relative to middle and late nineteenth century transportation patterns and evolving modes of transportation. The main trail branch is already governed by a management plan (Tomonari-Tuggle 1995) and it will not be directly impacted as a result of the current proposed expansion of the wind power project. The newly discovered remnant portion of the Mā‘alaea branch of this trail should be preserved although it does not currently provide a continuous link to the main branch of the Lahaina Pali Trail or to Mā‘alaea. A preservation plan for this site should be prepared and submitted to DLNR-SHPD for review and approval. Site 5648 is considered significant under Criterion D for both the information it has yielded and the potential information it is likely to yield if future work were to be conducted. The locations of the proposed wind generating towers and the associated infrastructure are being designed to avoid all of the features of this site. While it is possible that data recovery might enhance our knowledge relative to the age and specific function of the various features of Site 5648, such mitigation work is not necessary given the current proposed project layout. Therefore a preservation plan for this site should be prepared and submitted to DLNR-SHPD for review and approval. If in the future, it is necessary to impact one or more of the site's features, DLNR-SHPD should be contacted to address possible mitigation of impacts through data recovery. Site 6665 is considered significant under Criterion D for information it has yielded relative to the middle twentieth century ranching practices in the area. As it is not exceptional, nor is it likely to yield further important information, no further work in the recommended treatment for Site 6665.

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INTRODUCTION

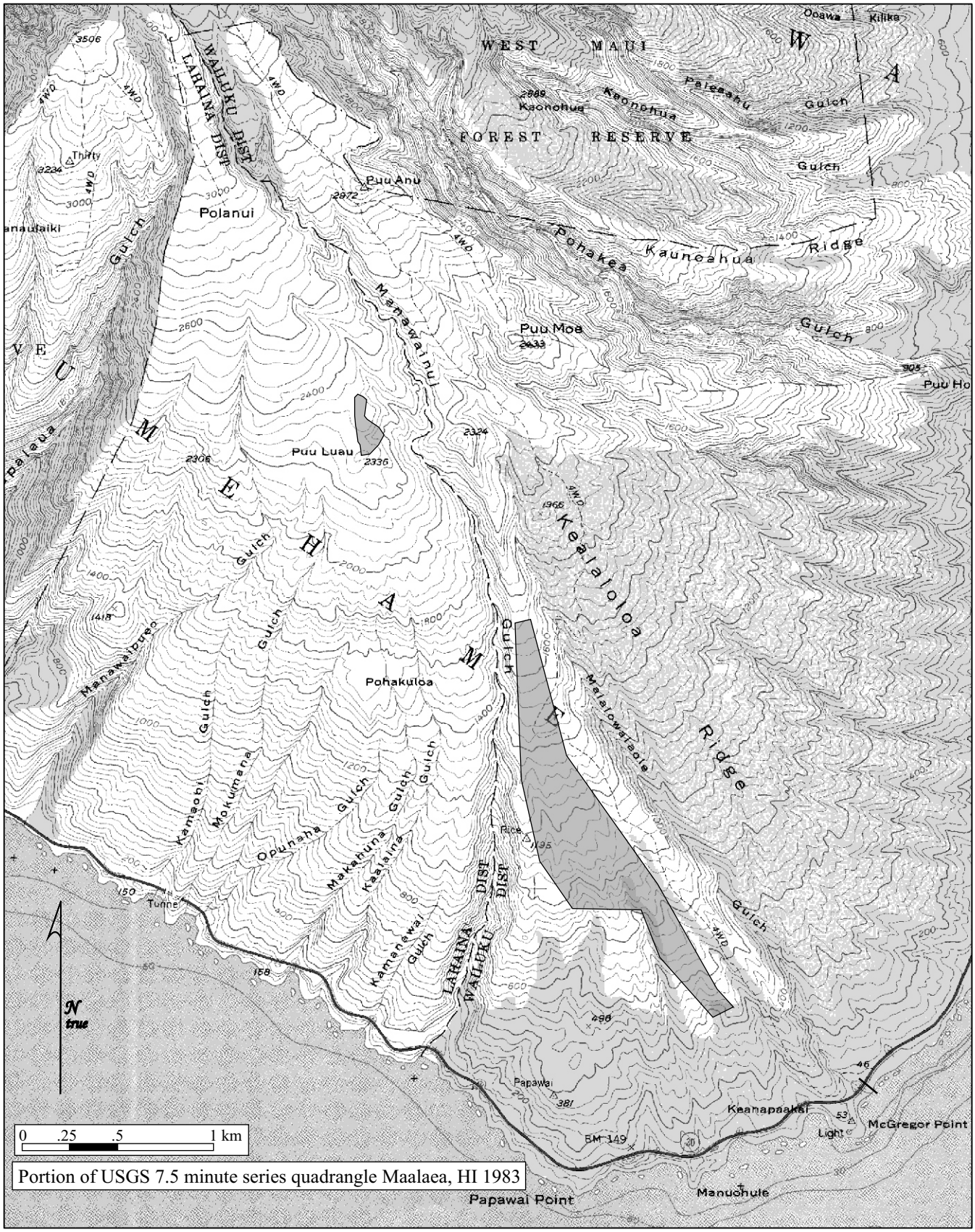
At the request of Kelly Bronson of First Wind, Rechtman Consulting, LLC conducted an archaeological inventory survey of a roughly 175-acre project area in Ukumehame Ahupuaʻa, Wailuku and Lahaina Districts, Island of Maui (TMK:2-3-6-001:por. 014 and TMK:2-4-8-001:por. 001) (Figure 1). The land encompassed by the current project area is owned by the State of Hawaiʻi and is administered through the Department of Land and Natural Resources (DLNR); it is designated as conservation land. The objective of the survey was to record the locations of all archaeological sites and features present within the study area and to provide preliminary significance evaluations for any recorded sites. First Wind would like to expand their existing wind farm operation (KWP Phase 1) by erecting fourteen new power generating wind turbines (KWP Phase 2) within the current study area (Figure 2). Rechtman Consulting, LLC previously conducted an archaeological inventory survey of an adjacent 200 acres for the construction of the existing wind farm (Clark and Rechtman 2005), and more recently an inventory survey of 333-acres as an alternative site for the current proposed expansion of the wind farm (Clark and Rechtman 2006). The current project was undertaken in support of all necessary permit approvals and in compliance with both the historic preservation review process requirements (HAR 13§13-275-5) of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) and the County of Maui Planning Department.

This report contains background information outlining the project area's physical and cultural contexts, a presentation of previous archaeological work in the immediate vicinity of the parcel, and current survey expectations based on that previous work. Also presented is an explanation of the project's methods, detailed description of the archaeological resources encountered, interpretation and evaluation of those resources, and treatment recommendations for all of the documented sites.

Project Area Description

The current project area is located on the southern slopes of the West Maui Mountains and stretches from an elevation of approximately 400 feet above sea level to a maximum elevation of approximately 2,000 feet above sea level. The project area is accessed through a gate along the northern edge of Honoapiliʻilani Highway that leads to the existing access road, servicing KWP Phase 1, and that runs all the way to the upper portions of the area, commonly referred to a Kaheawa Pastures. This land is designated as conservation land, and aside from the access road is currently not being used. Cattle were formerly grazed on the property, but a lease to Perreira Ranch was cancelled in the mid-1990s; cattle are currently grazed to the east of the project area on Wailuku Agribusiness lease lands (Tomonari-Tuggle 1998:1). The project area terrain consists of what is commonly referred to as tableland. Typical of the south rift of the West Maui volcano, this land consists of high, inter-valley ridges separated by steep-sided, dry gulches that descend the steep, southwest facing slope to the ocean (Tomonari-Tuggle 1998:1). The two largest gulches that cross the current project area are Malalowaiaole Gulch and Manawainui Gulch; the latter marks the boundary between the Lahaina and Wailuku Districts. Owing to the former use as ranch land, grass is the dominant vegetation over most of the project area.

The current study covers two discontinuous project areas: (1) the main (*makai*), approximately 165-acre area for the placement of the fourteen proposed wind turbines extends *makai* from the lower MECO transmission corridor; and (2) a smaller (*mauka*) area, approximately ten acres, for the proposed KWP Phase 2 substation is immediate adjacent to the earlier (Clark and Rechtman 2006) study area (see Figures 1 and 2). Each of these specific study areas is discussed in detail below.



Portion of USGS 7.5 minute series quadrangle Maalaea, HI 1983

Figure 1. Project area location (shaded).

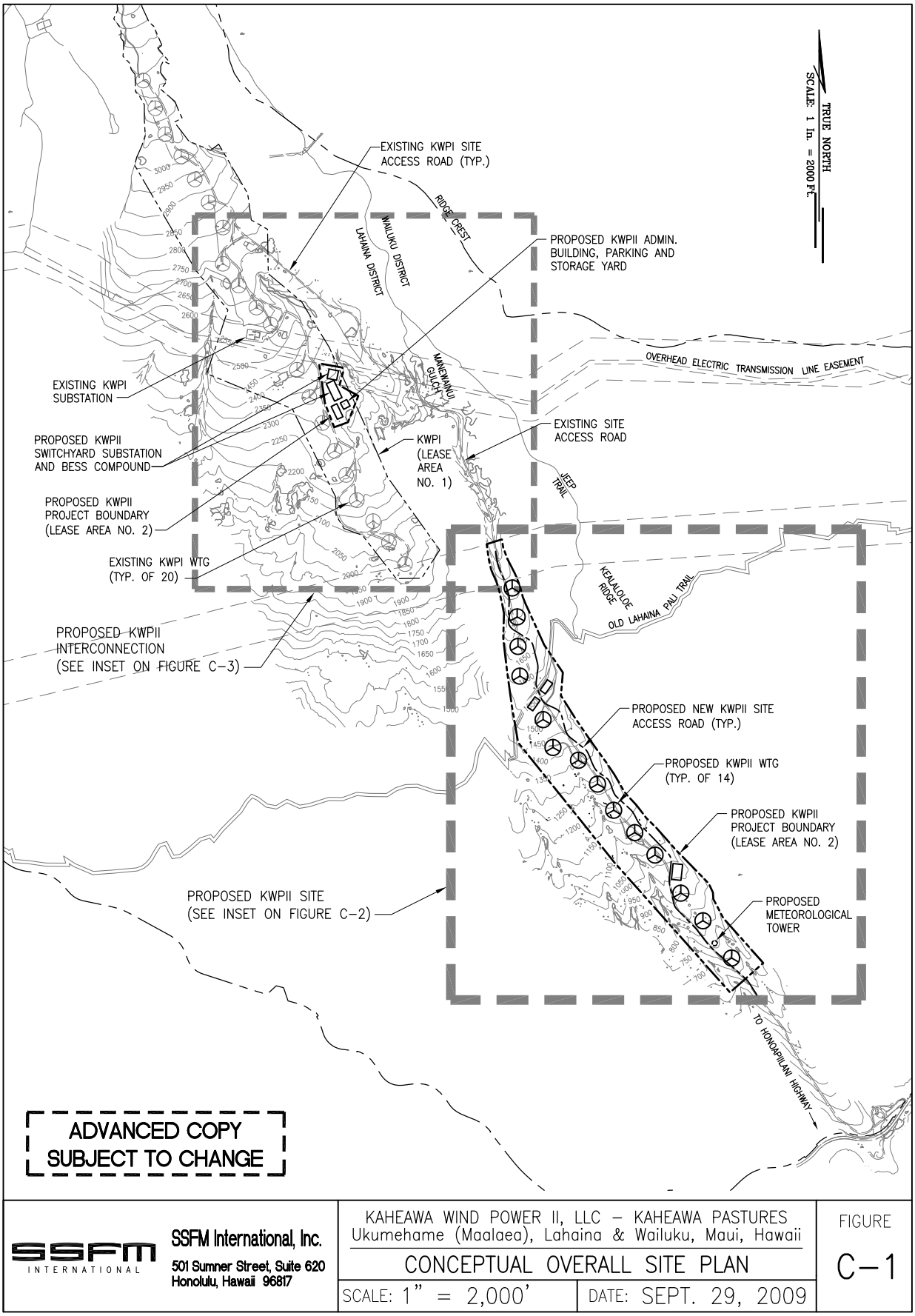


Figure 2. Conceptual development plan for KWP Phase 2.

The *makai* survey area ranges in elevation from about 1,800 feet to 400 feet above sea level and encompasses the narrow ridge between Malalowaiaole Gulch (to the east) and Manawainui Gulch (to the west) (Figure 3). Within this area is the existing KWP Phase 1 roadway (Figure 4), a portion of the original 4WD road that traversed this ridge (Figure 5), and a portion of the Lahaina Pali Trail (Figure 6). This lower survey area is located just *makai* of the unnamed *pu'u* near the head of Malalowaiaole Gulch. Rasmussen, who previously surveyed this portion of the project area, described the environment thusly:

> The soil consists of Oli silty loam, part of a soil series consisting of well-drained, moderately deep to deep soils that are developed in volcanic ash and weathered igneous rock (Foote et al. 1972:97). The lower elevations are characterized by exposed bedrock with uplifted or tilted rock outcroppings along the ridge. Grasses and weeds are short and sparse. . . Native plants such as *pūkiawe* (*Syphelia* sp.), *'a'ali'i* (*Dodonaea viscosa*), *'ūlei* (*Osteomeles anthyllidifolia*), and *'ōhi'a lehua* (*Metrosideros polymorpha*), grow on the sides of the *pu'u*. (Rasmussen 2005a:1)

During the current field investigation ground visibility within the main, *makai*, survey area was excellent with buffelgrass (*Pennisetum ciliare*) dominant and a few burned *kiawe* trees also present (Figure 7).

Figure 3. Manawainui Gulch along the western project area boundary, view to southwest.

Figure 4. Existing access road through the lower study area, view to northeast.

Figure 5. Portion of the original 4WD road in the lower study area, view to south.

Figure 6. Portion of Lahaina Pali Trail in the lower study area, view to southwest.

Figure 7. Typical vegetation cover in the *makai* portion of project area, view to northeast.

The *mauka* survey area, along the western edge of Manawainui Gulch is located at an elevation of 2,000 feet above sea level, just below Puʻu Lūʻau. The western edge of this survey area is bound by the existing access road. Tomonari-Tuggle, who previously surveyed this portion of the current survey area, described the environment thusly:

> The tableland is relatively level, although it becomes steep at the upper end and drops significantly at the lower end below the prominent hill called Puʻu Luʻau. The terrain is slightly undulating and is mildly dissected by feeder channels to Manawainui gulch. And to the small gulches to the south especially Manawaipueo; the fourth anemometer tower is near the head of Manawaipueo. The broad, level topped Puʻu Luʻau separates the head of Mokumanu gulch on the west from Manawainui gulch. The area below the puʻu is steep, rocky, and punctured by numerous boulder outcrops.
>
> There are three soil zones in the project area. The upper edge of the area is Olelo silty clay, which is well-drained upland soil formed in "material derived from basic igneous rock" and occurring on narrow to broad ridge tops (Foote et al. 1972:101). The central portion of the project area, inland of Puʻu Luʻau, consists of Maiwa silty clay loam, which is a well-drained upland soil developed in volcanic ash and weathered igneous rock (Foote et al. 1972:102-103). The adjacent gulches are classified as rough broken and stony land in very steep gulches. The section of Manawainui gulch southeast of the project area is classified as rock land where exposed rock covers 25 to 90 percent of the surface.
>
> The top of Puʻu Luʻau and scattered areas along the upper edge of Manawainui gulch are deflated, with exposed dirt and boulders and cobbles.
>
> Mean annual rainfall ranges from 750 mm at the lower edge of the project area to 1,500 mm at the upper edge of the area (Giambelluca et al. 1986:112).
>
> The project area is primarily grasslands, with scattered Christmas berry (*Schinus terebinthifolius*) and scrub *ʻōhiʻa* (*Metrosideros polymorpha*) in the upper portion and lantana (*Lantana camara*), *ʻilima* (*Sida fallax*), *koa haole* (*Leucaena leucocephala*), and klu (*Acacia farnesiana*) in the lower portion. The vegetation below Puʻu Luʻau is largely dense, tall scrub lantana. There are scattered small groves of ironwood trees (*Casuarina equisitfolia*) on the grass-covered slopes. Above the uppermost anemometer tower, the vegetation changes from grassland to increasingly larger and denser stands of *ʻōhiʻa* and Christmas berry. Taller vegetation in the project area clearly shows the sculpting effect of the near constant winds. (Tomonari-Tuggle 1998:3)

During the current study, ground visibility in this area was good, and the vegetation was a mix of thick grasses and shrubs with stands of ironwood (Figure 8).

Figure 8. Typical vegetation cover in the *mauka* portion of the project area, view to southeast.

BACKGROUND

To generate a set of expectations regarding the nature of archaeological resources that might be encountered within the current study area, and to establish an environment within which to assess the significance of any such resources, previous archaeological studies relative to the project area and a general historical context for the region are presented.

Previous Archaeological Research

Nine previous archaeological studies were conducted for the KWP Phase 1 project area. These studies included a reconnaissance survey of twenty-seven wind turbine locations (Tomonari-Tuggle 1998), a study of an upland *heiau* site (Site 5232; Athens 2002) and a preservation plan for that *heiau* (Tomonari-Tuggle and Rasmussen 2005), a supplemental survey of the wind turbine pad alignments (Magnuson 2003), a supplemental survey for a proposed access road (Athens 2004), a reconnaissance survey of the southern portion of a new low impact road (Rasmussen 2005a), a supplemental reconnaissance survey within the SMA zone for a proposed staging area (Rasmussen 2005b, 2005c), and an inventory survey of the entire proposed development area (Clark and Rechtman 2005). Three of these studies included portions of the current project area (Clark and Rechtman 2005; Rasmussen 2005a; Tomonari-Tuggle 1998). In addition to these studies, an archaeological survey report (Tomonari-Tuggle and Tuggle 1991) and a cultural resource management plan (Tomonari-Tuggle 1995) were prepared for the Lahaina Pali Trail, a portion of which crosses through the current project area; an inventory survey was conducted for MECO transmission lines that mark the *mauka* terminus of the *makai* portion of the current project area (Hammatt et al. 1996; Robins et al. 1994); and an inventory survey of 333 acres for the alternative proposed location for KWP Phase 2 (Clark and Rechtman 2006). The findings of the previous archaeological studies are summarized below and their locations are shown in Figure 9.

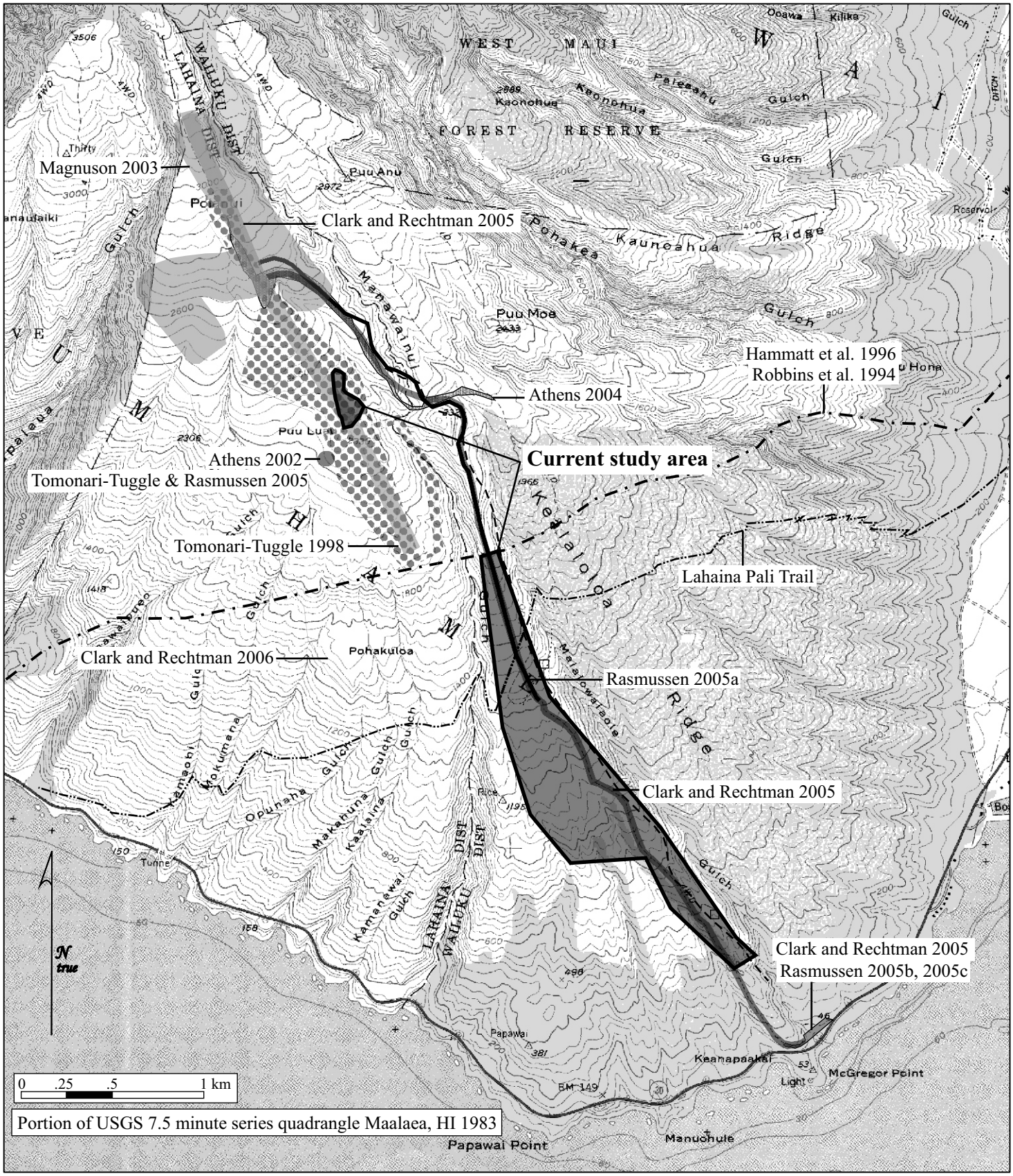


Figure 9. Previous archaeological studies.

Tomonari-Tuggle and Tuggle (1991) conducted an archaeological survey of two demonstration trails for the Hawai‘i statewide trail and access system. One of the demonstration trails was the Historic Lahaina Pali trail, a portion of which runs *makai* of the current project area. This trail was constructed around 1841 to accommodate horse traffic between the towns of Lahaina and Wailuku. Tomonari-Tuggle (1995) later prepared a cultural resource management plan for the trail as well. The trail is currently open to the public as part of the Na Ala Hele Statewide Trail and Access System. Tomonari-Tuggle and Tuggle describe the trail thusly:

> The Lahaina Pali trail extends 4.5 miles across the lower southern slopes of West Maui Mountains. At its west end, the trail is anchored inland of the Honoapili‘ilani Highway just east of Ukumehame State Beach Park. Its east end is located just inland of the pineapple fields near Ma‘alaea Harbor. The trail covers an elevation range from about 100 feet to 1600 feat above sea level. (1991:5)

During the survey of the Lahaina Pali Trail Tomonari-Tuggle and Tuggle (1991) recorded eighteen archaeological sites (Sites 2816 to 2833) along its route, but they did not assign a Site number to the trail itself. Sixteen of the sites were related to the construction and use of the trail or the old coastal road. These sites included alignments, enclosures, walls, petroglyphs, terraces, and C-shaped structures. The two sites not related to the trail included a midden scatter (Site 2816) and a rock shelter (Site 2833). Both of these sites were determined to be of likely Precontact Hawaiian origins. One of the recorded sites (Site 2825) is located *mauka* of trail within Manawainui Gulch along the western edge of the current project area. Tomonari-Tuggle describes Site 2825 as a:

> …complex of petroglyphs and retaining walls; petroglyphs are historic names scratched into boulder outcrop adjacent to trail and about 8 m above trail; one inscription in upper set is the date “1874”; stacked boulder retaining walls up to 1.5 m high, built into natural outcropping on E side of gulch; possible cupboard in outcrop, 1x.50m, top of cliff overhang is 1 m above cupboard surface; stacked boulder wall continues discontinuously upstream about 70 m to an old fencepost. (1995:44)

Robins et al. (1994) conducted an archaeological inventory survey of a then proposed 14.7-mile long transmission line corridor from Mā‘alaea to Lahaina. The alignment of the transmission lines crosses the general project area at an elevation of approximately 1,880 feet above sea level. A later survey for access roads leading to the transmission lines was conducted by Hammatt et al. (1996). While these two surveys did locate a number of sites including Historic irrigation ditches, a Historic dam, Historic cattle walls, and Precontact temporary shelters, wind breaks, enclosures, and agricultural features, no archaeological resources were encountered in the vicinity of the current project area.

Archaeological studies of the previously developed portion of the Kaheawa Wind Power project area began in 1998 with a reconnaissance survey of twenty-seven proposed wind turbine locations (Tomonari-Tuggle 1998). This survey took place at elevations ranging from roughly 2,000 to 2,900 feet above sea level. The survey area included a 200-foot wide by roughly 1.5-mile long corridor following a line of five anemometer towers and a potion of Manawainui Gulch extending inland from the MECO transmission line inland approximately 3,000 feet. The only cultural sites observed during the reconnaissance survey were a concrete water trough and a metal waterline. Tomonari-Tuggle concludes that:

> As a result of this one-day survey, it is highly unlikely that any archaeological sites are located within the Maui wind turbine project area. This area was probably not used intensively by Hawaiians and thus, would retain little, if any, evidence of prehistoric or early historic activity. Except for the watering trough and the pipeline, there are no remains of cattle ranching, the only identified use of this area in historic and modern times. (1998:15)

In 1999 a brush fire burned a portion of the wind farm project area, removing some dense brush from the southwestern edge of Puʻu Lūʻau, and revealing the presence of an upland *heiau* in Ukumehame Ahupuaʻa (Site 50-50-09-5232). The location of the *heiau* places it slightly to the west of the area studied by Tomonari-Tuggle (1998). Mr. Ed Lindsey, a cultural monitor for the wind farm project, discovered the site in late 1999 and notified Dr. Melissa Kirkendall, staff archaeologist at the Maui Branch office of the SHPD (Athens 2002:1). After a field visit by SHPD staff members, it was recommended that a qualified archaeologist document the *heiau* in detail. In 2002 IARII conducted archaeological investigations at the *heiau* that included site mapping, photographs, and subsurface testing (Athens 2002).

According to Athens (2002), the *heiau* consists of two adjacent stone enclosures joined by a massive central wall, with one of the enclosures displaying a notch on one side. Excavation inside the notched enclosure revealed a dense deposit of charcoal associated with use of the *heiau*. An AMS radiocarbon determination on charcoal from a short-lived wood taxon (*Chamaesyce* sp.) indicated that the *heiau* likely dated to AD 1670-1770. Several pieces of branch coral were also recovered from the *heiau*, further confirming the religious nature of the site. No food (marine shell or animal bone) or tool (basalt or volcanic glass flake debris, abraders) remains were found either in the excavation or on the surface of the site.

Tomonari-Tuggle and Rasmussen (2005) prepared a preservation plan for the *heiau* (on behalf of the Michael Gresham of Makani Nui Associates, LLC). The plan calls for several short-term preservation measures including a temporary buffer of 100 to 200 feet around the entire site (this buffer was to be marked by 4 to 6 foot high construction fencing prior to any construction activities), monitoring by a qualified archaeologist during any construction activities that take place within 500 feet of the *heiau*, for a pre-construction briefing to be conducted by a qualified archaeologist with the project manager, construction supervisors, and crews prior to any ground alteration activity, and that a report be prepared detailing these short-term preservation measures and submitted to SHPD (Tomonari-Tuggle and Rasmussen 2005:11-14). Long-term preservation measures called for in the plan include the creation of permanent signage and markers around the site, education for individuals and organizations having access to the project area, and community involvement in the maintenance and protection of the site (Tomonari-Tuggle and Rasmussen 2005:14-15). The long-term preservation of this site would be the responsibility of the State. All of the short-term preservation measures proposed by Tomonari-Tuggle and Rasmussen (2005) were followed during the construction of the existing wind farm, but the long-term preservation measures have not yet been implemented.

In 2003, IARII conducted a supplemental archaeological survey of a revised alignment for wind turbine pad locations (Magnuson 2003). This supplemental survey included three 200-foot wide corridors for two possible turbine rows and an access road connecting them. The survey corridor extended a total distance of 2,130 meters from elevations of 2,400 to 3,100 feet above sea level. As a result of the survey one site, a watering trough previously noted by Tomonari-Tuggle (1998), was relocated, mapped in detail, photographed, and assigned an SIHP site number (Site 50-50-09-5402). Inscriptions in the concrete of the trough indicate that Site 5402 was built in 1943 (Magnuson 2003).

In 2004, IARII conducted a supplemental archaeological survey for a portion of an access road leading to the existing wind farm (Athens 2004). The survey area consisted of a 75-meter wide corridor stretching 2.5 kilometers northwest from an existing jeep road across Manawainui Gulch to the previously surveyed wind farm area. As a result of the survey two small rock piles that probably served as cairns (Sites 50-50-09-5625 and 50-50-09-5626) were located and recorded. Site 5625 was located on a natural bench immediately upslope of a small unnamed cinder cone within a dense growth of ironwood samplings, and Site 5626 was situated on the edge of a small ridge descending into Manawainui Gulch from its western edge (Athens 2004:2). Athens (2004:3) concluded that the two stacked rock piles, probably cairns, were fully documented, and no further archaeological documentation was needed. In addition to these sites, a single brass 45-70 cartridge casing manufactured by Winchester Repeating Arms Company between 1866 and 1932 was also discovered along the western edge of Manawainui Gulch (Athens 2004:3).

In 2005, IARII conducted a supplemental archaeological reconnaissance survey of a new proposed low impact road leading to the existing wind farm that passed through the current project area (Rasmussen 2005a). This survey area consisted of a corridor approximately 75 meters wide that extended from roughly 1,400 to 2,300 feet above sea level (Rasmussen 2005a:6). The corridor commenced at an existing access road, followed a narrow ridge to the northwest, and eventually crossed Manawainui Gulch and joined up with the wind turbine locations. As a result of the reconnaissance survey three previously unrecorded archaeological sites thought to be of traditional Hawaiian origins were discovered (Sites 5648, 5649, and 5650). Two of the recorded sites (Sites 5648 and 5650) were located outside (to the west of) the actual road survey corridor. Site 5648 falls within the boundaries of the current survey area.

Site 50-50-09-5648, located between ca. 1,280 and 1,420 feet above sea level, consisted of six C-shaped rock shelters (Features 1, 2, 5, 6, 7, and 9), a possible C-shaped rock structure (Feature 4), one modified outcrop (Feature 10), and a cupboard (Feature 3). Marine shell was observed near Feature 4. Based on the presence of the shell and the formal attributes of the features, Site 5648 was interpreted as being used for habitation, perhaps related to the Lahaina Pali Trail, or an earlier trail (Rasmussen 2005a:7). Site 50-50-09-5649, located between ca. 1,880 and 1,980 feet above sea level, consisted of a rock cairn (Feature 11) and modified outcrop (Feature 12). Site 50-50-5650, located at the top of an unnamed cinder cone at an elevation of ca. 2,300 feet above sea level, consisted of four rock cairns (Features 13 to 16). Rasmussen concluded that, "the location (on top of a *pu'u*) and type of features present (cairn with linear stones that may be fallen upright stones) suggest that this site may have a ceremonial function" (2005a:8).

Later in 2005, IARII conducted a supplemental archaeological reconnaissance survey of a roughly 1.75-acre SMA area located along the northern (*mauka*) edge of Honoapili'ilani Highway (Rasmussen 2005b). As a result of that survey three archaeological sites were recorded. In the Rasmussen (2005b) report the sites are referred to with temporary site numbers, but in a letter dated February 11, 2005 the sites are referred to with SIHP site numbers (Rasmussen 2005c). The three recorded sites included a Historic road remnant (Site 50-50-09-5652), a traditional Hawaiian habitation area comprised of several rough features on a small knoll north of the staging area (Site 50-50-09-5654), and set of concrete steps with the date 1908 inscribed into one of the steps (Site 50-50-09-5654). According to Rasmussen (2005b) only Site 5652 was located within the SMA project area, and according to Rasmussen (2005c) all three sites were located outside of the project area. Nevertheless, Rasmussen (2005c:2) suggests that measures be taken to protect the sites during any construction activities in the area, and recommended that a full archaeological inventory survey be conducted of the access road leading to the proposed wind farm area prior to any development.

Following all of the preliminary work conducted by IARII, Rechtman Consulting, LLC conducted an archaeological inventory survey of the entire existing wind farm project area (Clark and Rechtman 2005). As a result of the inventory survey seven previously identified archaeological sites and two newly identified sites were recorded. The previously identified sites included the Historic Lahaina Pali Trail, a section of Historic highway (Site 4696), a concrete watering trough (Site 5402), a lone cairn (Site 5625), a cairn and a modified outcrop located next to one another (Site 5649), a terraced section of old road (Site 5652), and the remains of a Historic structure (Site 5654). The newly identified sites included a possible privy (Site 5714) and a Historic hoist location (Site 5715). Two isolated finds, consisting of marine shell fragments and an adze fragment, were also discovered. Five other archaeological sites previously recorded by IARII outside the boundaries of the current project area were also relocated. These sites included an upland *heiau* (Site 5352), a lone cairn (Site 5626), a Precontact habitation complex located between 1,280 and 1,420 feet above sea level (Site 5648), a grouping of four cairns on top of an unnamed *pu'u* (Site 5650), and a Precontact habitation complex located at approximately 70 feet above sea level (Site 5653). Clark and Rechtman summarized the findings within the KWP Phase 1 project area thusly:

> A review of archival resources and previous archaeological studies, combined with the findings of the current inventory survey, indicates that Precontact use of the project area centered around coastal habitation and the exploitation of marine resources, as indicated by Site 5653. A network of trails may have connected the coastal habitation

> area with inland resource areas (Devereux et al. 1999). Site 5648 may have been a Precontact habitation area located along one of these trails, or perhaps an early Historic site related to the use of the Lahaina Pali trail (Rasmussen 2005a). If a Precontact *mauka/makai* trail route traversed the current project area, then it likely accessed inland resource areas, and may have connected to trails leading to other areas of West Maui. No evidence of a Precontact trail was observed during the current survey, and it is likely that if one did exist, it was destroyed by the McGregor Point jeep road (Devereux et al. 1999). In late Precontact times trails likely ran to Site 5352, an inland *heiau* located on Puʻu Lūʻau (Athens 2002). Isolated marine shell fragments and an adze fragment observed within the wind turbine survey corridor may have been dropped along such a trail route leading to or from the *heiau*.
>
> Sites related to Historic use of the current project area are far more numerous than Precontact ones. Recorded Historic sites indicate that the area along the old Highway alignment (Site 4696) was the primary focus of Historic use. The date "1908" within the concrete stairs at Site 5654, indicates that a Historic structure was in use on the ridge to the west of Malalowaiole Gulch around that time period. Site 5652, a terraced roadbed may have run from Site 4696 to the structure. A possible privy (Site 5714) and a Hoist location (Site 5715) were also located in the area. All of these sites may relate to the use of the current project area for cattle ranching purposes. The land in the vicinity of the current project area was leased for ranching purposes and used as pasture from the late 1850s to the early 1990s (Tomonari-Tuggle 1998). The only site recorded in the extreme inland portions of the current project area was a concrete watering trough constructed in 1943 (Site 5402).
>
> In addition to these sites the Lahaina Pali trail crosses the current project area. This Historic trail was constructed around 1841 for horse travel between Wailuku and Lahaina. The trail fell into disuse approximately fifty years later with the construction of a carriage road (Site 4696) along the coast in Ukumehame Ahupuaʻa (Tomonari-Tuggle and Tuggle 1991). The trail brought numerous Historic travelers across the lower slopes of the West Maui Mountains, and it continues to bring modern day visitors to the area as part of the *Nā Ala Hele* Statewide Trail and Access System. [2005:40]

As the alternative proposed location for KWP Phase 2, in 2006 Rechtman Consulting, LLC conducted an archaeological inventory survey of a roughly 333-acre project area located north and west of the current study area (Clark and Rechtman 2006). As a result of their survey Site 5232, an upland *heiau* previously recorded by Athens (2002) was relocated, and five new sites including a windbreak shelter (Site 6218), three cairn (Sites 6219, 6220, and 6221), and a Historic ranching area containing the remains of a concrete trough and two recently burned wooden structures (possible troughs; Site 6222) were recorded within the project area. Two segments of an old metal waterline associated with Site 6222 also crossed the project area from north to south. With the exception of the previously identified *heiau*, all of the newly recorded archaeological sites were present within the southern portion of the project area *makai* of the existing wind farm. The *heiau* (Site 5232) is located along the southwestern flank of Puʻu Lūʻau near the western boundary of the existing wind farm. This site has a previously approved and partially implemented preservation plan (Tomonari-Tuggle and Rasmussen 2005). The site was examined and photographed during the Clark and Rechtman (2006) survey, but no new work was conducted at it, and no new features were discovered in its vicinity. In addition to the recorded archaeological sites a single, isolated piece of branch coral was found on the ground surface to the west of Site 6218 and the old metal waterline.

Cultural-Historical Context

A generalized Cultural-Historical model for the Hawaiian Islands, with specific reference to Maui Island, and Ukumehame Ahupuaʻa, is presented in order to better understand the current survey area within its regional context.

A Generalized Model of Hawaiian Prehistory

The generalized cultural sequence that follows is based on Kirch's (1985) model. The Settlement or Colonization Period is believed to have occurred in Hawaiʻi between A.D. 300–600 from the southern Marquesas Islands. This was a period of great exploitation and environmental modification, when early Hawaiian farmers developed new subsistence strategies by adapting their familiar patterns and traditional tools to their new environment (Kirch 1985; Pogue 1978). Their ancient and ingrained philosophy of life tied them to their environment and kept order. Order was further assured by the conical clan principle of genealogical seniority (Kirch 1984). According to Fornander (1969), the Hawaiians brought from their homeland certain universal Polynesian customs: the major gods *Kane, Ku*, and *Lono*; the *kapu* system of law and order; cities of refuge; the ʻ*aumakua* concept; various superstitions; and the concept of *mana*.

The Development Period (A.D. 600–1100) brought about a uniquely Hawaiian culture. The portable artifacts found in archaeological sites of this period reflect not only an evolution of the traditional tools, but some distinctly Hawaiian inventions. The adze (*koʻi*) evolved from the typical Polynesian variations of plano-convex, trapezoidal, and reverse-triangular cross-section to a very standard Hawaiian rectangular quadrangular tanged adze. The two-piece fishhook and the octopus-lure breadloaf sinker are Hawaiian inventions of this period, as are ʻ*ulu maika* stones and *lei niho palaoa*. The later was a status item worn by those of high rank, indicating a trend toward greater status differentiation (Kirch 1985).

The Expansion Period (A.D. 1100–1650) is characterized by the greatest social stratification, major socioeconomic changes, and intensive land modification. Most of the ecologically favorable zones of the windward and coastal regions of all major islands were settled and the more marginal leeward areas were being developed. The greatest population growth occurred during the Expansion Period. Subsistence patterns intensified as crop farming evolved into large irrigated field systems and expanded into the marginal dryland areas. The *loko* or fishpond aquaculture flourished during this period (Bellwood 1978; Kirch 1985). It was during the Expansion Period that a second major migration settled in Hawaiʻi, this time from Tahiti in the Society Islands (Kamakau 1976).

The *ahupuaʻa* concept was established during the A.D. 1400s (Kirch 1985), adding another component to a then well-stratified society. This land unit became the equivalent of a local community, with its own social, economic, and political significance. *Ahupua'a* were ruled by *aliʻi ʻai ahupuaʻa* or lesser chiefs; who, for the most part, had complete autonomy over this generally economically self-supporting piece of land, which was managed by a *konohiki*. *Ahupuaʻa* were usually wedge or pie-shaped, incorporating all of the eco-zones from the mountains to the sea and for several hundred yards beyond the shore, assuring a diverse subsistence resource base (Hommon 1986). The *aliʻi* and the *makaʻāinana* (commoners) were not confined to the boundaries of the *ahupuaʻa*; when there was a perceived need, they also shared with their neighbor *ahupuaʻa ohana* (Hono-ko-hou 1974).

Handy et al. relate that, "Maui was the only island that had a paved way that ran all the way around both its east and west ends" (1991:489). This road was known as the *Alaloa* (long road). Martha Foss Fleming (1933:3-9 in Handy et al. 1991) writes that:

> …This road was built in about 1516 by Kihapiʻilani, after his conquest and unification of the whole island. It was paved with stones along much of its extent, hence it was referred to as the "*kipapa* (pavement) of Kihapiʻilani." Beaches were used as crossings where gulches came down to the shore. There were no bridges; and beaches were also used along the seashore in many localities…Travelers were sometimes ferried across streams by canoe, or along shore, as between ʻOlowalu and Maʻalaea, around the rough southern tip of West Maui [this includes the area of the current study]. (1991:489).

The *ahupuaʻa* was further divided into smaller sections such as the *ʻili, moʻoʻaina, paukuʻaina, kihapai, koele, hakuone*, and *kuakua* (Hommon 1986, Pogue 1978). The chiefs of these land units gave their allegiance to a territorial chief or *moʻi* (king). *Heiau* building flourished during this period as religion became more complex and embedded in a sociopolitical climate of territorial competition. Monumental architecture, such as *heiau*, "played a key role as visual markers of chiefly dominance" (Kirch 1990:206). At least four *heiau* are known to exist in Ukumehame Ahupuaʻa; Ukumehame Heiau (Site 50-50-08-03) and Hikiʻi Heiau (Site 50-50-08-02), located on either side of Ukumehame Gulch to the west of the current project area, Kawaiʻaole Heiau (Site 50-50-08-04) located near the coast to the east of the current project area, and an unnamed upland *heiau* located on Puʻu Lūʻau (Site 50-50-09-5232) to the west of the current project area at a similar elevation (Athens 2002; Devereux et al. 1999; Walker 1931).

The Proto-Historic Period (A.D. 1650–1795) is marked by both intensification and stress. Wars occurred between intra-island and inter-island polities. This period was one of continual conquest by the reigning *aliʻi* of all islands. Kamakau (1992:74) relates that Alapaʻi, a Hawaiʻi Island chief, spent a whole year in preparation for a war with Maui, battles of which may have taken place nearby the current project area. Kamakau writes:

> It was 1738 that he set out for the war in which he swept the country…It employed the usual method of warfare of drying up streams…The wet taro patches and the brooks were dried so that there was no food for Ka-uhi [a Maui chief] or for the country people. Alapaʻi's men kept close watch over the brooks of Olowalu, Ukumehame, Wailuku, and Honokawai. (1992:74)

However, Alapaʻi's forces, consisting of some 8,440 warriors, were surprised and slaughtered by Peleioholani, an Oʻahu chief in cahoots with Kauhi, whose force consisted of only 640 warriors. According to Kamakau (1992:74), Alapaʻi regrouped and held Lahaina District from Ukumehame to Mala on the north. When Peleioholani tried to join his forces with Kauhi's forces, Alapaʻi forces, led by Kalaniʻōpuʻu and Keoua, attacked at Puʻunene and were victorious.

On Hawaiʻi Island, Keʻeaumoku, son of Keawepoepoe, set up a fort at Pololu and Honokane; he was attacked there by Kalaniʻōpuʻu, so he moved to Maui. About A.D. 1759 Kalaniʻōpuʻu conquered East Maui, defeating his wife's brother, the Maui king Kamehamehanui, by using Hana's prominent Puʻu Kauʻiki as his fortress. He appointed one of his Hawaiʻi chiefs, Puna, as governor of Hana and Kipahulu. Kahekili became king of Maui in A.D. 1766 when Kamehamehanui died following an illness. Keʻeaumoku took his widow, Namahana, a cousin of Kamehameha I, as his wife. Their daughter, Kaʻahumanu, the future favorite wife of Kamehameha I, was born in a cave at the base of Puʻu Kauʻiki, Hana, Maui in A.D. 1768 (Kamakau 1992). In A.D. 1775 Kalaniʻōpuʻu and his Hana forces raided and destroyed the neighboring Kaupo district, then launched several more raids on Molokai, Lanai, Kahoʻolawe, and parts of West Maui. It was at the battle of Kalaeokaʻilio that Kamehameha, a favorite of Kalaniʻōpuʻu, was first recognized as a great warrior and given the name of Paiʻea (hard-shelled crab) by the Maui chiefs and warriors (Kamakau 1992). During the battles between Kalaniʻōpuʻu and Kahekili (1777–1779), Kaʻahumanu and her parents left Maui to live on the island of Hawaiʻi (Kamakau 1992).

History After Contact

Captain James Cook landed in the Hawaiian Islands on January 18, 1778. Ten months later, on a return trip to Hawaiian waters, Kalaniʻōpuʻu, who was at war with Kahekili, visited Cook on board the *Resolution* off the East coast of Maui. Kamehameha observed this meeting, but chose not to participate. The following January [1779], Cook and Kalaniʻōpuʻu met again in Kealakekua Bay and exchanged gifts. In February, Cook set sail; however, a severe storm off the Kohala coast damaged a mast and they had to return to Kealakekua. Cook's return occurred at an inopportune time, and this misfortune cost him his life (Kuykendall and Day 1976).

Around A.D. 1780 Kalaniʻōpuʻu proclaimed that his son Kiwalao would be his successor, and he gave the guardianship of the war god Kuʻkaʻilimoku to Kamehameha. Kamehameha and a few other chiefs were concerned about their land claims, which Kiwalao did not seem to honor, so after usurping Kiwalao's authority with a sacrificial ritual, Kamehameha retreated to his district of Kohala. While in Kohala, Kamehameha farmed the land, growing taro and sweet potatoes (Handy et al. 1991). After Kalaniʻōpuʻu

died in A.D. 1782 civil war broke out and Kiwalao was killed. The wars between Maui and Hawaii continued until A.D. 1795 (Kuykendall and Day 1976; Handy et al. 1991).

In A.D. 1790 two American vessels, the *Eleanora* and *Fair American*, were in Hawaiian waters. Following an altercation between his crew and natives, the Captain of the *Eleanora* massacred more than 100 natives at Olowalu [Maui], then sailed away leaving one of its crew, John Young, on land. The other vessel, the *Fair American,* was captured and its crew killed except for one member, Issac Davis. Kamehameha also observed this but did not participate, although he did prevent Young and Davis from leaving. He also kept the vessel as part of his fleet. Young eventually became governor of the island of Hawai‘i. By 1796 Kamehameha had conquered all the island kingdoms except Kauai. It wasn’t until 1810, when Kaumuali‘i of Kauai gave his allegiance to Kamehameha, that the Hawaiian Islands were unified under one ruler (Kuykendall and Day 1976).

Demographic trends during this period indicate population reduction in some areas, due to war and disease, yet increases in others, with relatively little change in material culture. However, there was a continued trend toward craft and status specialization, intensification of agriculture, *ali‘i* controlled aquaculture, upland residential sites, and the enhancement of traditional oral history. The Kū cult, *luakini heiau*, and the *kapu* system were at their peaks, although western influence was already altering the cultural fabric of the Islands (Kirch 1985; Kent 1983). Foreigners had introduced the concept of trade for profit, and by the time Kamehameha I had conquered O‘ahu, Maui and Moloka‘i, in 1795, Hawaiian natives were actively engaged in a Western market system (Kent 1983). This marked the end of the Proto-Historic Period and the end of an era of uniquely Hawaiian culture.

Hawai‘i’s culture and economy continued to change drastically as capitalism and industry established a firm foothold. The sandalwood (*Santalum ellipticum*) trade, established by Euro-Americans in 1790 and turned into a viable commercial enterprise by 1805 (Oliver 1961), was flourishing by 1810. This added to the breakdown of the traditional subsistence system, as farmers and fishermen were ordered to spend most of their time logging, resulting in food shortages and famine that led to a population decline. Kamehameha I did manage to maintain some control over the trade (Kuykendall and Day 1976; Kent 1983).

Kamehameha I died on May 8, 1819 in Kailua-Kona, and once again the culture of Hawai‘i was to change radically. Six months after his death, during the reign of his son and successor, Liholiho (Kamehameha II), the traditional *kapu* system that governed all social political and religious interactions was abandoned (Oliver 1961; Kuykendall and Day 1976; Kamakau 1992).

Liholiho’s cousin, Kekuaokalani, caretaker of the war god *Ku-Kailimoku*, objected to the abolition of the traditional religious system and revolted. By December of 1819 the revolution was quelled. Kamehameha II sent edicts throughout the kingdom renouncing the ancient state religion, ordering the destruction of the *heiau* images, and ordering that the *heiau* structures be destroyed or abandoned and left to deteriorate. He did, however, allow the personal family religion, the ‘*aumakua* worship, to continue (Oliver 1961; Kamakau 1992).

The religious, socioeconomic, and demographic changes that gradually took place in the period between 1790 and the 1840s throughout the Hawaiian Kingdom, promoted the establishment of a Euro-American style of land ownership, and the Great *Māhele* was the vehicle for determining ownership of the native land. During this period (1848-1899), the *Māhele* defined the land interests of the King (Kamehameha III), the high-ranking chiefs, and the low-ranking chiefs, the *konohiki*. The chiefs and *konohiki* were required to present their claims to the Land Commission to receive awards for lands provided to them by Kamehameha III. They were also required to provide commutations to the government in order to receive royal patents on their awards. The lands were identified by name only, with the understanding that the ancient boundaries would prevail until the land could be surveyed. This process expedited the work of the Land Commission and speeded the transfers (Chinen 1961:13).

During this process all lands were placed in one of three categories: Crown Lands (for the occupant of the throne), Government Lands, and Konohiki Lands. All three types of land were subject to the rights of

the native tenants. Commoners could make claims for land, and if substantiated, they would receive awards referred to as *kuleana*, from the Land Commission. During this period, other land grants were also made to individuals directly from the Kingdom. In 1862, the Commission of Boundaries (Boundary Commission) was established in the Kingdom of Hawai‘i to legally set the boundaries of all the *ahupua‘a* that had been awarded as a part of the *Māhele*. Subsequently, in 1874, the Commissioners of Boundaries was authorized to certify the boundaries for lands brought before them. The primary informants for the boundary descriptions were old native residents of the lands, many of which had also been claimants for *kuleana* during the *Māhele*. The information was collected primarily between 1873 and 1885. The testimonies were generally given in Hawaiian and simultaneously transcribed in English. Ukumehame Ahupua‘a was retained as Crown Lands during the *M hele*.

Ukumehame Ahupua‘a

Ukumehame Ahupua‘a straddles the boundary between the modern day judicial districts of Lahaina and Wailuku, but the *ahupua‘a* was once the easternmost of the traditional Hawaiian district of Lahaina (Tomonari-Tuggle and Tuggle 1991:8). The main productive area of the *ahupua‘a*, as described by Tomonari-Tuggle and Tuggle, was to the west of the current project area on “the broad coastal plain fronting Ukumehame Gulch and the smaller, neighboring gulches of Makiwa, Hanaula and Palaua” (1991:8) (Figure 10). On the Ukumehame plain and further inland within the gulches, Precontact peoples cultivated taro in irrigated fields. Handy (1940:103) describes taro cultivation on the flat entering Ukumehame Gulch still occurring in the 1940s. Although the *ahupua‘a* was retained as Crown Lands during the *Māhele*, forty-three claims were made for land in Ukumehame Ahupua‘a, all within the agriculturally productive gulches located to the west of the current project area. Only sixteen of the claims were awarded (Devereux et al. 1999:12). The distribution of Land Commission Awards (LCAw.) within Ukumehame Ahupua‘a supports the predicted Precontact settlement model. A smaller settlement area was located at Mā‘alaea to the east of the current project area.

Although coastal trails once ringed much of Maui, according to Handy et al. no coastal trail was present fronting the current project area because of the rough terrain, so “from ‘Olowalu [to the west of the current project area] travelers were ferried by canoe to Ma‘alaea [to the east of the current project area], thence to Makena” (1991:490). The main *mauka*/*makai* trail in the vicinity of the current project area followed Kealaloloa Ridge (Devereux et al. 1999), likely passing through the current project area. Devereux et al. (1999:12) relate that the more accessible areas of the Kealaloloa Trail were probably destroyed by a present day jeep trail.

One trail that still crosses through the current project area is the Lahaina Pali trail. This Historic trail was constructed around 1841 for horse traffic between the towns of Wailuku and Lahaina, with another branch connecting to Mā‘alaea (Tomonari-Tuggle and Tuggle 1991). Within Ukumehame Ahupua‘a the trail runs from the coast at Manawaipueo Gulch, inland to an elevation of 1,600 feet, and then back down towards the coast near Mā‘alaea. In Historic times the trail was known as a long and treacherous route. In 1841, Laura Fish Judd, a missionary who was making the trip between Lahaina and Wailuku, called the trail “the crookedest, the rockiest ever traveled by mortals” (Judd in Tomonari-Tuggle and Tuggle 1991:12). In 1847 Chester Lyman, a visitor to Maui, reiterates this point, writing that the trail “is one of the roughest and most difficult imaginable. It is all the way zigzag and winding, up steep, rocky and barren precipices, being in places dangerous on horseback (Lyman in Fleming 1933:21)” (Tomonari-Tuggle and Tuggle 1991:12).

Robbers were another danger encountered on the Lahaina Pali trail, especially on the remote section of trail in the vicinity of the current project area. The two stories provided below tell of the dangers of robbers:

> Kaiaupe was a noted female robber who lived by the pali road of Aala-loloa [Kealaloloa], Maui. She would entice men to lay with her at the edge of the pali and then kick them over the precipice with her foot. This act was known as Ka-ai-a-Kaiaupe. (T. Kelsey, from E. Sterling’s notes, Maui Historical Society in Tomonari-Tuggle and Tuggle 1991:12)

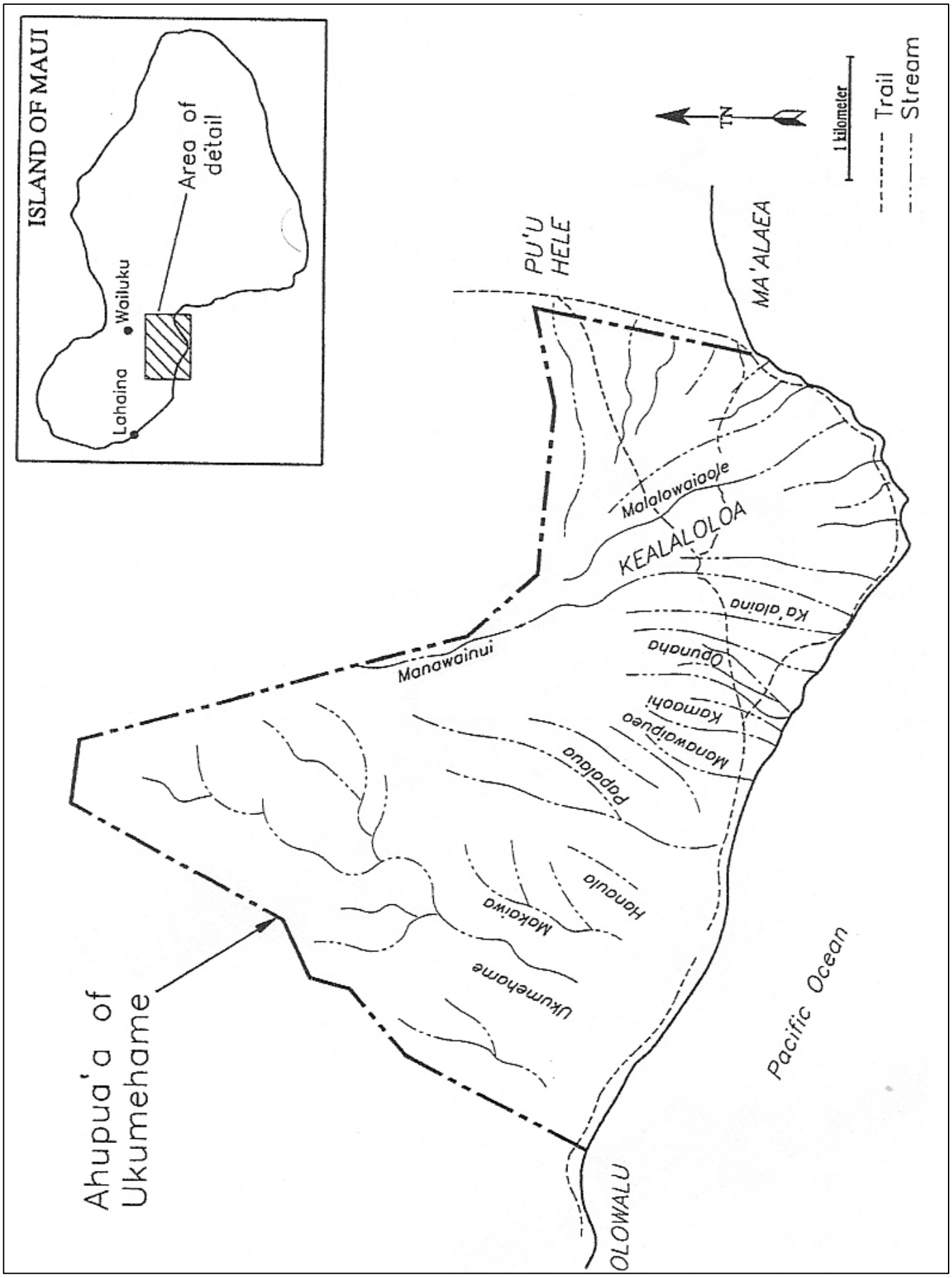


Figure 10. Gulch locations within Ukumehame Ahupua'a (from Tomonari-Tuggle 1998).

> About 1836, when I was a young lad at Lahaina, a native employed to bring letters from Wailuku to my father, reported that he was attacked by a robber on the mountain coast route not [far] from Maʻalaea Bay. In the struggle, he bit off one of the robber's big toes. The robber at once relaxed his hold and fled. In proof of his story, the messenger exhibited the bloody toe. (Dr. D. D. Baldwin, in Fleming) [Tomonari-Tuggle and Tuggle 1991:12]

By the 1850s, portions of Ukumehame Ahupuaʻa were being leased for various enterprises. An 1865 letter from William Enos and Joseph Sylva clarified a lease for the "pali of Ukumehame", which they defined as, "from the foot of the mountain on the west, or Lahaina, side to its boundaries on this, or east side for 10 years at $60 per year. $30 payable every six months in advance" (Enos and Sylva 1865 in Tomonari-Tuggle 1998:8). It appears that they had held this lease from at least the latter part of the 1850s, as an earlier letter, sent in 1858 from E. Duvauchelle to the king's land agent on Maui, William Webster, requested the Wailuku side of Ukumehame mountain, citing that Joe Sylva had related to him that he did not wish to renew his lease on this area. Nothing apparently came of the Duvauchelle letter, however, records indicate that Sylva held the lease on the land until at least 1871. Furthermore, it is apparent from the letter that the lease was for cattle ranching. Duvauchelle writes, "as for the other side of the big gulch on the mountain [presumably Manawainui Gulch] and the Ukumehame side I do not want the lease as it is too far from the run of cattle on this side" (Duvauchelle 1858 in Tomonari-Tuggle 1998:8).

In 1886, the western half of Ukumehame Ahupuaʻa was listed as being leased to Olowalu Plantation Company, for sugarcane cultivation and sugar production, and the eastern half (including the current project area) was listed as leased to John Richardson and Kahahawai for cattle ranching (Tomonari-Tuggle 1998:8). The 1884, McKenney's Hawaiian Directory reveals that John Richardson was the proprietor of the Maalaea Bay Stock Ranch, with approximately 15,000 acres of pasture and mountain land, 200 head of cattle, and 100 head of horses (Bagot 1884 in Tomonari-Tuggle 1998:8). In a side note, Tomonari-Tuggle (1998:8) relates that the Maalaea Stock Ranch was listed in subsequent directories until at least 1900.

By 1889, a new carriage road was under construction from Māʻalaea to Lahaina, along the coast of Ukumehame Ahupuaʻa. With the opening of this new road, use of the mountainous Lahaina Pali Trail dwindled, and the trail eventually fell into disuse. The new road was gradually widened and straightened to accommodate vehicular use, and then oiled and paved in 1918 (Fleming 1933:22 in Tomonari-Tuggle and Tuggle 1991:13). The road was eventually abandoned in favor of the current alignment of Honoapiliʻilani Highway.

Cattle ranching continued in the vicinity of the current project area until the mid-1990s, while portions of the wetter, western half of Ukumehame Ahupuaʻa continue to be used for sugarcane cultivation. At some point in the mid-1940s the McGregor Point jeep road was bulldozed to the project area, allowing vehicular access to the *mauka* areas, and perhaps obliterating an older road or trail. The road has been subsequently maintained by ranchers, MECO, and DLNR, with newer bulldozer routes approximating the older ones. During the 1970s Maui Electric (MECO) erected power-lines between Māʻalaea and Lahaina (Devereux et al. 1999) that cross above the current project area at an elevation of approximately 2,400 feet above sea level; and a second set of power lines was established crossing the general project area at an elevation of about 1,880 feet above sea level in the late 1990s (Robins et al. 1994). In 2006 the access road to the existing wind farm was bulldozed across the current project area. It generally followed the alignment of the older jeep road until just below the Lahaina Pali Trail (Clark and Rechtman 2005).

AHUPUA‘A SETTLEMENT PATTERNS AND PROJECT EXPECTATIONS

Devereux et al. (1999:85-86) offer a detailed summary of settlement patterns in the vicinity of the current project area, describing that, besides the primary settlement area on the broad costal plain fronting Ukumehame Gulch:

> …pre-historic occupation of the Ukumehame *ahupua‘a* between the alluvial flats of Ukumehame Gulch and the Maui Island isthmus, seems to be focused on the coastal zone, particularly between Mā‘alaea Bay and McGregor’s Point. This settlement comprises at least 45 “house and shelter” sites, some of which may have been fishing shrines or *koa* (Walker 1931:43). It seems likely a major focus of this village was fishing, given the shrines, its cliff side location, and the lack of abundant agricultural land. A major *heiau* and extensive panels of petroglyphs were also identified by Walker just inland of the village complex.
>
> The steep topography and arid environment of the upper, *mauka* elevations of Ukumehame *ahupua‘a* (east of the broad coastal plain fronting Ukumehame Gulch) presents a relatively inhospitable and unproductive agricultural landscape. However, as indicated by a traditional Hawaiian trail present on the Mā‘alaea side of the region and the possible existence of comparable trails ascending *mauka* of Walker’s coastal settlement, the upper elevations of Ukumehame provide a way to the summit of West Maui and hence to the other side. Kealaloloa “long pathway” Ridge, as it name suggests, may have been the main travel route used during the prehistoric and early historic times to cross to the West Maui Mountain, with auxiliary trails once serving to connect the main travel route. This prominent landform ascends above McGregor’s Point, which apparently represents the western extent of the coastal settlement observed by Walker. The main travel route of Kealaloloa and auxiliary *mauka-makai* trails probably provided coastal residents with access to *mauka* resources (*e.g.* wild plant goods, bird catching, and stone materials), and communication with other West Maui regions.

Based on the results of previous archaeological surveys conducted within and in the vicinity of the current study area (Athens 2002, 2004; Clark and Rechtman 2005 and 2006; Magnuson 2003; Rasmussen 2005a, 2005b, 2005c; Tomonari-Tuggle 1998; Tomonari-Tuggle and Rasmussen 2005), it is known that one multi-feature Precontact temporary habitation site (Site 5648) will be present in the central portion of the main survey area. Trails may also be present that provided access to this habitation area, although the primary trail was likely converted to a 4WD road. Remnant trail routes could be marked by worn paths or cairn (Devereux et al. 1999). It is possible that additional Precontact habitation features may be encountered. If any such features are found they are expected to take the form of C-shape enclosures or stone alignments that block the prevailing trade winds. It is likely that Historic cattle ranching features are present within the project area. Such features may include concrete water troughs, metal water lines, wire fence lines, windbreak shelters, roads, or cairn that mark Historic trails. One Historic trail, the Lahaina Pali Trail, is known to pass through the project area.

FIELDWORK

Fieldwork for the current project was conducted between August 17-21, 2009 by Matthew R. Clark, B.A.., Christopher S. Hand, B.A.., and Ashton K. Dircks, B.A.., under the direction of Robert B. Rechtman, Ph.D.

Methods

The current inventory survey included a visual inspection of the entire project area. To accomplish this, fieldworkers walked east/west pedestrian transects spaced at 50-meter intervals working from the southern end of the project area to the northern end. This spacing was adequate for locating all archaeological resources. The low-lying vegetation allowed for an unobstructed view of the surface terrain. When

archaeological features (or land alterations; i.e. bulldozing, roads, etc.) were encountered, they were plotted on a map of the study area using Garmin 76s handheld GPS technology (with sub five-meter accuracy), and then (if necessary) cleared of vegetation, mapped in detail, photographed, and described using standardized site record forms. No subsurface testing was conducted during the current inventory survey. Random subsurface testing was deemed unnecessary given the geomorphic conditions of the project area.

Findings

As a result of the current inventory survey SIHP Site 5648, as recorded by Rasmussen (2005a), was relocated. The ten features comprising this site were identified and twenty new features were described. Following a discussion with DLNR-SHPD, it was decided that the Site 5648 designation would be retained for all of the related features recorded in this portion of the current study area. The thirty features of this site were assigned an alphabetic designation (A to DD) and the correlations with the earlier Rasmussen (2005a) feature designations (Features 1-10) are presented in the feature descriptions. In addition, the Lahaina Pali Trail was identified as was a section of the possible Mā‘alaea branch of that trail, a concrete water trough (SIHP Site 6665), and two seemingly modern rock piles located near the main Lahaina Pali Trail (Figure 11).

Each of the archaeological sites recorded within the project area are discussed in detail below, and their locations relative to the project area boundaries and the proposed KWP Phase 2 are shown in Figure 12.

Figure 11. One of two seemingly modern rock piles situated just above the Lahaina Pali Trail (possible dozer scarring noted).

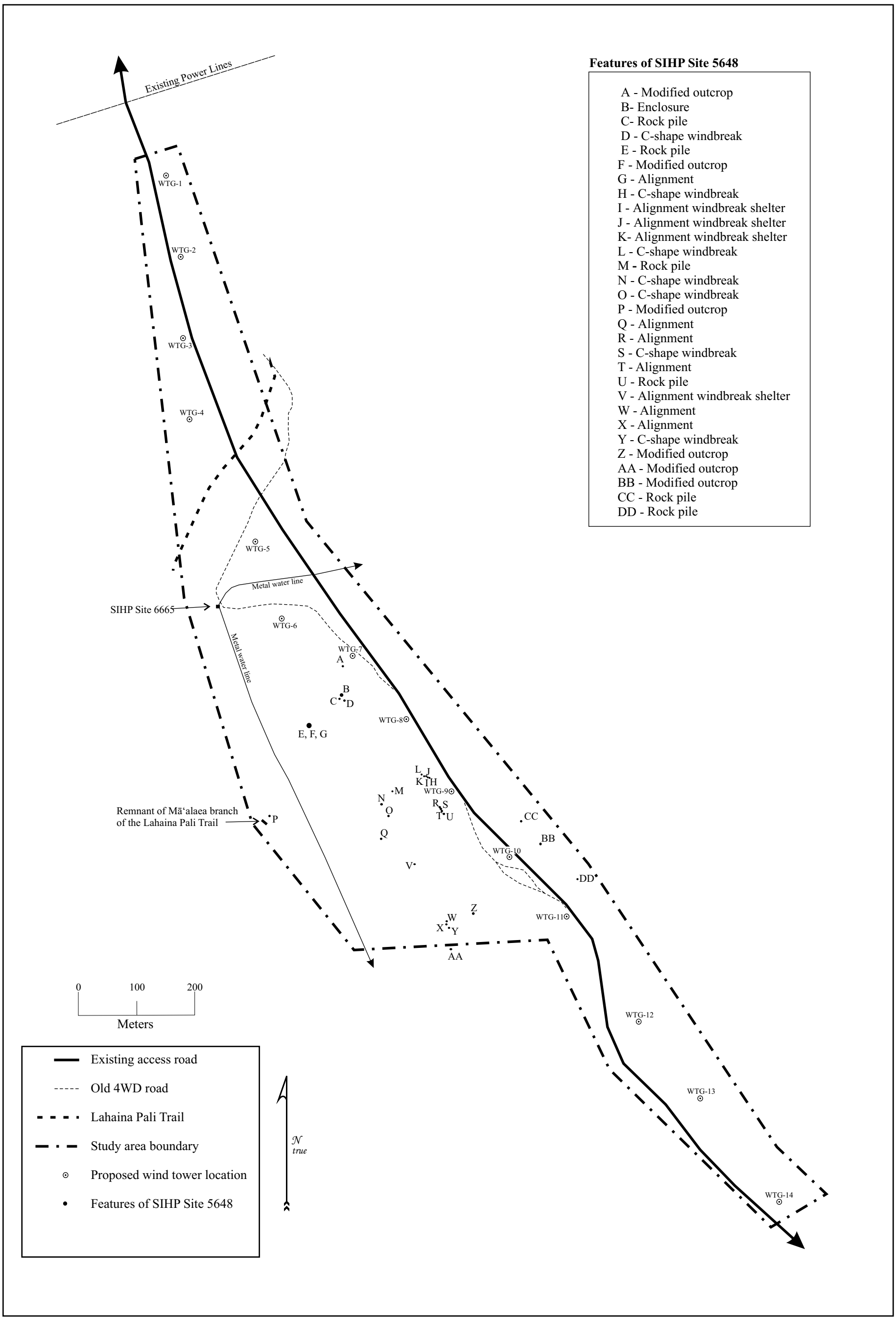


Figure 12. Project area plan view.

The Lahaina Pali Trail

The Lahaina Pali Trail is a 4.5-mile long section of a Historic trail that once connected the towns of Lahaina and Wailuku. The trail is currently part of the *Na Ala Hele* Statewide Trail and Access System. The Lahaina Pali Trail was constructed around 1841 for horse traffic, but fell into disuse approximately 50 years later when a carriage road was constructed along the coast to Lahaina (Rasmussen 2005a:5). The route of the trail crosses the current project area (Figure 13) at an elevation of roughly 1,600 feet above sea level (see Figure 12). This trail was extensively studied and thoroughly documented by Tomonari-Tuggle and Tuggle (1991) and Tomonari-Tuggle (1995). No state site number was assigned to the trail itself, but features along the trail were individually assigned state site numbers. No previously recorded sites related to the Lahaina Pali Trail are present in the immediate vicinity of the current project area. Tomonari-Tuggle and Tuggle describe the portion of the trail that crosses the current project area thusly:

> …This central section of the trail crosses the two deepest gulches and the highest point along the length of the trail. The trail is well defined, in generally excellent condition, and with minimal overgrowth.
>
> Within Manawainui Gulch, the trail is curbed, with water bars on the west side of the gulch. Where the trail crosses the gulch floor, cattle have created a wallow in the trail; there is one wiliwili tree at this point.
>
> On the gently sloping ridge between Manawainui and Malalowaiaole Gulches, the trail is a two meter wide swale, partially curbed; the area is presently used for cattle which, combined with the constant wind, keeps the vegetation close-cropped [Figure 15]. The trail in Malawaiaole Gulch has been obliterated by the McGregor Point jeep road. On the east ridge, where the jeep road continues uphill, the trail diverges slightly makai as a deeply eroded swale on which are scattered bottle glass fragments. (1991:23-25)

On an 1885 Hawaiian Government Survey Map (Figure 14) a branch of the Lahaina Pali Trail is shown to diverge from the main trail between Manawainui and Malalowaiaole Gulches (in the vicinity of the current project area) and continue on to the coast at Mā‘alaea. What may very likely be a small section of this branch of the trail was recorded during the current study (see Figure 12).

Figure 13. View to east of the Lahaina Pali Trail where it crosses the current project area.

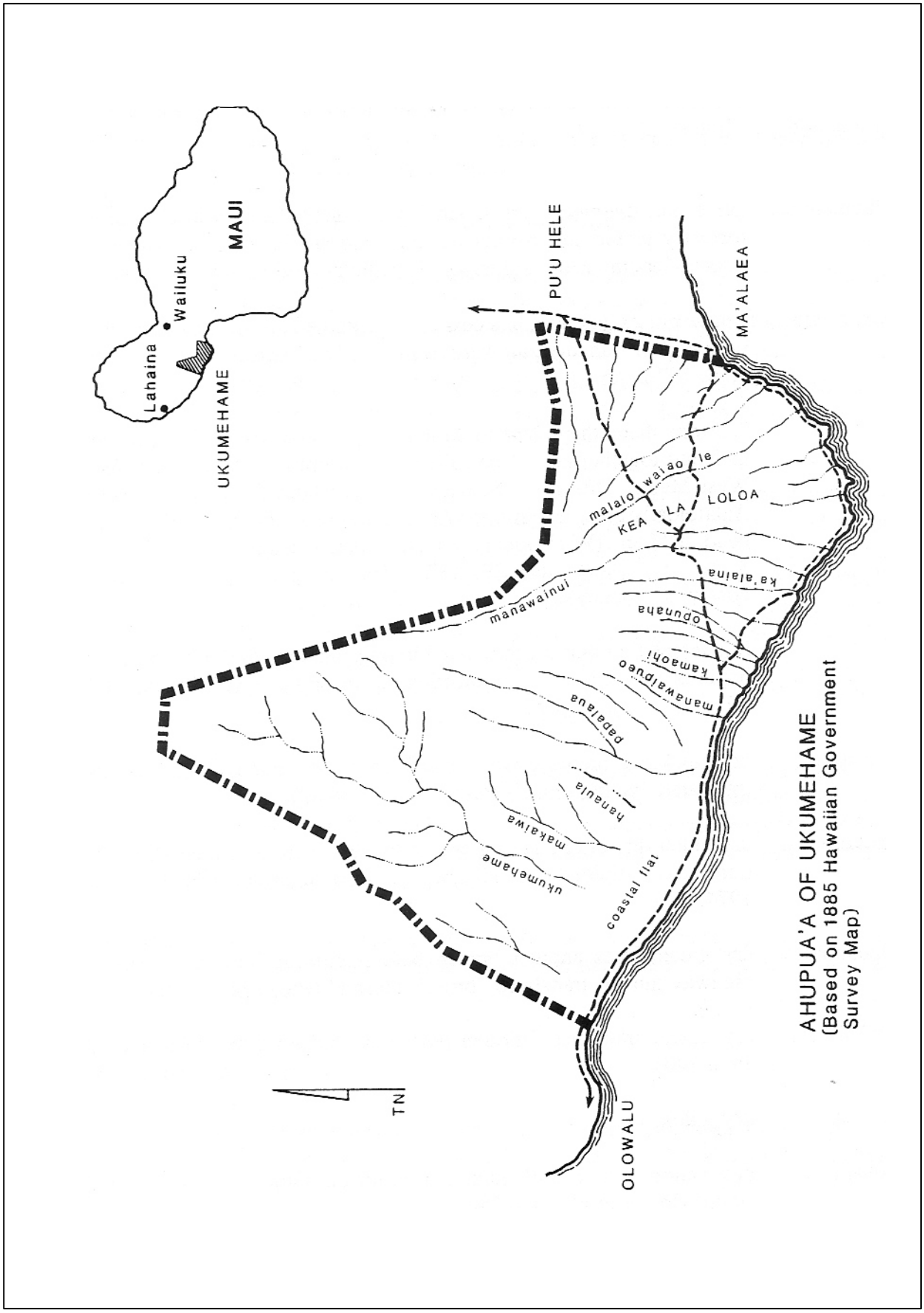


Figure 14. Map of the Lahaina Pali trail showing a branch leading to Mā'alaea (from Tomonari-Tuggle and Tuggle 1991:9).

Located approximately 13 meters southwest of Site 5648 Feature P, and constructed along the eastern edge of a natural drainage (Figure 15), is a 7 meter long section of constructed trail/roadway. The down slope edge of the construction is a stacked wall consisting of small to large cobbles oriented in a northeast/southwest direction (Figure 16). The stacking is between 0.9 an 1.1 meters tall and creates a level road bed 3.5 meters wide (Figure 17). To the southeast, this former pathway enters open pasture and is no longer distinguishable; to the northwest the trail descends the drainage and is washed out. Given its location, this trail segment appears to correlate with the branch trail that led to Mā‘alaea.

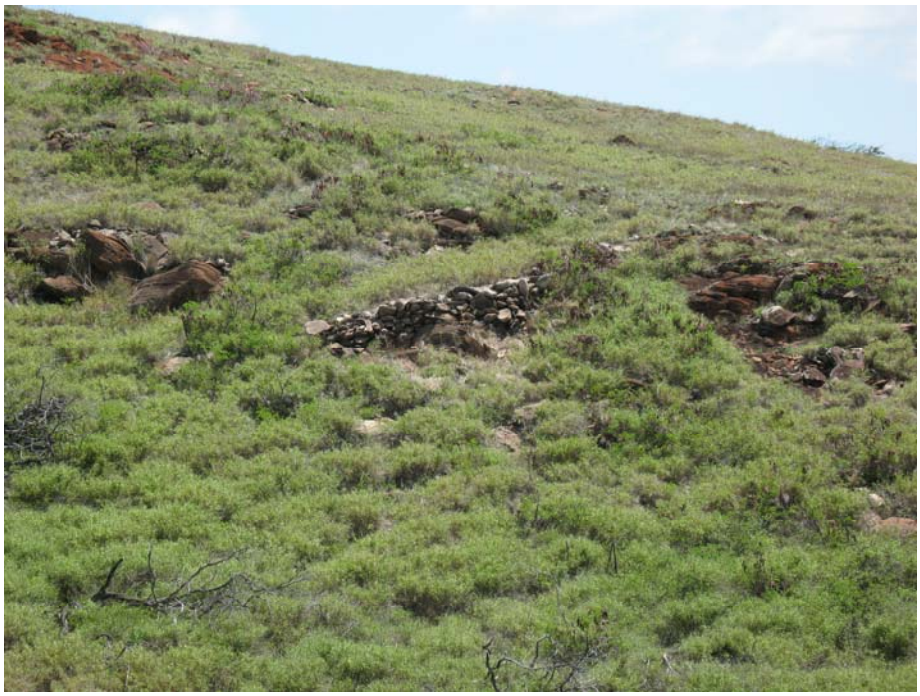


Figure 15. Remnant section of the Mā‘alaea branch of the Lahaina Pali Trail, view to the east.

Figure 16. Stacking along the down slope edge of the trail, view to the east.

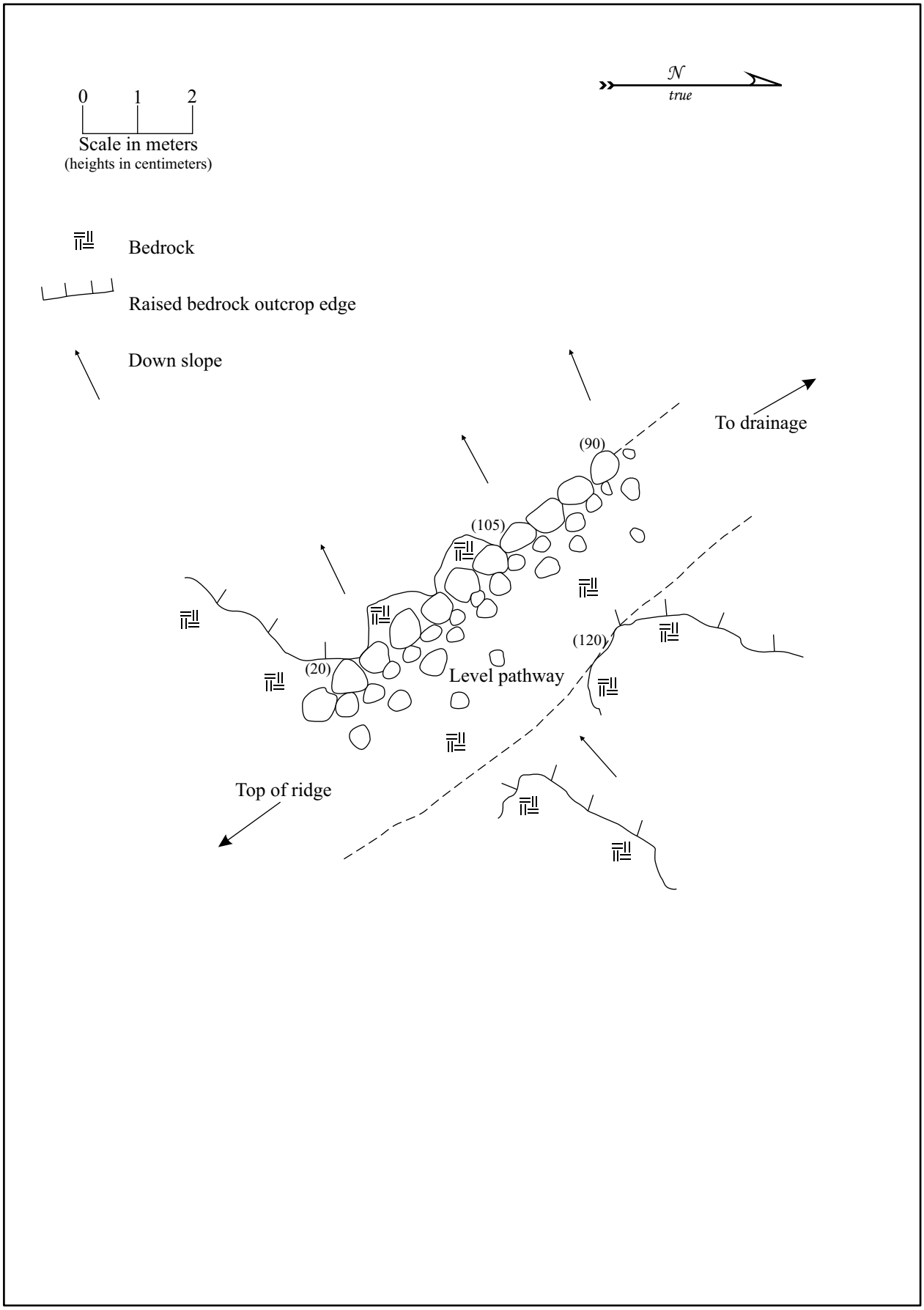


Figure 17. Remnant section of the Mā‘alaea branch of the Lahaina Pali Trail plan view.

SIHP Site 50-50-09-5648

Site 5648 was first reported by Rasmussen and described as "six C-shaped [SIC] rock structures (Feats. 1, 2, 5, 6, 7, and 9), one possible C-shaped [SIC] rock structure (Feat. 4), one modified outcrop (Feat. 10), one cupboard (Feat.3), and one rock cairn (Feat. 8)" (2005:7). She goes on to explain that "it is possible unrecorded features are present at Site 5648 since high grass limited ground visibility" (ibid.). Rasmussen's supposition was correct, as a result of the current study at total of thirty features were recorded for Site 5648. Collectively these features seem to represent temporary or short-term recurrent habitation likely associated with the use of upland trails. The historic expressions of these trails are still visible on the landscape (e.g. the Lahaina Pali Trail), but the earlier trails (perhaps even Precontact in age) are no longer discernable. Tomonari-Tuggle (1991) recorded similar sites (i.e., Site 2820 and 2828) to the west of the current study area that she believed were associated with the Lahaina Pali Trail. Overall Site 5648 retains integrity of location, design, and setting, and it is significant for the information it has provided relative to the past use of the current project area. The distribution of the Site 5648 features is shown on Figure 18.

Feature A

Feature A is a modified outcrop windbreak shelter located at the northern end of the north/south running drainage ravine (approximately 50 meters north of Feature B) (see Figure 18). This feature measures 5.0 meters by 3.5 meters and consists of a northwest/southeast running outcrop modified with a few medium cobbles piled to increase the wind blocking effect of the bedrock. The exposed bedrock along the outcrop ridge stands 0.50 to 0.70 meters above the surrounding ground surface. The cobbles used in the construction of Feature A have an average width of 0.40 meters, and stand 0.40 meters above surrounding bedrock and soil (Figure 19). The bedrock and cobbles create a total height of 0.60 to 1.10 meters on the southwest edge of this feature. A small curved section of piled cobbles extends for 1.1 meters west from the bedrock outcrop (Figure 20). Feature A was previously recorded by Rasmussen (2005) as Feature 10.

Figure 19. SIHP Site 5648 Feature A, view to the northeast.

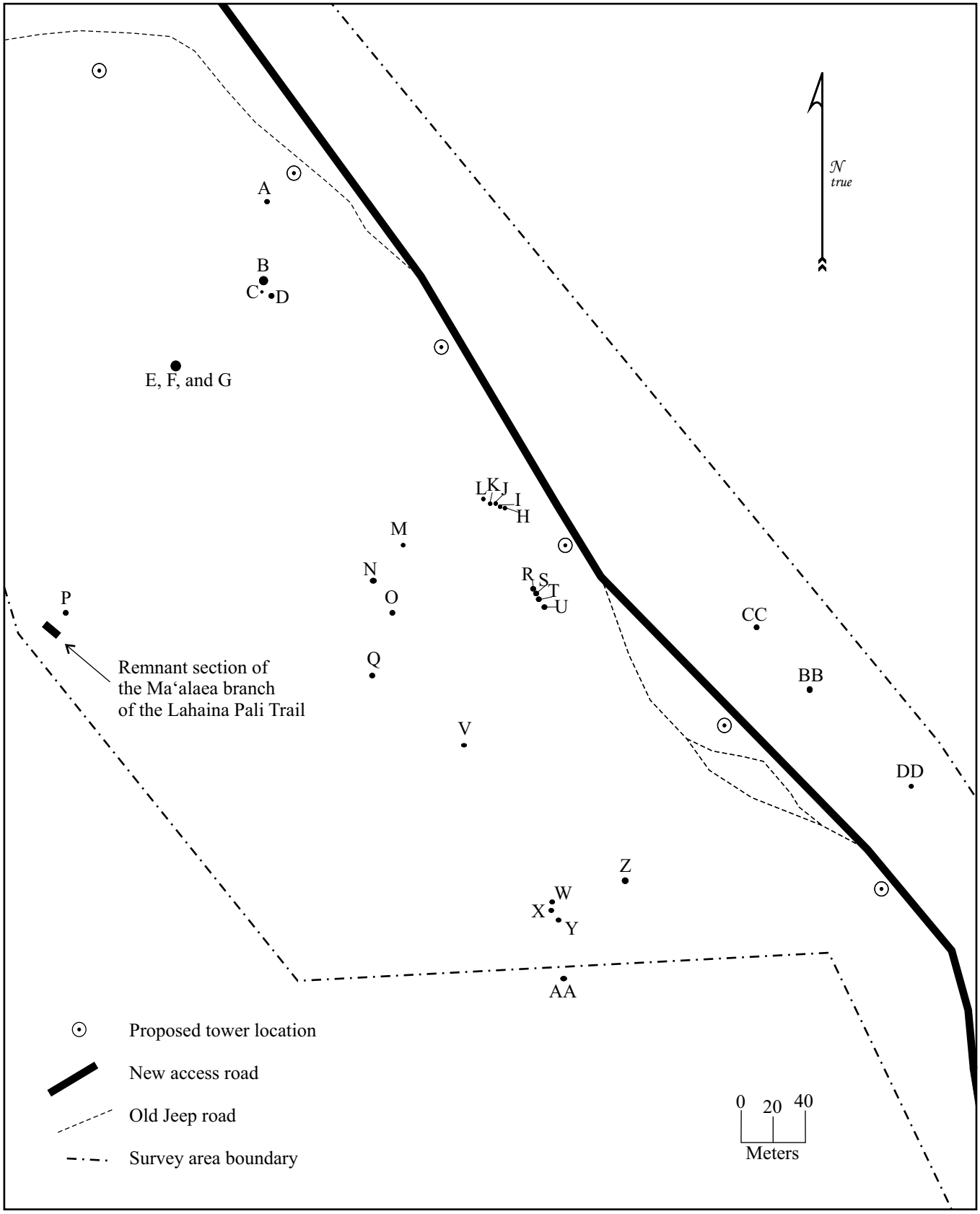


Figure 18. SIHP Site 5648 plan view.

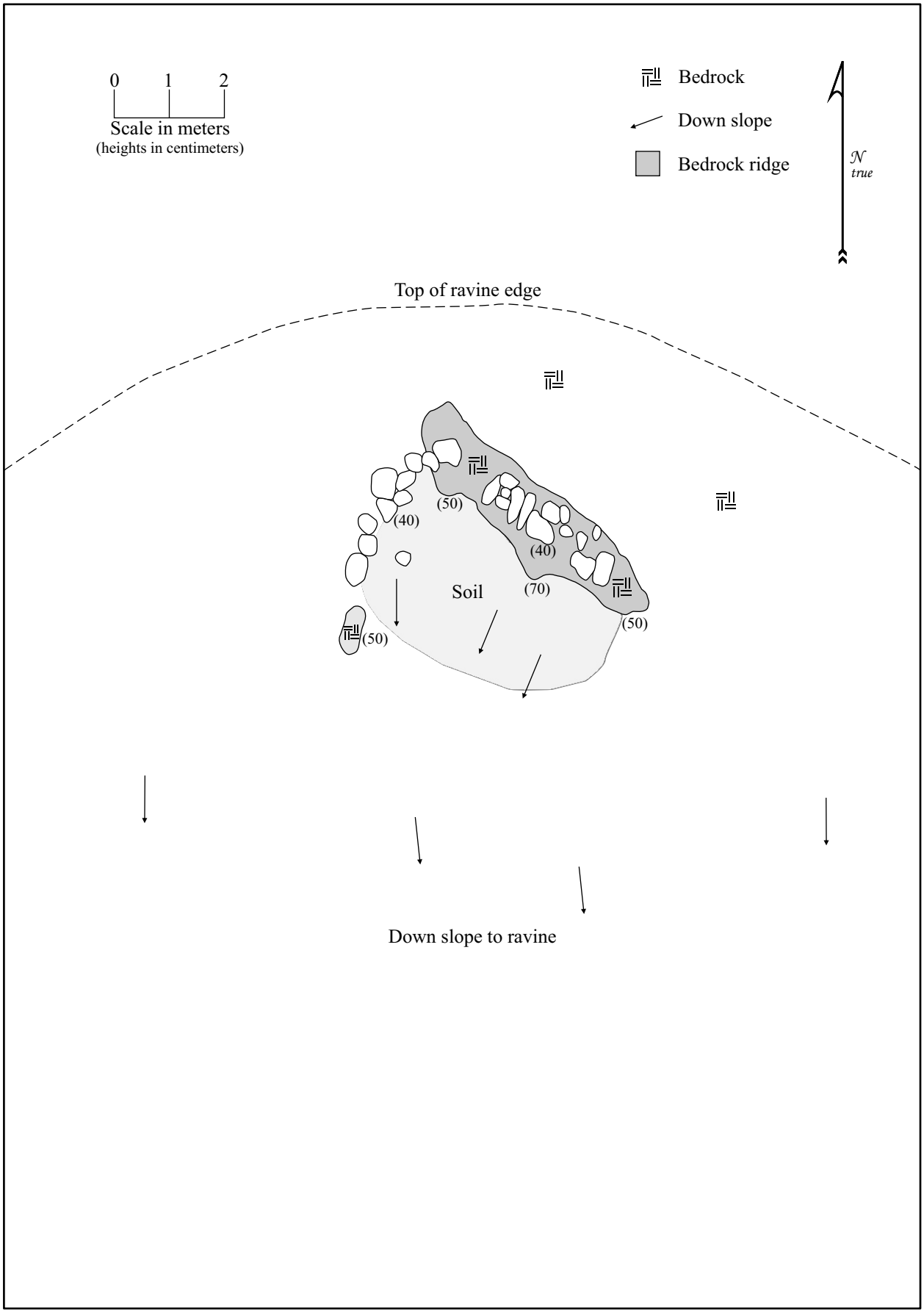


Figure 20. SIHP Site 5648 Feature A plan view.

Feature B

Feature B is a terraced enclosure area 50 meters south of Feature A (see Figure 18) that measures 3.5 meters long by 2.5 meters wide, and stands 0.20 to 0.75 meters tall (Figure 21). It is constructed against the west facing edge of a raised bedrock ridge formation standing 2.0 meters above the surrounding ground surface (Figure 22). This feature consists of piled and stacked small to large cobbles. The interior of Feature B is fairly level with soil and cobbles. In the southern edge of the feature is a slab with a smooth concave surface that measures 0.70 meters long by 0.40 meters wide, and is 0.10 meters thick. This slab appears placed and could have been used for processing resources or sitting. It does not appear ground, but it is pitted and wind blown. In the southeast corner of the feature is an upright boulder that measures 0.60 meters tall by 0.40 meters wide, and 0.25 meters thick. The boulder appears placed at its location, though it could be naturally occurring. There is a wall along the back (north) edge of the feature constructed of piled and stacked small to large cobbles. This wall measures 2.7 meters long by 0.60 meters wide, and stands 0.75 meters above the surrounding ground surface. The east end of the wall is built on raised bedrock and it along with the bedrock ridge act as a barrier to the prevailing wind.

Figure 21. SIHP Site 5648 Feature B, view to the northeast.

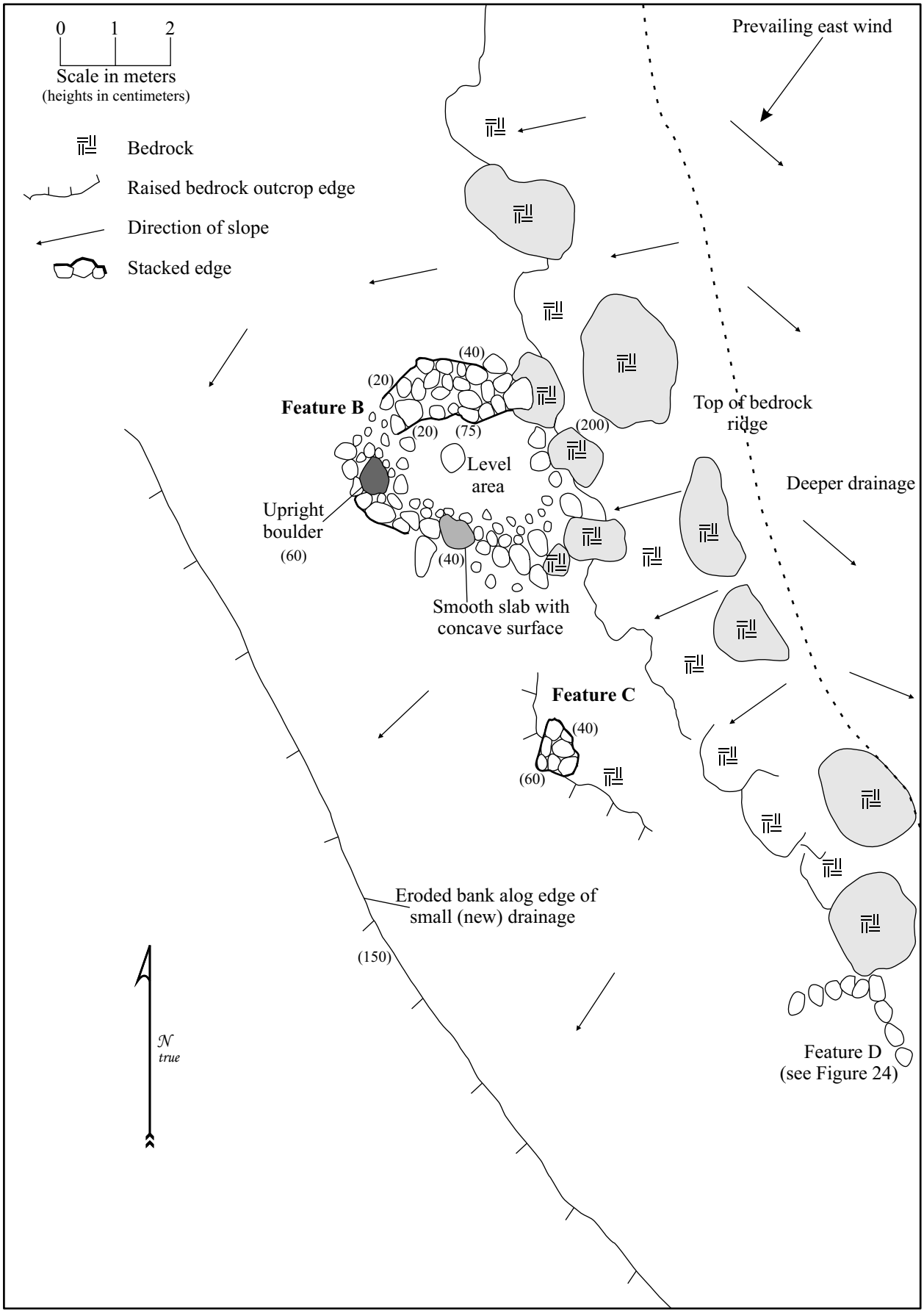


Figure 22. SIHP Site 5648 Features B and C plan view.

Feature C

Feature C is a rock pile located 3 meters south of Feature B (see Figure 18) constructed of approximately fifteen medium to large cobbles (Figure 23). It measures 0.90 meters by 0.80 meters, and stands 0.40 to 0.60 meters above the surrounding ground surface (see Figure 22).

Figure 23. SIHP Site 5648 Feature C, view to the northeast.

Feature D

Feature D is a C-shape windbreak shelter located 13 meters southwest of Feature C (see Figure 18). This feature opens to the southwest. Feature D is located on the top of a west facing slope at the western edge of the steep sided north/south running natural drainage (Figure 24). This feature is constructed of eroded bedrock boulders and medium to large cobbles stacked 0.40 to 0.70 meters above the surrounding ground surface (Figure 25). The bedrock boulders have heights ranging from 0.30 to 0.80 meters tall. This feature measures 2.8 meters by 2.5 meters. The immediate area southwest of Feature D measures 2.0 meters wide, and 1.0 to 1.5 meters deep. This area consists of fine soil and is protected from the prevailing northeasterly winds. Feature D was previously recorded by Rasmussen (2005a) as Feature 9.

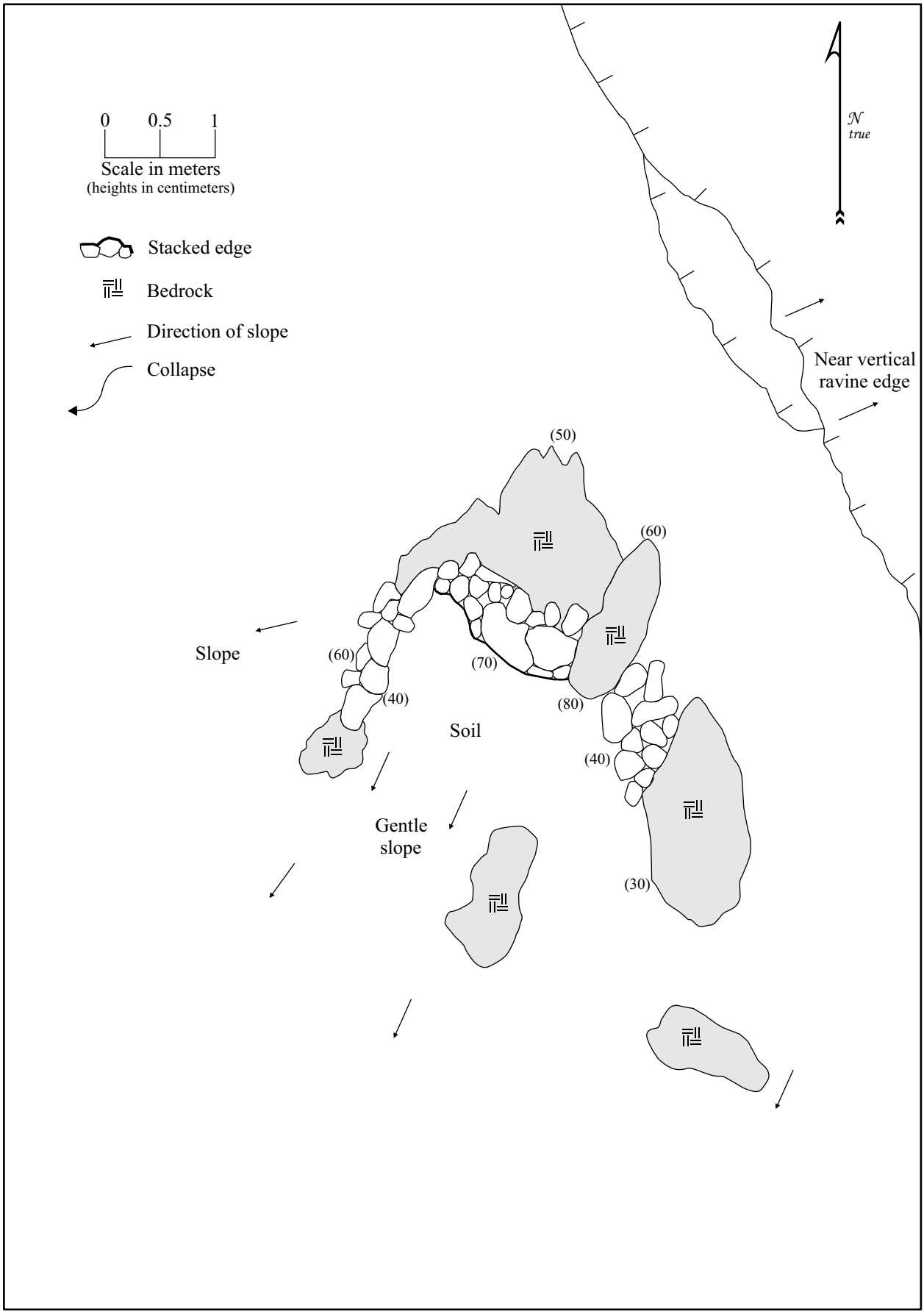


Figure 24. SIHP Site 5648 Feature D plan view.

Figure 25. SIHP Site 5648 Feature D, view to the northeast.

Feature E

Feature E is located on top of a small outcrop approximately 74 meters west/southwest of Feature D (see Figure 18). Feature E consists of fifty to seventy-five piled medium angular basalt cobbles, measures 3.5 meters by 2.1 meters, and stands 0.2 to 0.3 meters above the surrounding bedrock outcrop (Figure 26). A small level area to the south of the feature may have been utilized as a windbreak shelter (Figure 27).

Feature F

Feature F is a possible storage area located 2 meters southwest of Feature E (see Figure 18). Bedrock boulders are used along with placed boulders and cobbles to create a small enclosed storage space 0.60 meters deep and 0.60 meters in diameter (Figure 28). This feature measures 4.7 meters by 2.7 meters with heights ranging from 0.45 to 0.90 meters. To the west of the cupboard is a small leveled area of cobbles against a bedrock boulder, possibly an enlargement of the level area near Feature E. One water rounded cobble observed. To the southeast of the bedrock outcrop, a low piled wall extends for 2.2 meters. To the south of outcrop area, the ground surface is level and protected from the prevailing trade winds (see Figure 26).

Feature G

Feature G is an alignment stacked against bedrock located 4.5 meters southeast of Feature F (see Figure 18). The area between the alignment and bedrock is backfilled with medium cobbles creating a level terraced area (Figure 29). Feature G measures 3.7 meters long by 1.5 meters wide, and stands 0.60 meters above surrounding ground surface on the downslope (southern) edge, and is level with the bedrock on the upslope (north) edge (see Figure 26). The constructed level area increases the size of usable space on the outcrop.

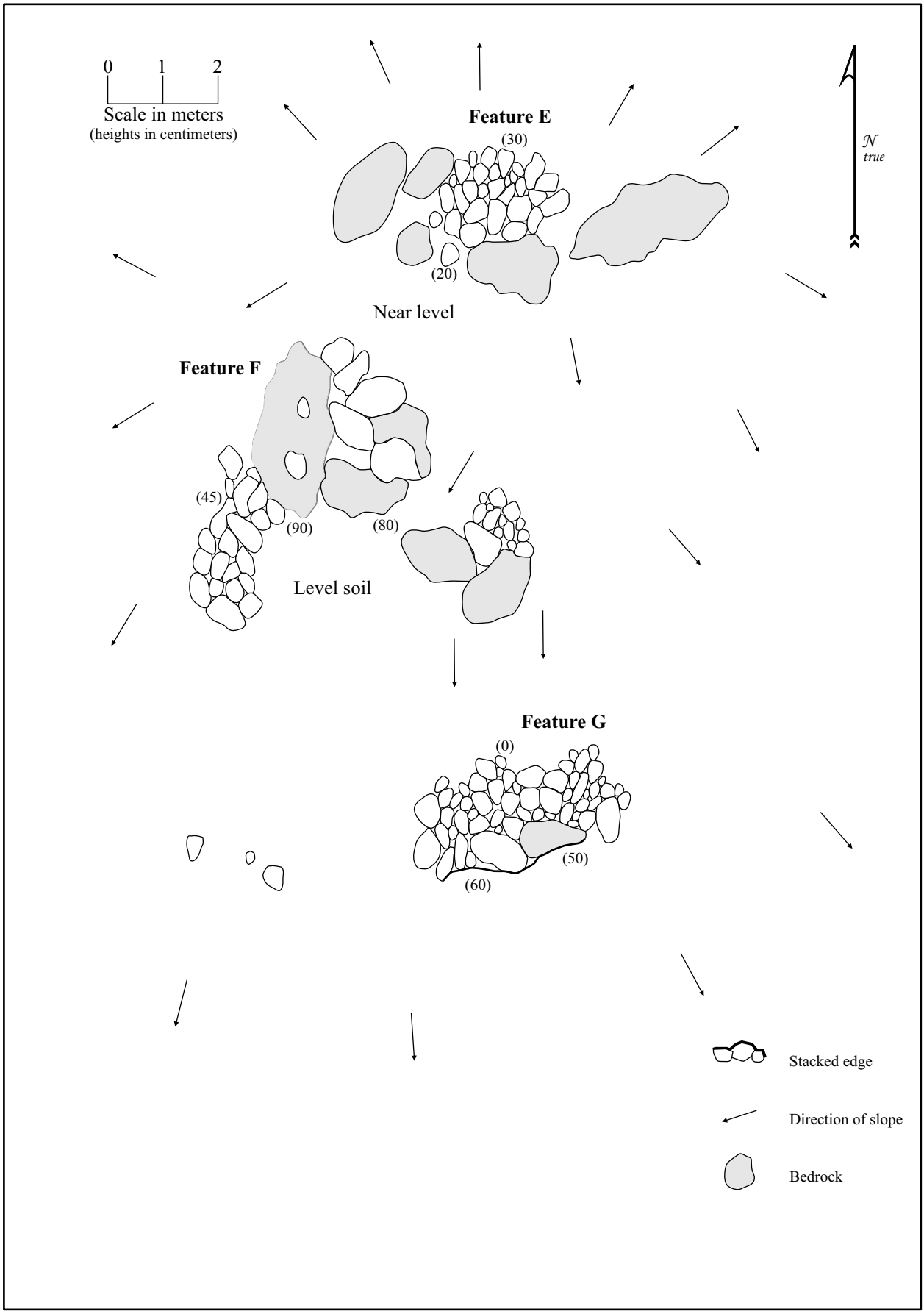


Figure 26. SIHP Site 5648 Features E, F, and G plan view.

Figure 27. SIHP Site 5648 Feature E, view to the northwest.

Figure 28. SIHP Site 5648 Feature F, view to the north-northwest.

Figure 29. SIHP Site 5648 Feature G (Feature F in background), view to the north.

Feature H

Feature H is a C-shape enclosure that opens to the southwest and is located southeast of Feature I (see Figure 18). It is constructed of piled and loosely stacked small to large cobbles and measures 3.2 meters long by 1.3 meter wide (Figure 30). This feature affords good wind protection on a slightly south sloping ground surface (well suited for sleeping or sitting). The C-shape stands 0.17 to 0.45 meters tall, and 0.80 to 1.2 meters wide along its edges (Figure 31). The north end of this C-shape abuts exposed bedrock that runs 2.1 meters north to Feature I. Feature H exhibits collapse throughout.

Feature I

Feature I is an alignment windbreak shelter located 2.1 meters northwest from Feature H (see Figure 30). It is constructed of roughly thirty piled and loosely stacked small to large cobbles. This feature measures 1.7 meters long by 0.60 meters to 0.80 meters wide, and stands 0.26 to 0.52 meters on its downslope (southwest) edge, and 0.05 to 0.12 meters on its upslope side (where exposed bedrock is present). The slightly sloped area to the southwest of the cobbles is protected from the wind and measures 2.3 meters by 1.6 meters (Figure 32). A long cylindrical cobble is present at the north end of Feature I and measures 0.68 meters long by 0.20 meters wide. This cobble is 0.15 meters thick and could have been placed there as an upright stone (currently dislodged).

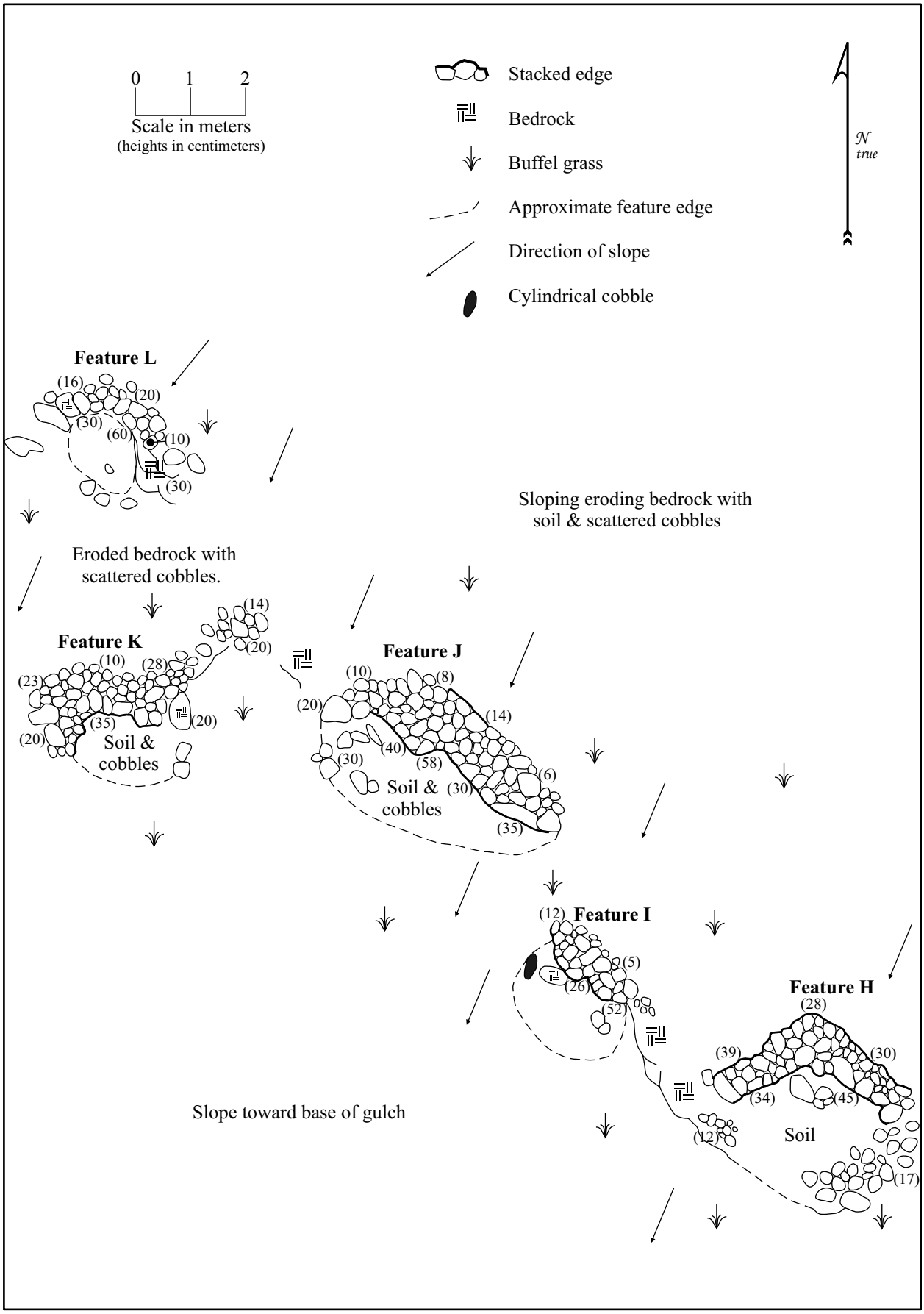


Figure 30. SIHP Site 5648 Features H, I, J, K, and L plan view.

Figure 31. SIHP Site 5648 Feature H, view to the north-northeast.

Figure 32. SIHP Site 5648 Feature I, view to the northeast.

Feature J

Feature J is an alignment windbreak shelter situated 2.1 meters north of Feature I along the same natural slope contour (see Figure 30). It consists of loosely stacked small to large cobbles on the bedrock slope. The stacking measures 4.2 meters long by 0.80 meters wide, and stands 0.58 meters tall in the center of the downslope side, and 0.06 to 0.20 meters tall on the upslope side (Figure 33). A 1.0 meter wide area at base of the southwest portion of the stacking is fairly level and protected from the wind.

Figure 33.SIHP Site 5648 Feature J, view to the northwest.

Feature K

Feature K is an L-shape alignment located 2.5 meters northwest of Feature J (see Figure 30). The alignment is constructed of small to large cobbles piled and loosely stacked on top of a natural bedrock contour. This feature measures 2.3 meters long (northwest/southeast) and has a 1.0 meter long extension perpendicular to its northwest end (Figure 34). It stands 0.35 meters high at the center of the downslope edge and 0.20 to 0.28 meters on the upslope edge, with a width of 0.80 meters. A 1.9 meter by 1.3 meter area southwest of the alignment is fairly level and protected from the wind. A loose collection of cobbles on bedrock runs northeast for 1.8 meters from the south end of Feature K.

Feature L

Feature L is a small C-shape shelter located 4.8 meters northeast of Feature K (see Figure 30). This feature is constructed of roughly twenty small to large cobbles which have been placed along an exposed nearly vertical bedrock face. It measures 3.2 meters long by 0.60 meters wide, and stands 0.10 to 0.60 meters tall (Figure 35). At its north end, three large bedrock slabs appear to have eroded from the outcrop and tumbled downslope. A 2.6 meter by 2.0 meter area of soil and loose gravel southwest of Feature L is fairly level and protected from the wind.

Figure 34. SIHP Site 5648 Feature K, view to the northeast.

Figure 35. SIHP Site 5648 Feature L, view to the north.

Feature M

Feature M is a rock pile located on the western side of a north/south running drainage, west of the current access road (see Figure 18). This feature is constructed of seventeen medium to large cobbles and boulders piled on an exposed section of bedrock (Figure 36). It measures 1.1 meters in diameter with a downslope height of 1.3 meters and upslope height of 0.50 meters. Feature M was previously recorded by Rasmussen (2005a) as Feature 8. It is possible that the pile is an *ahu* marking the route of a former trail, although no such route was observed across the rocky terrain.

Figure 36. SIHP Site 5648 Feature M, view to the west.

Feature N

Feature N is a C-shape enclosure located approximately 23 meters northwest of Feature O (see Figure 18). This feature is constructed on a *makai* (south) sloping portion of a ridge with piled small to medium cobbles, and opens to the southwest. The enclosure measures 2.3 meters long by 2.1 meters wide (Figure 37). The enclosing edges have widths from 0.3 meters to 1.2 meters (Figure 38). Feature N has an interior height of 0.55 meters and exterior heights that range from 0.23 to 0.63 meters above the surrounding ground surface. The enclosed area slopes to the southwest and consists of mostly soil and bedrock with a few small loose cobbles. Feature N was previously recorded by Rasmussen (2005a) as Feature 7.

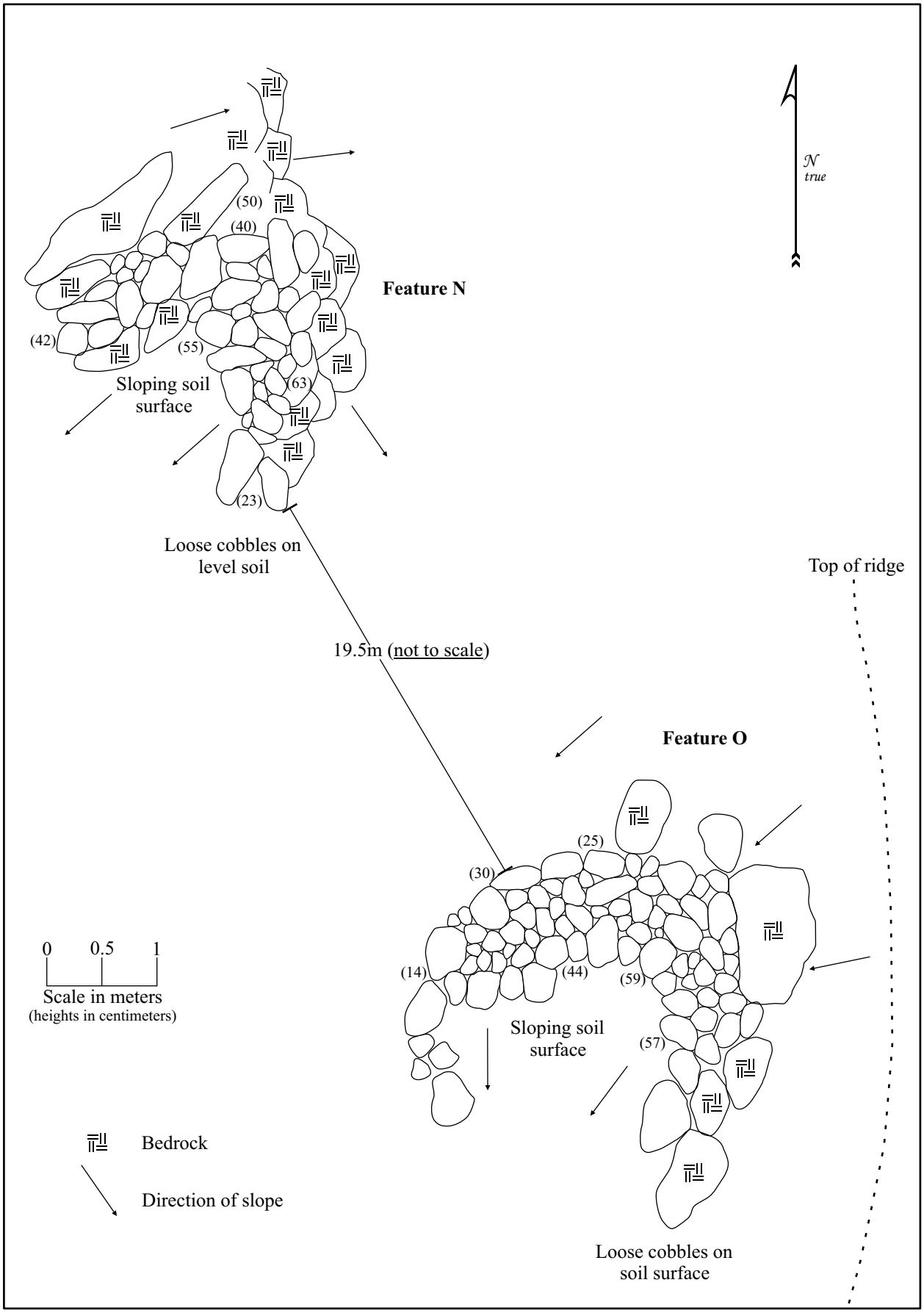


Figure 37. SIHP Site 5648 Features N and O plan view.

Figure 38. SIHP Site 5648 Feature N, view to the north.

Feature O

Feature O is a C-shaped enclosure located 23 meters southeast of Site Feature N (see Figure 18). This enclosure is constructed against the western edge of a *mauka/makai* running ridge. It utilizes large bedrock in its construction. This enclosure opens to the southwest, and is constructed of piled small to large cobbles (Figure 39). The enclosure measures 3.0 meters long by 2.4 meters wide with widths ranging from 0.7 meters to 1.1 meters. It has interior heights range from 0.44 to 0.59 meters and exterior heights from 0.14 to 0.30 meters (see Figure 37). The interior ground surface slopes to the southwest and consists of mostly soil with a few small cobbles. Feature O was previously recorded by Rasmussen (2005a) as Feature 6.

Figure 39. SIHP Site 5648 Feature O, view to the northeast.

Feature P

Feature P is a modified outcrop windbreak shelter located approximately 13 meters northeast of the Mā‘alaea branch of the Lahaina Pali Trail (see Figures 12 and 18). This feature is constructed of medium to large cobbles stacked and piled against a raised portion of a bedrock outcrop (Figure 40). The windbreak shelter measures 2.7 meters long (east/west) by 0.40 meters wide (north/south), and stands 0.40 meters above the surrounding ground surface (Figure 41). The bedrock below the stacking is 0.50 meters tall giving the total modification a height of 0.90 meters above natural grade (Figure 42). The ground surface leeward (southwest) of the windbreak consists of near level, smooth bedrock with a light soil and small cobble accumulation. This protected area provides shelter from the prevailing winds. A pile of twelve small to medium cobbles are located 1.0 meters southwest of Feature P’s west end. This windbreak shelter could have been used as a rest area by travelers along the nearby trail.

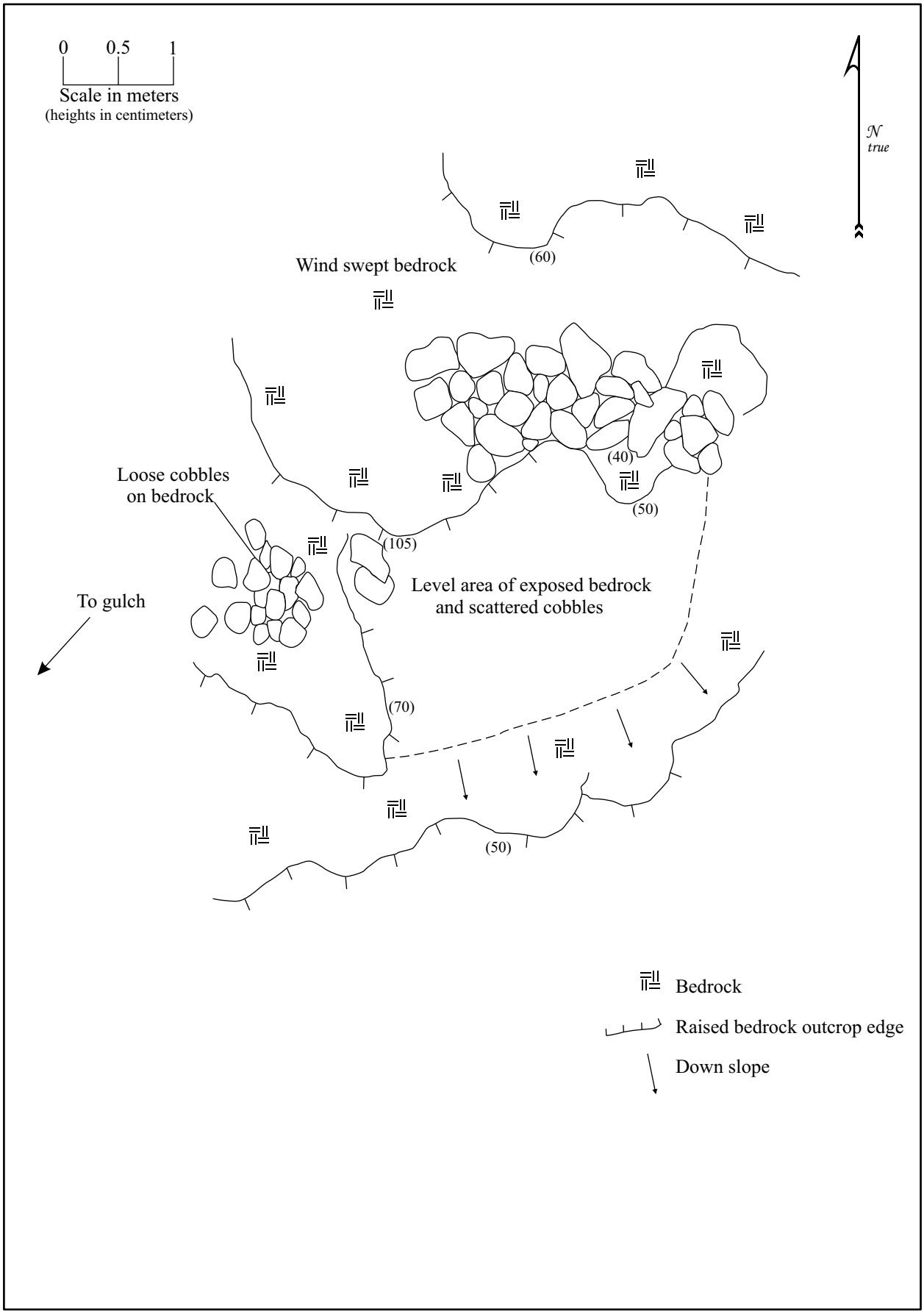


Figure 40. SIHP Site 5648 Feature P plan view.

Figure 41. SIHP Site 5648 Feature P, view to the southwest.

Figure 42. SIHP Site 5648 Feature P, view to the northeast.

Feature Q

Feature Q is a low-lying cobble alignment located approximately 42 meters southwest of Feature O (see Figure 18). This feature is constructed on a level ground surface consisting of soil and loose cobble near the edge of a steep drop which slopes to the south (*makai*) (Figure 43). The alignment is oriented in a north/south direction and constructed on the north side of a (1.2 meter) tall bedrock boulder with piled small to large cobbles (Figure 44). The alignment measures 2.2 meters long by 1.0 meter wide, and stands 0.30 to 0.50 meters above the surrounding ground surface (Figure 45). This area provides an excellent view of surrounding terrain. Feature Q was previously recorded by Rasmussen (2005a) as Feature 5.

Figure 43. SIHP Site 5648 Feature Q, view to the southwest.

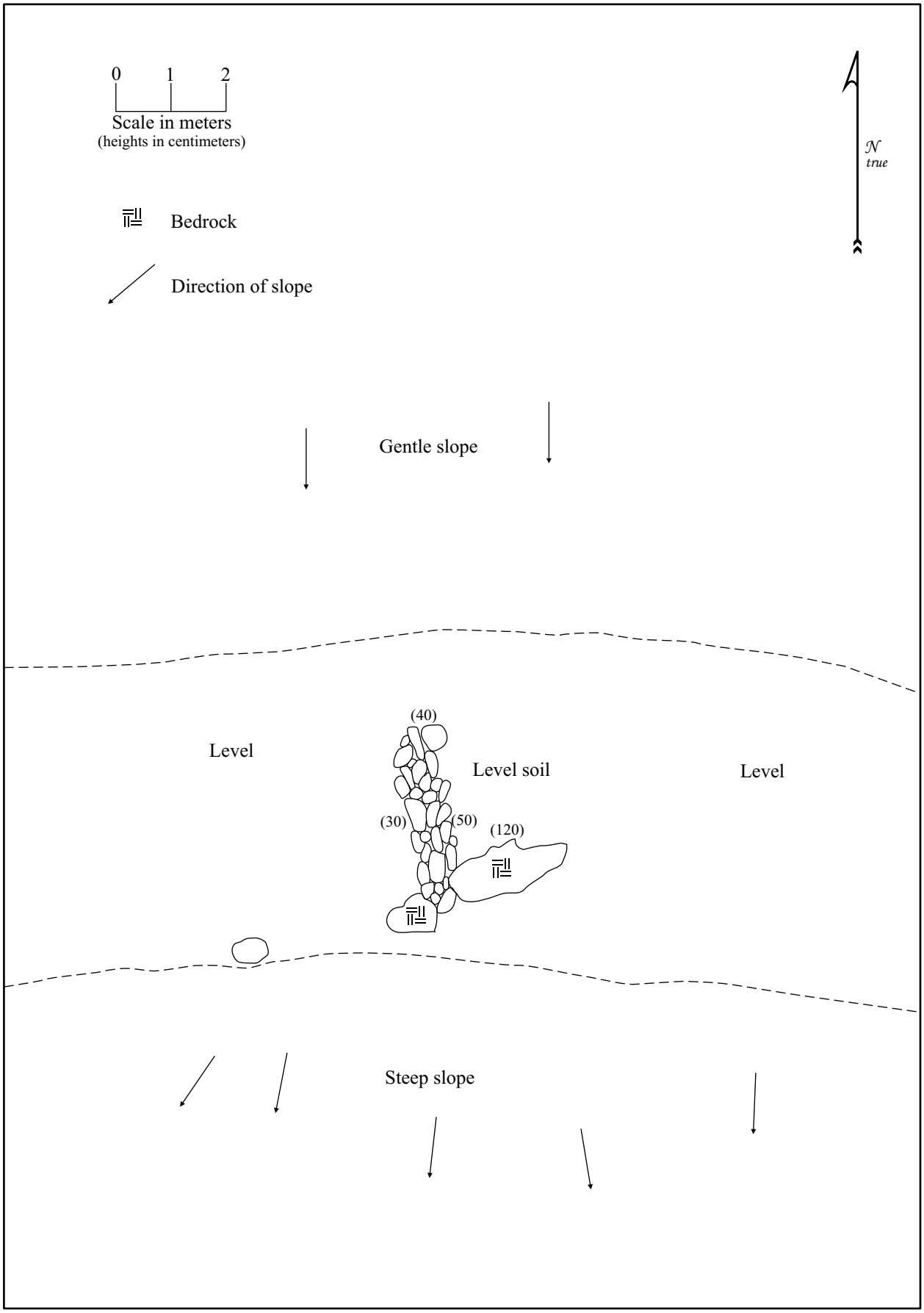


Figure 44. SIHP Site 5648 Feature Q plan view.

Figure 45. SIHP Site5648 Feature Q, view to the south.

Feature R

Feature R is an alignment located approximately 55 meters southeast of Feature H (see Figure 18). This linear pile of small to large cobbles is constructed of against a vertical bedrock edge (Figure 46), and measures 3.0 meters long by 1.6 meters wide with heights ranging from 0.24 to 0.60 meters above the surrounding ground surface. The outcrop edge that the linear pile sits against has a length of 8.0 meters with heights ranging from 0.50 to 1.3 meters (Figure 47). The ground surface southwest of the outcrop edge is sloping bedrock, soil, and loose cobbles. A single piece of marine shell was observed in the southern portion of Feature R.

Figure 46. SIHP Site 5648 Feature R, view to the northeast.

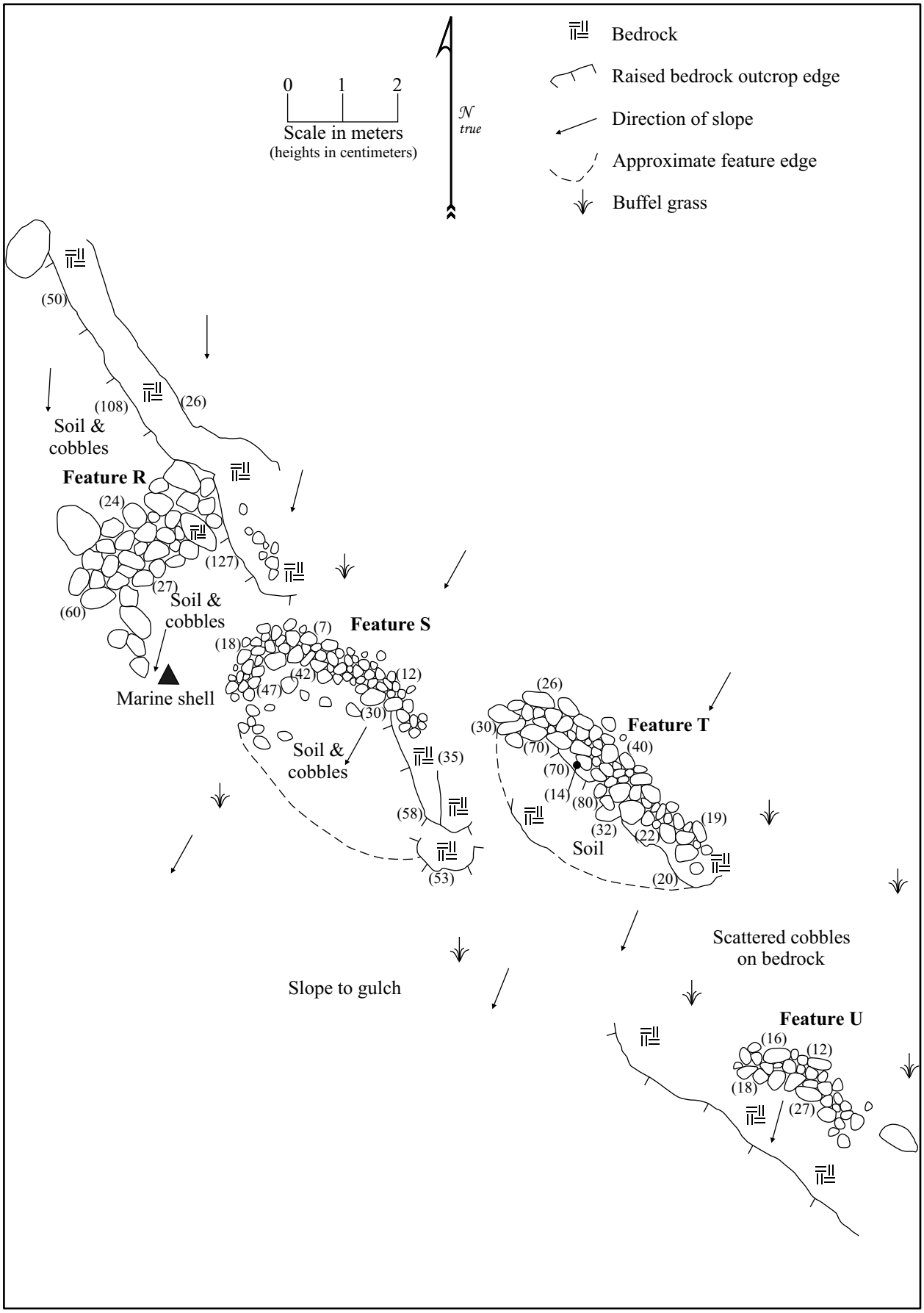


Figure 47. SIHP Site 5648 Features R, S, T, and U plan view.

Feature S

Feature S is a C-shape enclosure located 0.70 meters southeast of Feature R (see Figure 18). This enclosure is constructed on a raised southeast facing portion of bedrock with piled small to medium cobbles (Figure 48). Feature S measures 3.6 meters long (northwest/southeast) by 1.6 meters wide (northeast/southwest). The enclosing wall measures 0.6 to 0.8 meters wide, with an upslope height of 0.07 to 0.18 meters and a downslope height ranging from 0.3 to 0.5 meters above the surrounding ground surface (see Figure 47). A portion of the bedrock located at the feature's southeast end stands 0.35 to 0.58 meters tall. A soil and cobble area located immediately southwest of Feature S slopes southwest to the base of a small gulch.

Figure 48. SIHP Site 5648 Feature S, view to the north-northwest.

Feature T

Feature T is a cobble alignment located 1.2 meters east of Feature S (see Figure 18). It is constructed of piled small to medium cobbles, and measures 4.5 meters long (northwest/southeast) by 1.6 meters wide (northeast/southwest) (see Figure 47). Stacking is evident on vertical bedrock edges in the central and southeast portions of alignment (Figure 49). The alignment has an average width of 0.80 meters, with upslope heights ranging from 0.19 to 0.40 meters and downslope heights ranging from 0.22 to 0.80 meters. The wind protected area immediately southwest of the alignment consists of soil that slopes southwest.

Figure 49. SIHP Site 5648 Feature T, view to the north.

Feature U

Feature U is a linear rock pile located approximately 3.7 meters southeast of Feature T (see Figure 18). This linear rock pile is constructed of small to medium cobbles, and measures 2.6 meters long (northwest/southeast) by 0.6 to 0.8 meters wide (northeast/southwest) (see Figure 47). This feature has upslope heights ranging from 0.12 to 0.16 meters and downslope heights ranging from 0.18 to 0.27 meters (Figure 50). The surrounding ground surface consists of soil and loose cobbles on bedrock.

Figure 50. SIHP Site 5648 Feature U, view to the north.

Feature V

Feature V is a piled alignment windbreak shelter located approximately 70 meters southeast of Feature Q (see Figure 18). The feature is constructed on a level ground surface which is located on ridge between two drainages (Figure 51). This feature is oriented in a northwest/southeast direction to block the prevailing easterly winds (providing a sheltered area to the southwest). Feature V is constructed of small to large cobbles and a few small boulders piled to a height of 0.9 meters (up to 1.0 meters in the center), and stands 0.3 meters to 0.8 meters at its edges (Figure 52). The windbreak shelter measures 4.0 meters long by 1.8 meters wide (Figure 53). A cleared level soil area to southwest of Feature V measures roughly 3.0 meters long by 2.0 meters wide. Feature V was previously recorded by Rasmussen (2005a) as Feature 4.

Figure 51. SIHP Site 5648 Feature V, view to the southwest.

Figure 52. SIHP Site 5648 Feature V, view to the northeast.

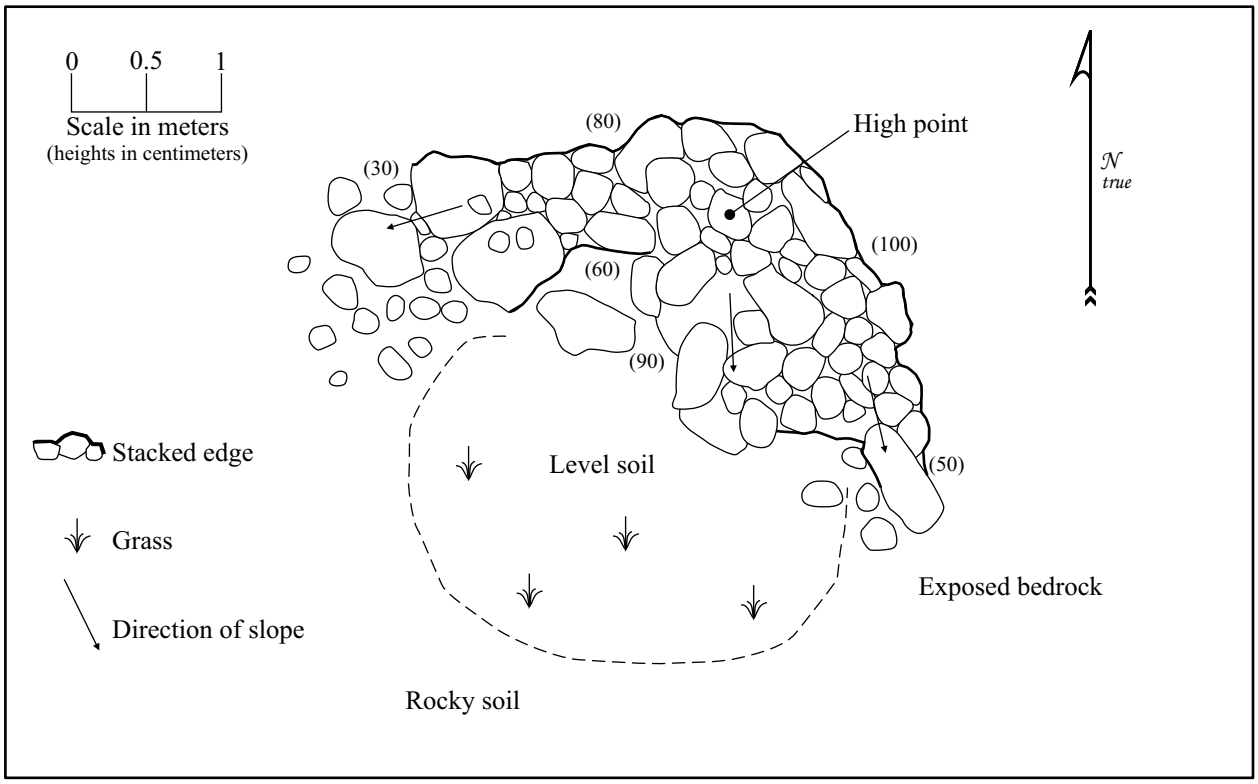


Figure 53. SIHP Site 5648 Feature V plan view.

Feature W

Feature W is a small alignment that is located approximately 115 meters south/southeast of Feature V (see Figure 18). This alignment is constructed of piled small to medium cobbles on fractured/raised bedrock (Figure 54). Feature W measures 1.8 meters long by 0.6 meters wide, and has an interior height of 0.63 meters above the ground surface and exterior heights of 0.14 to 0.32 meters above the bedrock (Figure 55). This alignment creates a small windbreak. The interior west facing ground surface consists of sloping soil with scattered cobbles.

Figure 54. SIHP Site 5648 Feature W, view to the east.

Feature X

Feature X is a small alignment that is located 1.7 meters southwest of Feature W (see Figure 18). Feature X is constructed of piled small to large cobbles. This alignment measures 1.6 meters long by 0.6 meters wide, and extends in a westerly direction from the outcrop (see Figure 55). Feature X stands 0.16 to 0.46 meters above the surrounding ground surface and 0.17 meters above the bedrock (Figure 56). The interior south facing ground surface consists of mostly soil with a few scattered cobbles. Feature X was previously recorded by Rasmussen (2005a) as Feature 2.

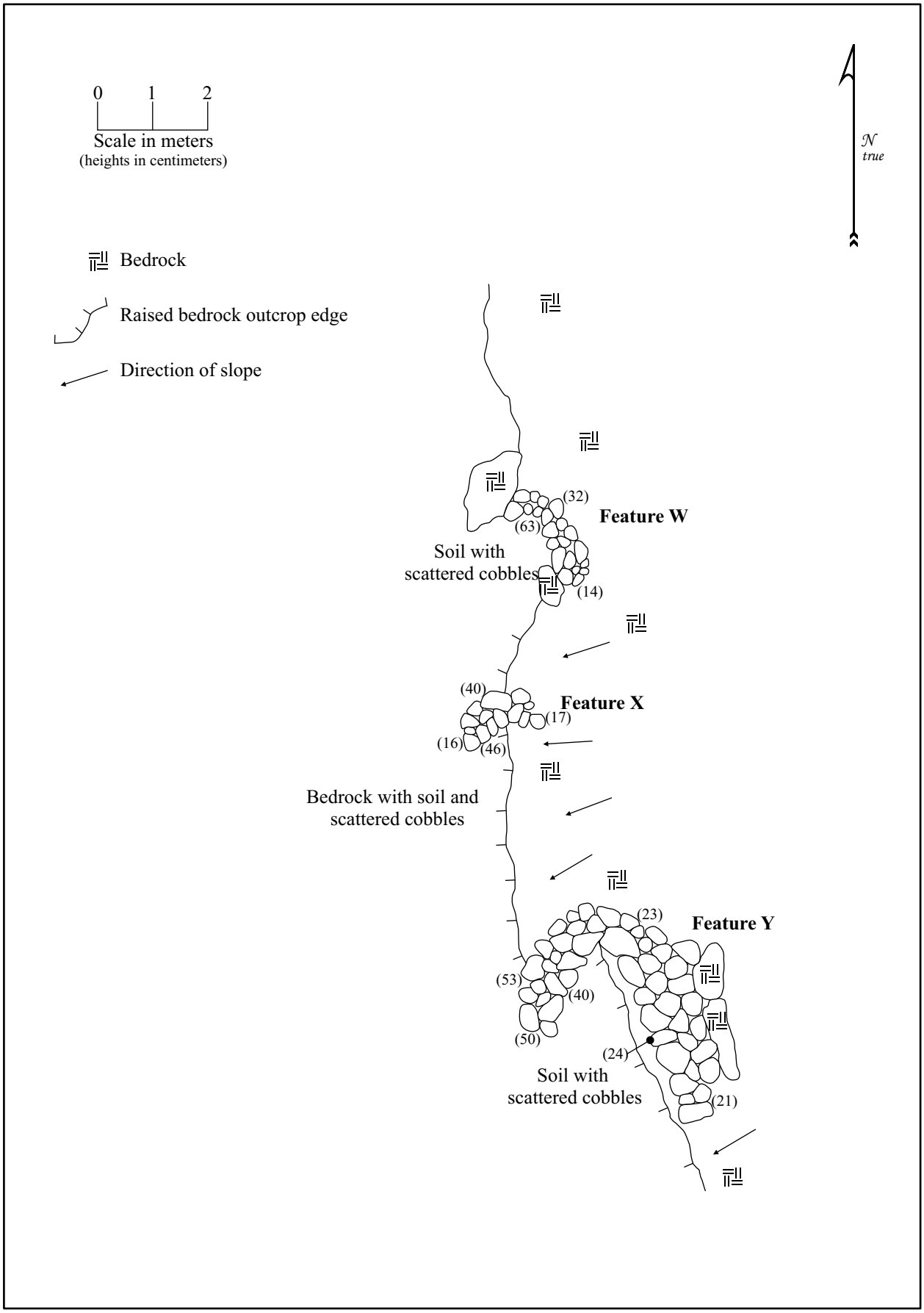


Figure 55. SIHP Site 5648 Features W, X, and Y plan view.

Figure 56. SIHP Site 5648 Feature X, view to the northeast.

Feature Y

Feature Y is a C-shape enclosure located 4.5 meters southwest of Feature X (see Figure 18) that opens to the southwest and is constructed of stacked and piled small to large cobbles (Figure 57). This feature measures 4.4 meters long by 3.0 meters long, and has an average width of 1.0 meters with heights ranging from 0.40 to 0.53 meters above the surrounding ground surface (see Figure 55). The northeastern portion of the enclosure is constructed on/against a bedrock ridge. The enclosed interior consists of a fairly level soil surface with sporadic small cobbles. Feature Y was previously recorded by Rasmussen (2005a) as Site 5648 Feature 1.

Figure 57. SIHP Site 5648 Feature Y, view to the southeast.

Feature Z

Feature Z is a triangular shape feature located approximately 48 meters east of Feature W (see Figure 18). Feature Z is constructed of two leaning slabs supporting each other over a protected covered space (Figure 58). The slabs measure 0.75 to 0.80 meters long by 0.40 meters wide and are 0.10 meters thick. The area under the slabs is protected from the wind and sun. A bedrock outcrop surrounds the feature creating a natural enclosure. Feature Z was previously recorded by Rasmussen (2005a) as Site 5648 Feature 3.

Figure 58. SIHP Site 5648 Feature Z, view to the southwest.

Feature AA

Feature AA is a modified outcrop windbreak shelter located approximately 40 meters south of Feature Y (see Figure X). This feature is constructed along the upper edge of a short, southwest sloping (into a shallow drainage) ridge. The windbreak is constructed of roughly fifty small to large cobbles (Figure 59), and it measures 2.0 meters long by 0.8 meters wide. The cobbles used in the construction of Feature AA are piled on bedrock, standing 0.2 to 0.5 meters tall along the north edge, and 0.9 meters tall along the south edge (Figure 60). The immediate area southwest of construction is protected from the prevailing winds.

Figure 59. SIHP Site 5648 Feature AA, view to the north.

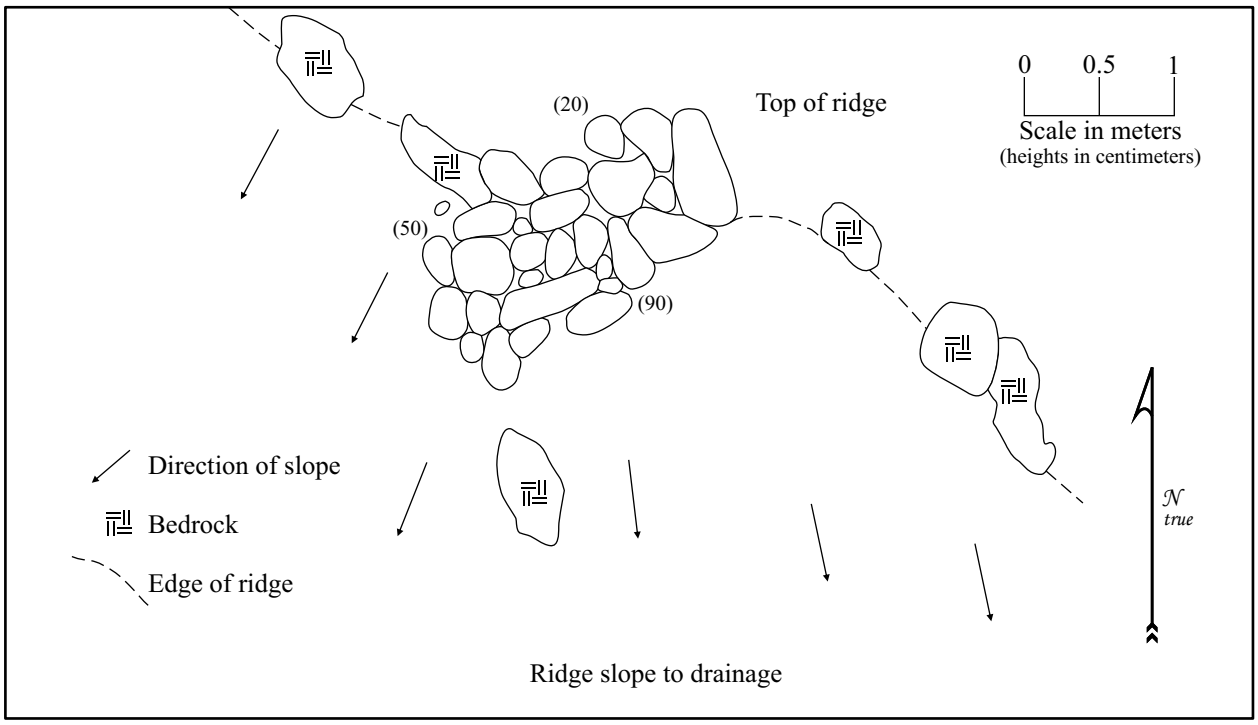


Figure 60. SIHP Site 5648 Feature AA plan view.

Feature BB (T-20)

Feature BB is a modified outcrop windbreak shelter located approximately 180 meters east-southeast of Feature U (see Figure 18). This feature is constructed 20 meters west of a steep cliff face that defines the eastern boundary of the current study area (see Figure 12). The curvilinear windbreak consists of piled and stacked small to large cobbles (Figure 61). It measures 2.4 meters long by 0.60 meters wide, with heights ranging 0.10 to 0.50 meters above the surrounding ground surface (Figure 62). Feature BB is slightly concave to the southwest (leeward) side, almost to the point of being considered a C-shape enclosure.

Figure 61. SIHP 5648 Feature BB, view to the north.

Feature CC (Cairn #4)

Feature CC is a rock pile located approximately 52 meters northwest of Feature BB (see Figure 18). It consists of 7 large flat cobbles and 15 smaller cobbles loosely stacked against a small outcropping of bedrock (Figure 63). This rock pile is 1.40 meters long by 0.70 meters wide and stands 0.46 meters tall. Feature CC is only visible from a downslope vantage point.

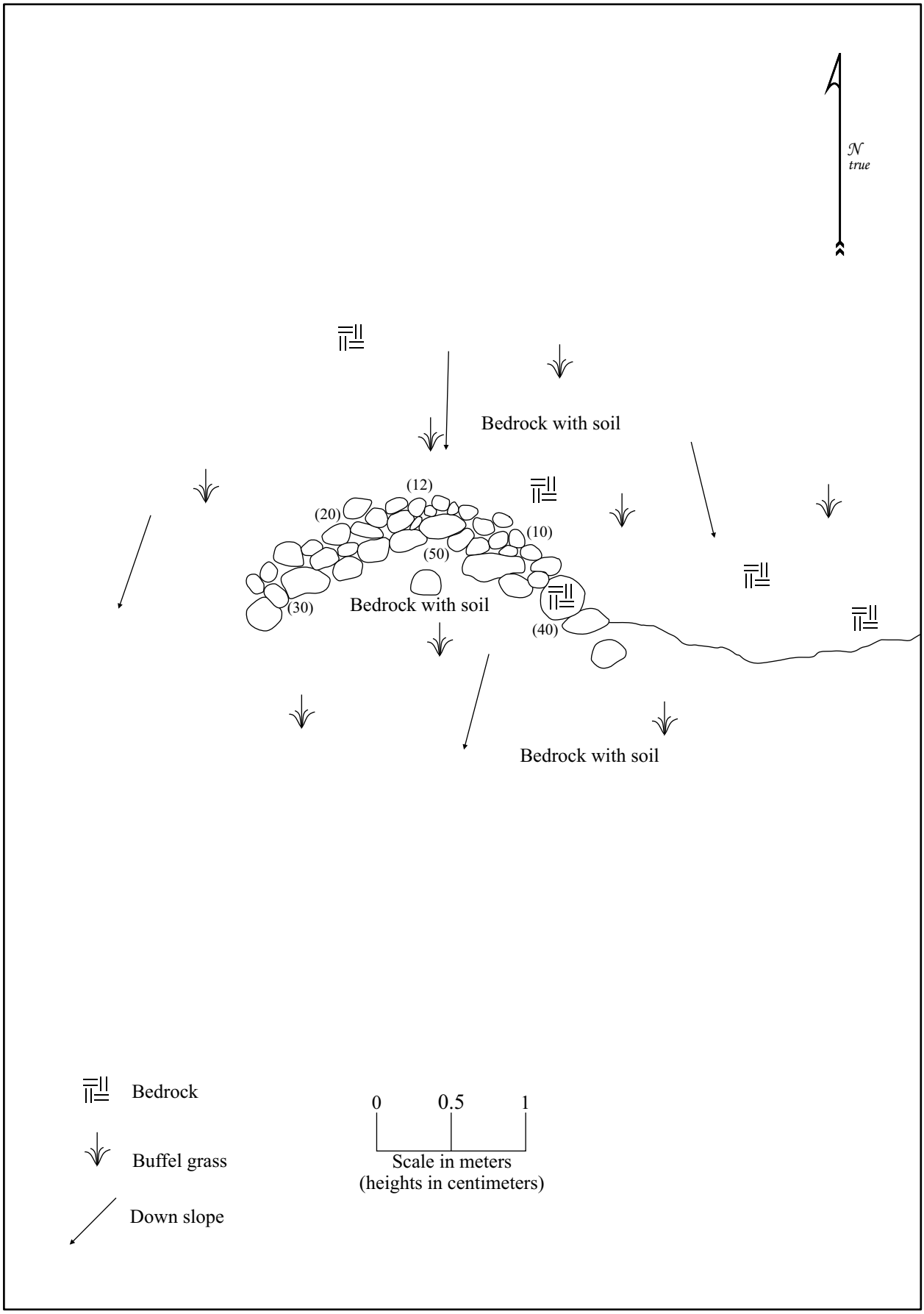


Figure 62. SIHP Site 5648 Feature BB plan view.

Figure 63. SIHP 5648 Feature CC, view to the northwest.

Feature DD

Feature DD is a rock pile located approximately 190 meters east/northeast of Feature Z (see Figure 18). It consists of four flat cobbles placed on a large bedrock boulder (Figure 64). Feature DD does not appear to possess great antiquity.

Figure 64. SIHP 5648 Feature DD, view to the southeast.

SIHP Site 50-50-09-6665

Site 6665 is a concrete water trough (Figure 65) located in the upper portion of the main study area, west of main access road roughly 5 meters northwest of the old jeep access road area (see Figure 12). The trough measures 3.05 meters long by 1.7 meters wide and stands 0.60 to 0.80 meters above the surrounding ground surface, with an interior height of 0.48 to 0.74 meters from the base to the top of the trough (Figure 66). The concrete walls of the trough measure 0.13 meters thick and were poured in place using a wooden form. Two rusted anchor bolts are located in the top surface of the trough and the interior currently contains some soil and a small amount of collected rainwater with a fragment of decomposing burned lumber, and a section of galvanized water pipe. Other sections of galvanized water pipe extend both *mauka* and *makai* from the water trough. Several inscriptions are present in the concrete along the top surface of the trough (Figures 67 and 68). The inscriptions include several names and initials, presumably of the ranch hands that constructed the trough, along with the dates "DEC. 14/ 43" in two locations, and "12-14-43" and "1943" in separate locations. The names and initials include "LONO POAIPUNI", "MICKEY", "C.K.N.", "HUA KEKIWI", "S.K.N.", and "S.K.P." Some of these same names also appear on the other concrete water troughs recorded in the Kaheawa Pastures area (Clark and Rechtman 2005, 2006). Site 6665 is part of a water system developed by Honoula Ranch in Ukumehame in the 1940s. As documented in Clark and Rechtman (2005 and 2006), this system also included several other water troughs (Sites 5402 and 6222), interconnected by galvanized metal water supply pipes. This system provided drinking water for cattle in the once extensive, but arid pastures of this upland area. Cattle ranching continued within the project area until the 1990s.

Figure 65. SIHP Site 6665, view to the south.

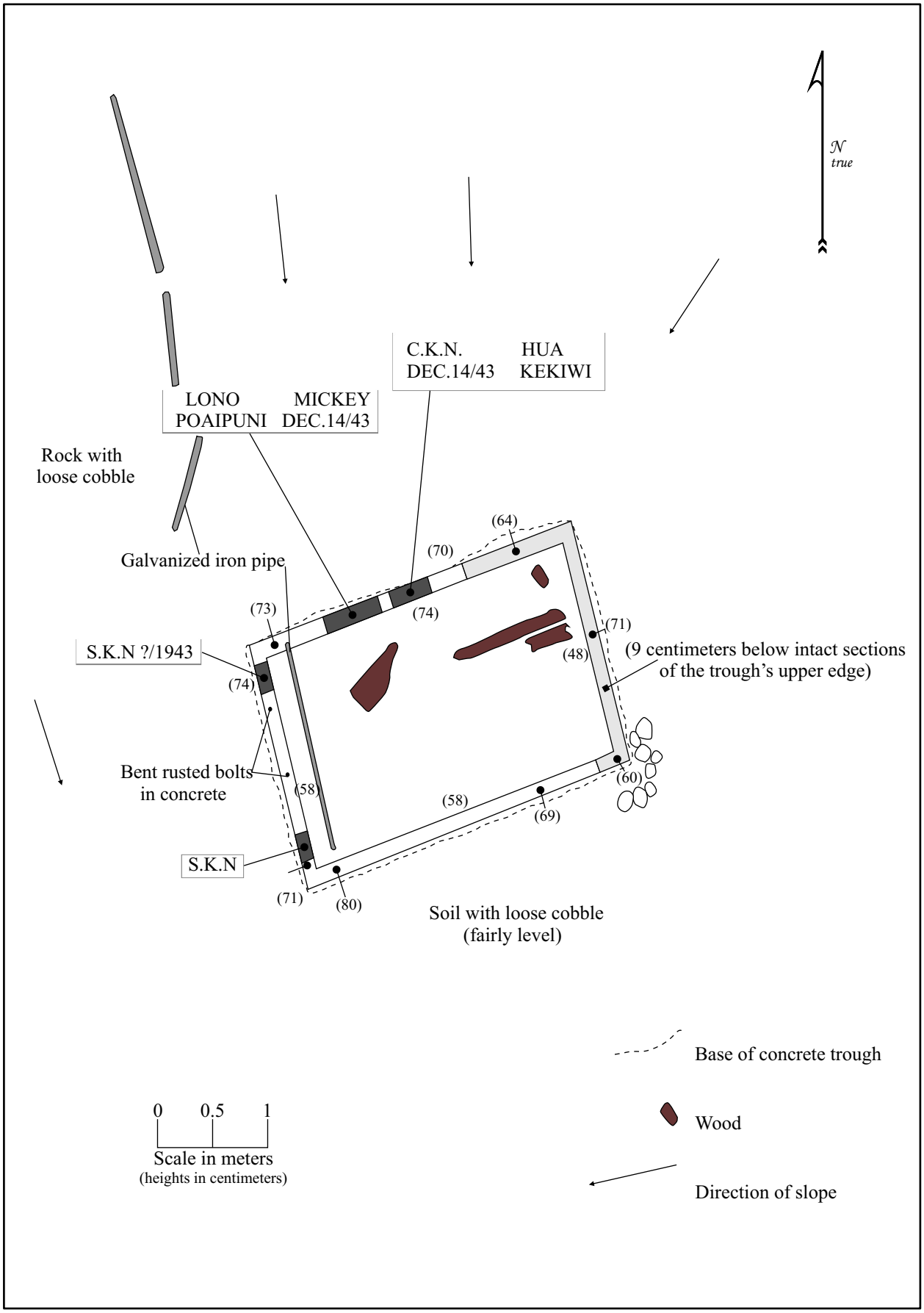


Figure 66. SIHP Site 6665 plan view.

Figure 67. SIHP Site 6665 inscriptions.

Figure 68. SIHP Site 6665 inscriptions.

SUMMARY AND CONCLUSIONS

As a result of the current inventory survey the Lahaina Pali Trail and a possible remnant section of its Mā‘alaea branch were identified as was the previously recorded Site 5648, along with a concrete water trough (Site 6665) (Table 1). The Lahaina Pali Trail and the Mā‘alaea branch of this trail were constructed in 1841 and remained in use until 1891. It seems reasonable to assume that during earlier times other trails accessed this area; however, the physical evidence of such trails is no longer observable on the surface having been superseded by either the historic trails or the Jeep roads.

Table 1. Summary of sites recorded within the current project area.

Site	*Formal Type*	*Functional Type*	*Age*
Lahaina Pali Trail	Trail	Transportation	Historic
SIHP 5648	Complex	Habitation	Precontact/Historic
SIHP 6665	Concrete water trough	Ranching	Historic

At Site 5648, twenty new features were documented; bringing the total number of features at this site to thirty. The features are indicative of temporary habitation and may represent recurrent use shelters associated with trail routes. The use of these features likely dates from both Precontact and Historic times. The most intensive habitation may have occurred between 1841 and 1891 when the Lahaina Pali Trail and its Mā‘alaea branch were still in use.

Site 6665 is a concrete water trough that was built on December 14, 1943. This water trough is part of a water system developed by Honoula Ranch in Ukumehame in the 1940s. As documented in Clark and Rechtman (2005 and 2006), this system also included other water troughs (Sites 5402 and 6222), interconnected by metal pipes that supplied water. This system provided drinking water for cattle in the once extensive, but arid pastures of this upland area. Cattle ranching continued within the project area until the 1990s.

SIGNIFICANCE EVALUATION AND TREATMENT RECOMMENDATIONS

The above-described archaeological resources are assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in the Hawai‘i Administrative Rules 13§13-284-6. These significance evaluations should be considered as preliminary until DLNR-SHPD provides concurrence. For resources to be considered significant they must possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet one or more of the following criteria:

A Be associated with events that have made an important contribution to the broad patterns of our history;

B Be associated with the lives of persons important in our past;

C Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value;

D Have yielded, or is likely to yield, information important for research on prehistory or history;

E Have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity.

The significance and recommended treatments for the recorded sites are discussed below and are presented in Table 2.

Table 2. Site significance and treatment recommendations.

Site	*Site Type*	*Significance*	*Recommended Treatment*
Lahaina Pali Trail	Transportation	D	Preservation*
SIHP 5648	Habitation	D	Preservation
SIHP 6665	Historic ranching	D	No further work

* The preservation of this site is guided by an existing cultural resource management plan (Tomonari-Tuggle 1995).

The Lahaina Pali Trail and the remnant of the Mā‘alaea branch of this trail are considered significant under Criterion D for the information yielded relative to middle and late nineteenth century transportation patterns and evolving modes of transportation. The main trail branch is already governed by a management plan (Tomonari-Tuggle 1995) and it will not be directly impacted as a result of the current proposed expansion of the wind power project. The newly discovered remnant portion of the Mā‘alaea branch of this trail should be preserved although it does not currently provide a continuous link to the main branch of the Lahaina Pali Trail or to Mā‘alaea. A preservation plan for this site should be prepared and submitted to DLNR-SHPD for review and approval.

Site 5648 is considered significant under Criterion D for both the information it has yielded and the potential information it is likely to yield if future work were to be conducted. The locations of the proposed wind generating towers and the associated infrastructure are being designed to avoid all of the features of this site. While it is possible that data recovery might enhance our knowledge relative to the age and specific function of the various features of Site 5648, such mitigation work is not necessary given the current proposed project layout. Therefore a preservation plan for this site should be prepared and submitted to DLNR-SHPD for review and approval. If in the future, it is necessary to impact one or more of the site’s features, DLNR-SHPD should be contacted to address possible mitigation of impacts through data recovery.

Site 6665 is considered significant under Criterion D for information it has yielded relative to the middle twentieth century ranching practices in the area. As it is not exceptional, nor is it likely to yield further important information, no further work in the recommended treatment for Site 6665.

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Appendix 5

KAHEAWA WIND POWER II: POST-CONSTRUCTION REVEGETATION/RESTORATION PLAN

April 2010

I. Introduction

Kaheawa Wind Power II, LLC (KWP II) proposes to construct and operate a new 21-megawatt (MW) wind energy generation facility at Kaheawa Pastures above Mā‘alaea in the southwestern portion of the Island of Maui, Hawai‘i. The proposed project is situated on approximately 143 acres (58 ha) of State Conservation District Land southeast of the existing 30-MW Kaheawa Wind Power (KWP) project operated and owned by Kaheawa Wind Power LLC (KWP LLC) (KWP II 2009). The proposed project location is referred to as the Downroad Siting Area (Planning Solutions, Inc. 2009).

The area to be disturbed during construction of the KWP II facility is former pasture that was converted from native plant communities well over 100 years ago, and is currently dominated by a mixture of native and non-native grasses and low shrubs with scattered small trees. The area is prone to periodic wildfires, which suppress native plants and favor the spread of non-native, fire-tolerant grasses. Several native plant species are widely scattered throughout the project area, mixed among the non-native grasses (Hobdy 2009b). Native plants are more prevalent at higher elevations of Kaheawa Pastures and in the rocky habitat bordering Manawainui and Malalowaiaole Gulches (Hobdy 2009a, 2009b, 2010).

Construction of the proposed KWP II facility will disturb approximately 43 ac (17 ha) of land. Approximately one third of the disturbed area will be revegetated upon completion of earthwork. Areas suitable for stabilization by revegetation include cut and fill slopes and road cuts. Turbine pads, as well as some portion of the road cuts, will be stabilized with hard materials (e.g., rip-rap and compacted gravel) rather than vegetation in order to ensure stability or increase searchability of turbine plots for downed wildlife.

This plan describes the goals, methods, monitoring, and success criteria for revegetation of areas temporarily disturbed during the construction of KWP II. This plan is intended to meet the dual goals of 1) stabilizing disturbed areas immediately following construction, and 2) re-introducing and establishing several native plant species throughout the site as a longer-term effort. Most elements of this plan involve the application of Best Management Practices (BMPs) and are derived from experiences and lessons learned at the adjacent KWP project site, which underwent construction in early 2006, and which has a comparable plant ecological history.

II. Existing Conditions

The proposed KWP II project area is located in an area known locally as Kaheawa Pastures, on the southern slope of the West Maui Mountains between 695 and 1,825 ft elevation (212 and 556 m). The project area is approximately 4 miles (6.4 km) mauka (inland) of McGregor Point. It is located in the General subzone of the State Conservation District to the southeast of the existing 30-MW KWP facility along the existing access road (Downroad Siting Area). Kealaloloa Ridge, situated immediately northeast of Malalowaiaole Gulch, separates the project area from the isthmus of Maui to the east.

Average annual rainfall at the proposed project area ranges from less than 15 inches (38 cm) per year at the Honoapi‘ilani Highway/site access road intersection to slightly over 40 inches (102 cm) per year at the uppermost portion of the existing wind facility (3,200 ft or 975 m). Most of the rainfall occurs during winter months (80+ percent from November through April).

Botanical surveys of the proposed KWP II area were conducted by Robert Hobdy in August 2009 and January 2010. The vegetation is mostly grasses and low-growing shrubs, with occasional small trees in the wetter gullies. The most abundant species in the project area is non-native buffelgrass (*Cenchrus ciliaris*), which proliferated after the fires in 1999 (Hobdy 2009a). Hobdy identified a total of 24 plants native to the Hawaiian Islands, which are widely scattered throughout the area. No state or federally threatened, endangered, or candidate species were found during his surveys.

III. Background of Revegetation Efforts at KWP

Because of the proximity and similarity of the landscape at the two facilities, the proposed KWP II facility will rely heavily on the lessons learned at KWP. The amended Conservation District Use Permit (CDUP MA-3103) granted to KWP by the Board of Land and Natural Resources (BLNR) on 24 June 2005 contained the following conditions related to revegetation:

20. *"All cleared areas shall be revegetated in a manner consistent with other permit conditions, with specific consideration given to the fire contingency plan and the Habitat Conservation Plan. Any necessary revegetation shall be completed within thirty days of the completion of specific project components that resulted in ground clearing, using native species found in the area;"*

37. *"The applicant shall ensure that operations and maintenance staff do not damage native plants. If construction or operation required the removal of native plants, the plants will be removed, relocated and replanted. The applicant shall pay for the cost of this effort;"*

38. *"The applicant shall work with plant experts to introduce appropriate native plant species back into the Kaheawa Pastures;"*

Similar conditions were required in the National Pollutant Discharge Elimination System (NPDES) General Permit for the KWP project area:

- *"Temporary soil stabilization with appropriate vegetation will be applied to areas remaining unfinished for more than 30 days; and*

- *Permanent soil stabilization will be applied as soon as practical after final grading. Contractor will coordinate with the Department of Land and Natural Resources (DLNR) regarding selection of appropriate vegetation as a condition of the Conservation District Use Permit."*

After extensive research and efforts at seeking source materials, KWP biologists concluded that establishing vegetation within 30 days by seeding with native species (per Condition 20) was not feasible due to the unavailability of native species in sufficient commercial quantities. Currently, the Hawai'i Department of Transportation is working with the Federal Highway Administration on a three-year research project to develop native grass mixes and hydro-seeding techniques for use on civil projects in Hawai'i (Dacus, pers. comm.). However, techniques have not yet been developed in Hawai'i for hydro-seeding or broadcasting with native seed mixes on a large scale.

In the *Response to October 27, 2005 Letter Regarding the Establishment of Stabilizing Vegetation Cover for Erosion and Sediment Control Related to Wind Farm Access Road Construction*, the State of Hawai'i Department of Land and Natural Resources (DLNR) authorized KWP's request to apply commercially available annual ryegrass (*Lolium multiflorum*) in order to comply with permit conditions of the CDUP and the NPDES permit, given the following conditions:

1. *"The permittee shall acquire commercial quantities of native pili grass bundles or other native species as soon as possible to substitute the annual rye; and*

2. *The permittee is responsible for controlling the annual rye if it starts invading adjacent State lands."*

KWP subsequently established a conservation partnership with the USDA/NRCS to obtain native pili grass (*Heteropogon contortus*) from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) Plant Materials Center on Moloka'i. This partnership resulted in field trials to test the ability to establish pili grass at KWP using seed and bales. Following several treatments, it was determined that while it is possible to establish pili grass in limited quantities, and over several months, it probably cannot be expected to meet rapid, site-wide ground cover re-establishment requirements.

Following the trials with pili grass, KWP petitioned DLNR and the Office of Conservation of Coastal Lands (OCCL) to consider allowing manual application and hydro-seeding with a grass seed mixture to accomplish site revegetation goals. DLNR officials in the Division of Forestry and Wildlife (DOFAW) provided comments on this proposal, citing that annual ryegrass is expected to die off and provide a more suitable environment for recruitment by adjacent species. DOFAW expressed interest in limiting the amount of emergent grass in the immediate vicinity of turbines, a recommendation intended to minimize the attraction of Nēnē, which are common in the area and browse on a wide range of emergent vegetation types. KWP biologists have documented that Nēnē are prevalent in the area and currently use the areas in proximity to the existing turbines on a regular (i.e., almost daily) basis. Thus, revegetating bare areas with grasses is not expected to pose an additional risk of bird collisions.

At the same time, KWP biologists have had considerable success at re-introducing native plants grown in the nursery at various locations throughout the site, including along cut and fill slopes and other open earth portions of the roadsides and turbine pads. Although these plantings do not provide a uniform stabilizing cover *per se*, it does appear that they will, over several seasons, come to dominate the areas treated. Between July 2007 and June 2008, approximately 7,500 young a‘ali‘i (*Dodonaea viscosa*) were propagated from seed collected at Kaheawa and planted along cut and fill slopes and other open earth portions of the roadsides and turbine pads. An intensive outplanting effort comprising nearly 16,000 individual plants of several key native species occurred during the winter and spring of 2009 at KWP.

IV. Revegetation Goals

The goals of the revegetation plan for KWP II are based on the relevant CDUP and NPDES permit conditions for KWP, as well as experiences and lessons learned at KWP.

The proposed revegetation strategy for KWP II has two goals:

1. Address the immediate requirement of stabilizing exposed soils following construction activities at KWP II, in accordance with erosion and sedimentation control BMPs and NPDES stormwater discharge permitting requirements; and

2. Re-introduce native plant species in selected areas throughout the site over several years, with the goal of re-establishing native plant species in areas that have been overgrown with non-native species for a century or more.

V. Revegetation Methods

KWP II biologists will work alongside the DLNR-DOFAW specialists to ensure that revegetation methods consider and incorporate all wildlife, forestry, fire, and rangeland concerns and are in alignment with the management provisions of the Conservation District. All revegetation material brought to the project area (e.g. seed mixes, sand, gravel, rock, and mulch) will be certified as weed free or inspected for invasive species prior to entering the project area. KWP II LLC will consult with the HDOA and the Maui Invasive Species Commission (MISC) to establish protocols for screening invasive species introductions during the revegetation process.

KWP II will work with construction contractors to ensure that slopes are not excessively compacted so as to inhibit establishment of vegetation. No other site preparation (e.g. weeding, adding soil amendments, etc.) is anticipated to be necessary prior to revegetation.

<u>Hydroseeding (*Goal 1*):</u>

KWP II biologists propose to hydroseed disturbed areas along the edges of turbine pads and along road cuts and fill slopes with annual ryegrass to establish an initial cover of vegetation after ground shaping and grading activities have been completed (Figure 1). Annual ryegrass was selected for erosion control because it provides rapid initial vegetation cover and forms an extensive, dense root system (Valenzuela and Smith 2002). This species is expected to gradually die back and allow natural recruitment of neighboring species or species present in the seed bank (DOFAW, pers. comm.).

Hydroseeding with annual ryegrass will require supplemental irrigation for a 90-day period and monitoring to ensure establishment of stabilizing cover. All hydroseeded areas will be monitored by a qualified botanist for the presence of problematic and/or invasive species. Monitoring will occur as needed during the 90-day establishment period, and a final inspection will occur six months post-application. This monitoring should be able to detect the presence of new problematic and/or invasive species inadvertently introduced as part of the seed mixes. In the event that any new invasive species is detected, appropriate measures, as advised by MISC, will be adopted to contain/eradicate the species and follow up surveys will be scheduled accordingly.

Erosion Mats and Hard Materials (*Goal 1*):

Excessively steep areas may require additional erosion control to achieve the immediate goal of stabilizing exposed soils and preventing erosion. For example, certain sections of the site may require the use of organic coir or jute mats and/or coir logs to reduce water flow velocity and capture sediments and seed material during periods of seasonal rainfall. The mats or logs will be secured in place along steep fill slopes and grades to provide temporary erosion control during the initial establishment period and further contribute to ground cover establishment. In addition, some portion of the disturbed area (particularly the turbine pads) will be stabilized with hard materials (e.g., rip-rap, compacted gravel) rather than vegetation in order to ensure stability and facilitate monitoring of turbine plots for downed wildlife. The use of these materials will be evaluated in consultation with DLNR and the U.S. Fish and Wildlife Service (USFWS), and implemented according to site-specific considerations.

Outplanting (*Goal 2*):

To accomplish the long-term goal, KWP II biologists propose to re-introduce native plants in discrete locations over several years, with the intent of eventually re-establishing some of the key elements of the plant communities that historically existed on the site (Figure 2). This phase will involve collecting native seeds and cuttings in the area, propagating these species at local nurseries, and subsequently outplanting these species at the site.

Native species that may potentially be used during this phase include ʻaʻaliʻi (*Dodonaea viscosa*), pili grass (*Heteropogon contortus*), ʻūlei (*Osteomeles anthyllidifolia*), and ʻilima (*Sida fallax*). These relatively fast-growing and easily propagated species provide excellent root structure for maintaining surface substrate retention, as well as provide a native seed source for the project area. Pili grass and ʻaʻaliʻi are particularly appropriate for Kaheawa Pastures because these species area among the few native Hawaiian plants shown to be fire tolerant (Tunison et al. 1994, Loh et al. 2009).

The specific species, sizes, densities, and location of native outplantings will be determined based on site-specific factors such as slope, erosion potential, and substrate. Due to physical constraints of the site (i.e. the presence of surface bedrock material), KWP II LLC may concentrate native outplants outside of the area disturbed during construction (i.e. near the puʻu). This location will be determined in consultation with DLNR, USFWS, and a revegetation/restoration specialist.

Because this phase will occur after the immediate revegetation phase, many of these plantings will be installed in or adjacent to areas that were previously stabilized with the annual ryegrass mixture and temporary measures (e.g., coir mats and logs). In certain cases, it may be necessary to remove or control undesirable non-native species, either manually or with the assistance of an approved herbicide. Any use of herbicides will be done only in consultation with DLNR, and only in accordance with applicable restrictions on handling and use.

KWP II biologists plan to approach this phase of the site revegetation plan in a manner that emulates the successful native plant reintroduction efforts at KWP. KWP II will work in collaboration with KWP to share resources and coordinate logistics.

Figure 1. Mechanized hydroseeding along a bare road cut during immediate site revegetation and soil stabilization efforts following construction at KWP.

Figure 2. Several native plant species successfully outplanted at KWP as part of long-term revegetation efforts.

VI. Timeline

Construction of the access roads and turbine foundations is anticipated to begin shortly after issuance of the Federal Incidental Take Permit (ITP) and State Incidental Take License (ITL). Revegetation of temporarily disturbed area with annual ryegrass will begin as soon as possible immediately after construction of the access roads and turbine foundations. Outplanting with native species will occur during the first several years of the project. Some species will be outplanted immediately after hydroseeding with annual ryegrass to take advantage of irrigation.

VII. Monitoring and Success Criteria

Regular irrigation and monitoring will be necessary at KWP II to ensure that immediate revegetation measures are successful. Young grasses and seedlings are especially vulnerable to root damage in the absence of rain or watering. All hydroseeded areas will be monitored and irrigated for a 90-day period following hydroseeding. The revegetation/restoration contractor shall provide sufficient irrigation during this period to assure adequate survival.

This phase of the project will be considered successful if it can be demonstrated that >75% of the bare areas, fill slopes, and road cut segments that receive treatment have established cover within one year following treatment. If initial applications appear to be only partially successful, subsequent hand and/or hydro-seeding applications or additional temporary measures (e.g., matting or logs) may be installed to ensure adequate coverage and erosion control.

The longer term revegetation efforts at KWP II are expected to be successful given the success at KWP. A well-established seed collection and propagation program exists in cooperation with local nurseries, native plant specialists, contract landscape specialists, and volunteers. Plants will be out-planted, maintained, monitored, and documented using resources available at KWP II, in collaboration with community and conservation groups. This effort will be considered successful if a minimum of 5,000 individual plants are installed during the first three years following construction, with an average survival rate of greater than 75% (i.e. a minimum of 3,750 surviving plants), for all plants one year after installation, as determined by representative sampling of planted areas. If mortality exceeds 25%, replacement plantings will be installed as needed to achieve the 75% minimum.

VIII. Literature Cited

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Appendix 6

Triggers and Timelines for Tier 2 Mitigation and Mitigation Contingencies.

Newell's Shearwater

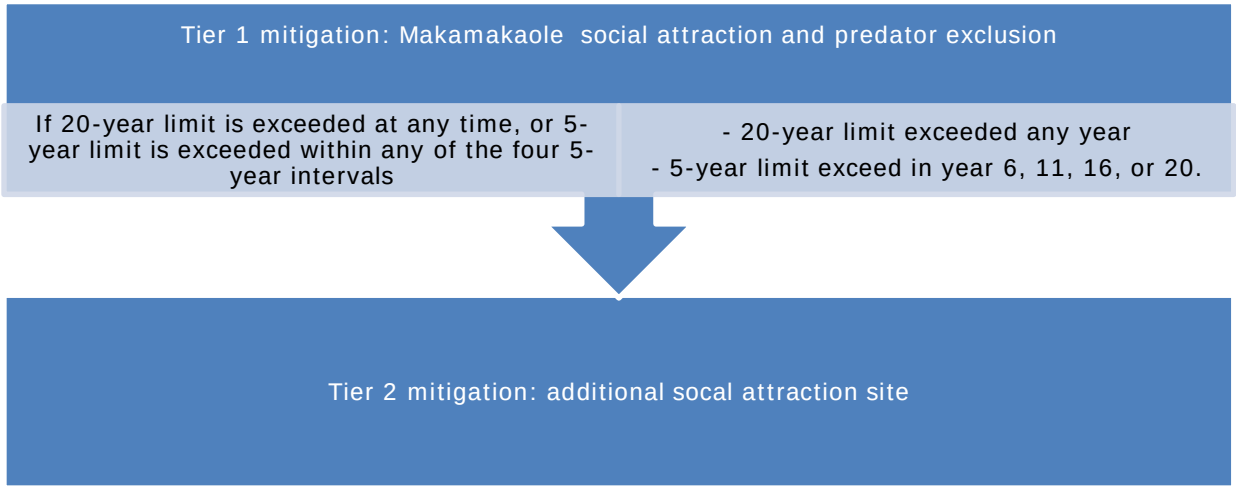

Figure 1: Triggers and timeline for Tier 2 mitigation for Newell's shearwater

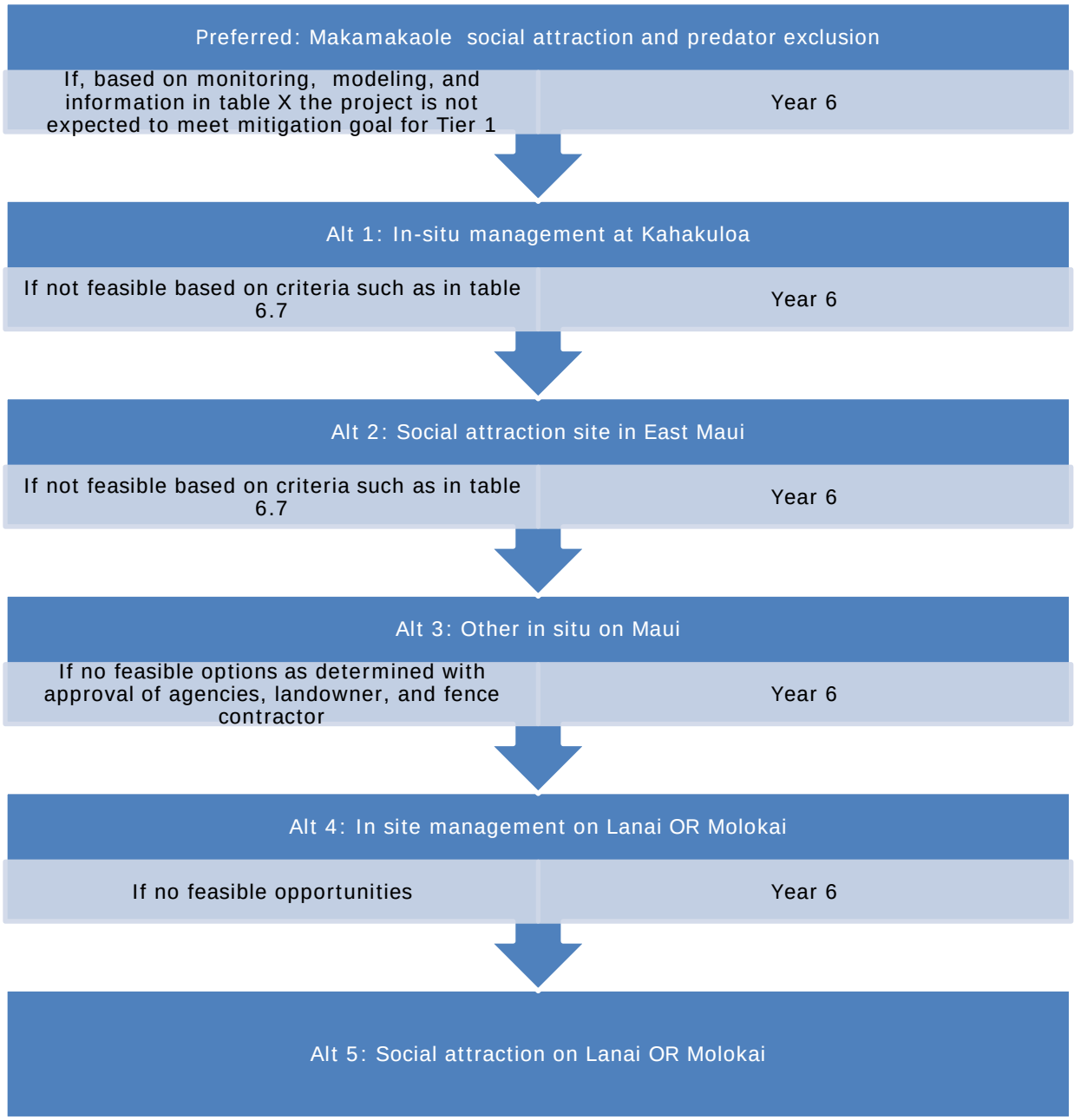

Figure 2: Triggers and timeline for mitigation contingencies for Newell's shearwater

Hawaiian Petrel

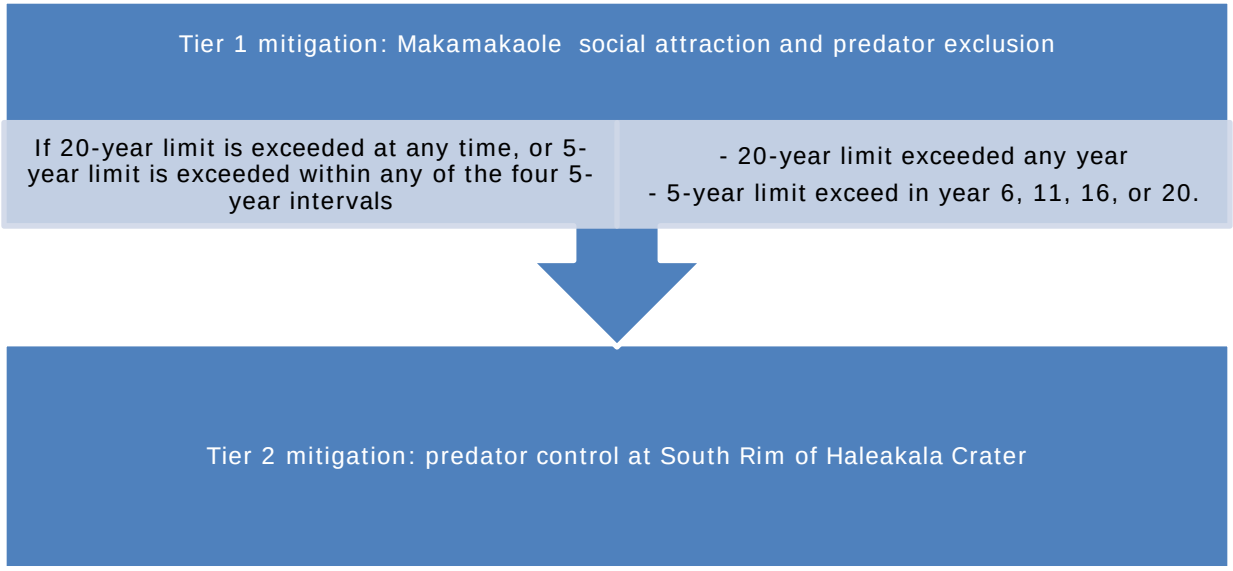

Figure 3: Triggers and timeline for Tier 2 mitigation for Hawiian petrel

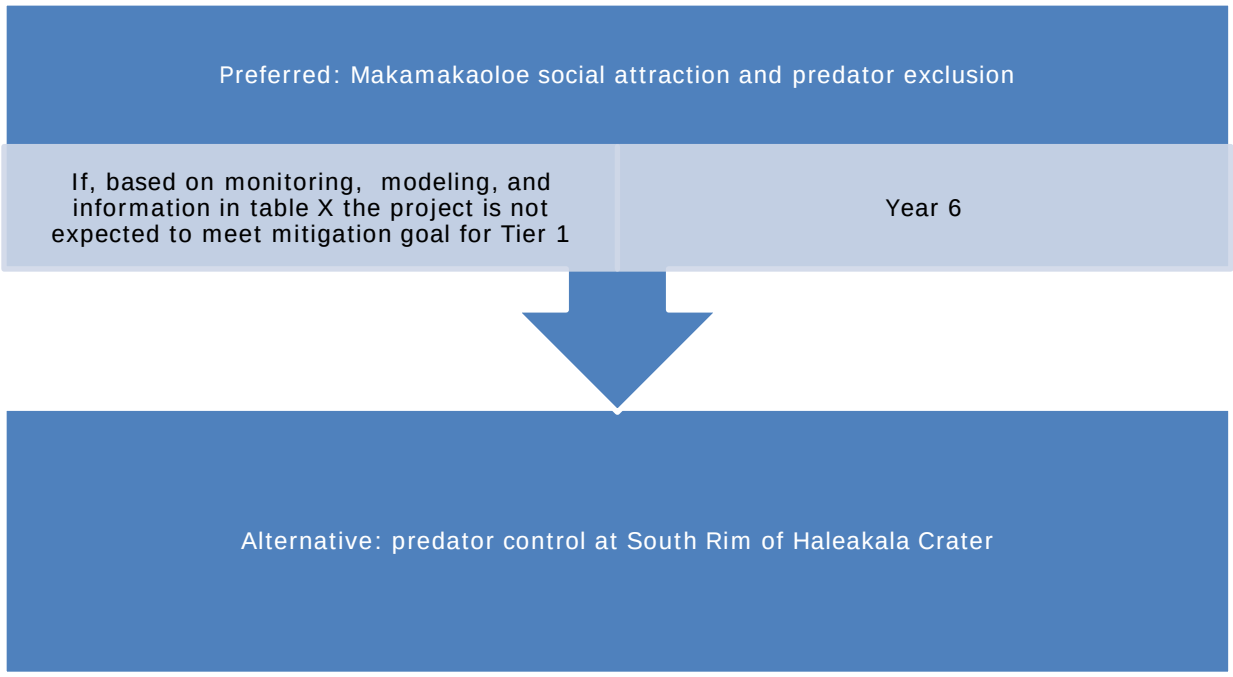

Figure 4: Triggers and timeline for mitigation contingencies for Hawaiian petrel

Nene

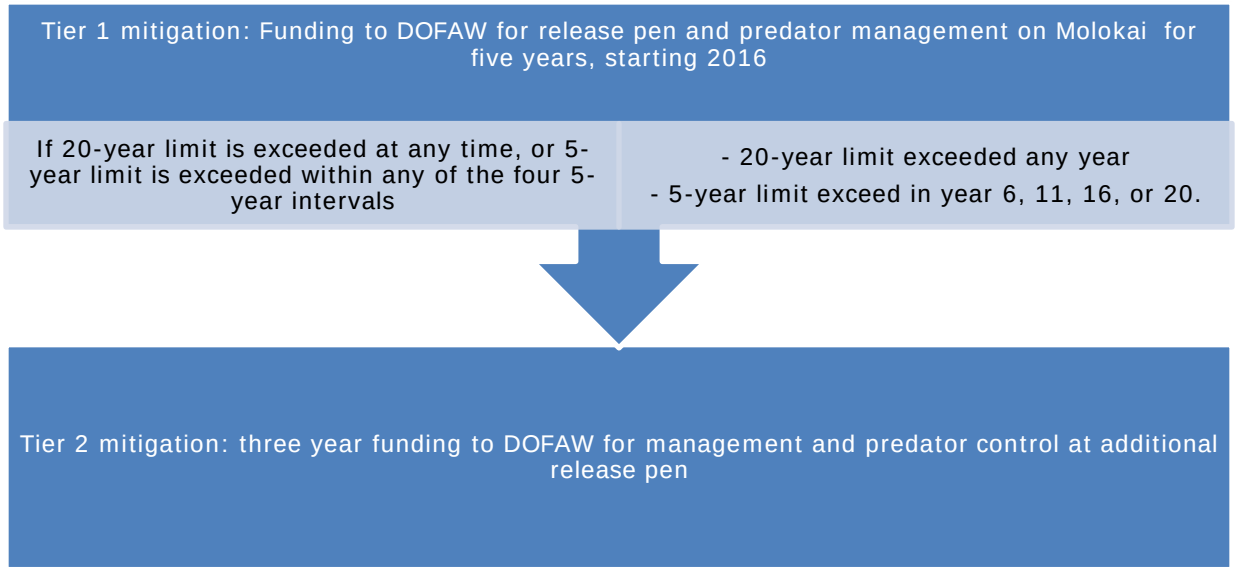

Figure 5: Triggers and timeline for Tier 2 mitigation for nene

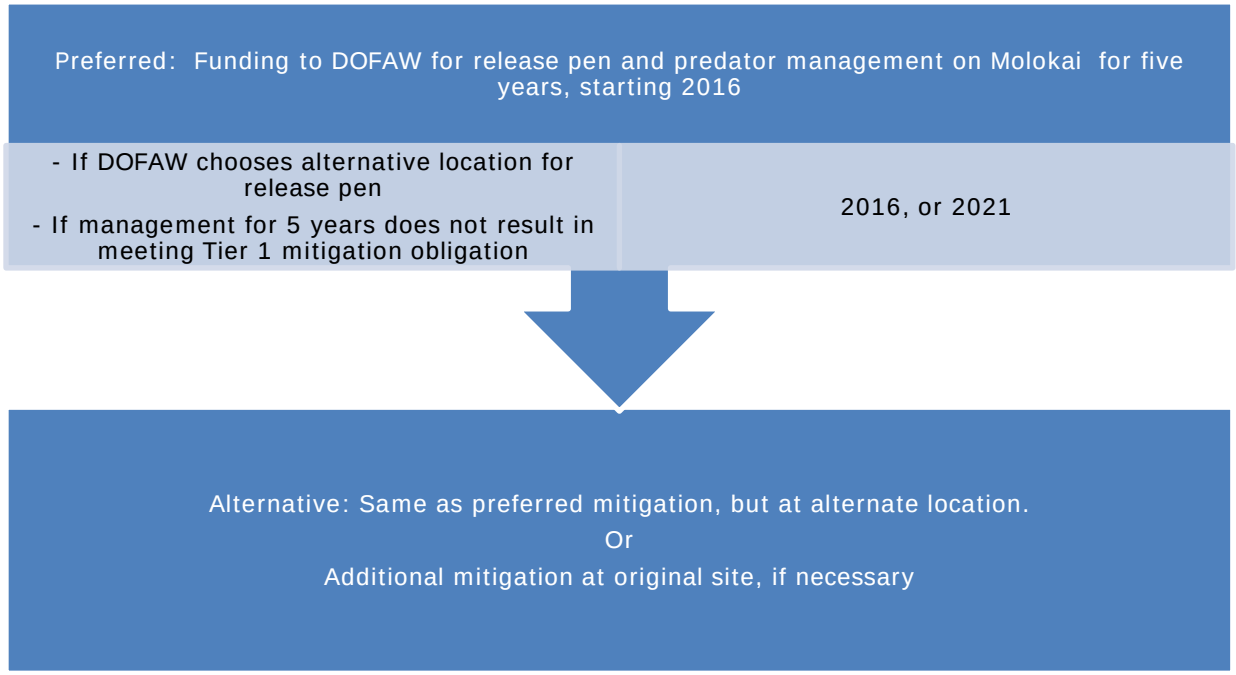

Figure 6: Triggers and timeline for mitigation contingencies for nene

Hawaiian Hoary Bat

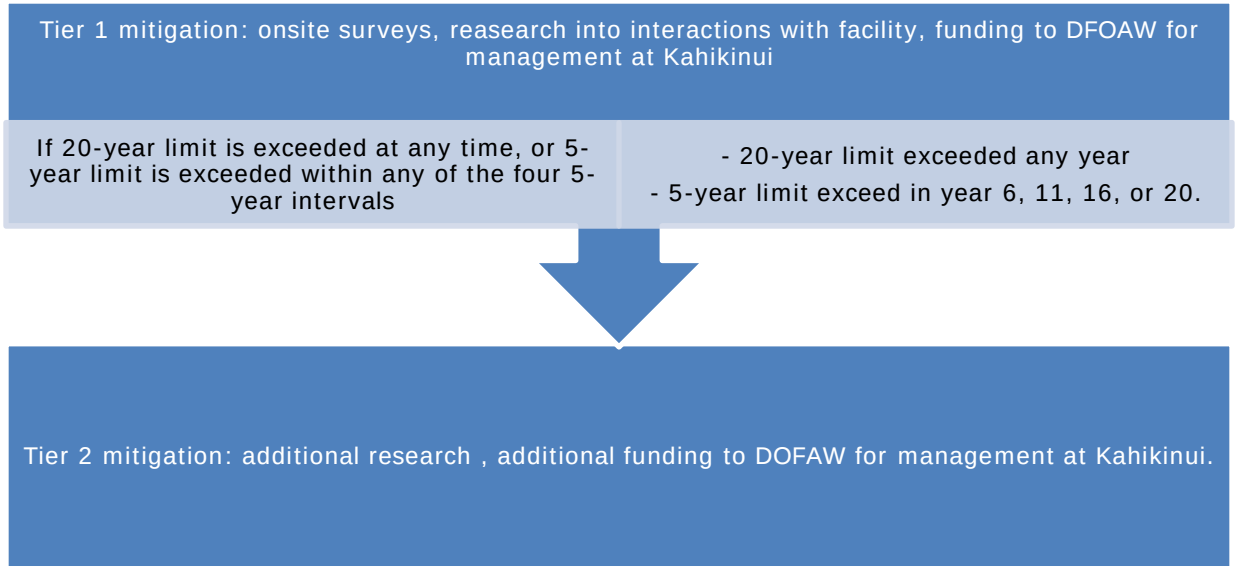

Figure 7: Triggers and timeline for Tier 2 mitigation for Hawaiian hoary bat

Appendix 7

APPENDIX 7. List of Plant Species Observed at Proposed Makamaka'ole Enclosures

The following checklist is an inventory of all the plant species observed by botanists Forest and Kim Starr in September 2011 at the proposed Makamaka'ole enclosures, Island of Maui. All plant species observed within the areas were documented.

The plant names are arranged alphabetically by family. The taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999)[1] and Wagner and Herbst (2003)[2]. Recent name changes are those recorded in the Hawaii Biological Survey series. Fern taxonomy and nomenclature follows Palmer (2003)[3].

For each species, the following is provided:

1. Scientific name.

2. Common English and/or Hawaiian name(s), when known.

3. Biogeographic status. The following classifications are used:

    - Endemic= native only to the Hawaiian Islands.
    - Indigenous= native to the Hawaiian Islands and elsewhere.
    - Polynesian = introduced by Polynesians.
    - Non-native = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact (Cook's arrival in the islands in 1778).

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[1] Wagner, W.L., D.R. Herbst and S.H. Sohmer. 1999. Manual of the flowering plants of Hawai'i, Volumes I & II. Revised edition. University of Hawai'i Press: Honolulu, HI.

[2] Wagner, W.L. and D.R. Herbst. 2003. Supplement to the Manual of the Flowering Plants of Hawai'i. Smithsonian Institute: Flora of the Hawaiian Islands. Available: http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/ManualSupplement3.pdf. Accessed July 2010.

[3] Palmer, D. 2003. Hawaii's Ferns and Fern Allies. University of Hawaii Press: Honolulu, HI.

Scientific Name	Common, Hawaiian Name	Status
Agavaceae		
Cordyline fruticosa	ti	Polynesian
Apiaceae		
Centella asiatica	Asiatic pennywort	Non-native
Apocynaceae		
Alyxia oliviformis	maile	Endemic
Aquifoliaceae		
Ilex anomala	kawau	Indigenous
Araliaceae		
Tetraplasandra hawaiensis	ohe mauka	Endemic
Asteraceae		
Ageratina riparia	Hamakua pamakani	Non-native
Ageratum conyzoides	maile honohono	Non-native
Conyza bonariensis	hairy horseweed	Non-native
Pluchea carolinensis	sour bush	Non-native
Blechnaceae		
Blechnum appendiculatum	blechnum	Non-native
Sadleria cyatheoides	amau	Endemic
Campanulaceae		
Clermontia kakeana	oha wai	Endemic
Cyperaceae		
Fimbristylis dichotoma	fimbristylis	Indigenous
Machaerina angustifolia	uki	Indigenous
Machaerina mariscoides subsp. *meyenii*	uki	Endemic
Dicksoniaceae		
Cibotium glaucum	hapuu pulu	Endemic
Cibotium menziesii	hapuu ii	Endemic
Elaphoglossaceae		
Elaphoglossum aemulum	laukahi nunui	Endemic
Gleicheniaceae		
Dicranopteris linearis	uluhe	Indigenous
Diplopterygium pinnatum	uluhe lau nui	Endemic
Goodeniaceae		
Scaevola chammisoniana	naupaka kuahiwi	Endemic
Hydrangeaceae		
Broussaisia arguta	kanawao	Endemic
Lindsaeaceae		
Odontosoria chinensis	palaa	Indigenous
Lycopodiaceae		
Lycopodiella cernua	wawaeiole	Indigenous
Lythraceae		
Cuphea carthagenensis	Colombian cuphea	Non-native
Lythrum maritimum	lythrum	Indigenous (?)
Malvaceae		
Triumfetta semitriloba	Sacremento bur	Non-native

Melastomataceae		
Clidemia hirta	Koster's curse	Non-native
Tibouchina herbacea	cane tibouchina	Non-native
Myrtaceae		
Metrosideros polymorpha	ohia	Endemic
Psidium cattleianum	strawberry guava	Non-native
Psidium guajava	guava	Non-native
Syzygium cumini	java plum	Non-native
Nephrolepidaceae		
Nephrolepis exaltata subsp. *hawaiiensis*	kupukupu	Endemic
Orchidaceae		
Arundina graminifolia	bamboo orchid	Non-native
Spathoglottis plicata	Philippine ground orchid	Non-native
Pandanaceae		
Freycinetia arborea	ieie	Indigenous
Phyllanthaceae		
Antidesma platyphyllum	hame	Endemic
Poaceae		
Andropogon virginicus	broomsedge	Non-native
Melinis minutiflora	molasses grass	Non-native
Paspalum conjugatum	Hilo grass	Non-native
Paspalum dilatatum	Dallis grass	Non-native
Sacciolepis indica	Glenwood grass	Non-native
Setaria parviflora	yellow foxtail	Non-native
Pteridaceae		
Pteris vittata	ladder brake	Non-native
Rosaceae		
Rubus rosifolius	thimbleberry	Non-native
Rubiaceae		
Bobea elatior	ahakea	Endemic
Coprosma pubens	pilo	Endemic
Kadua affinis	manono	Endemic
Psychotria mariniana	kopiko	Endemic
Smilacaceae		
Smilax melastomifolia	hoi kuahiwi	Endemic
Thelypteridaceae		
Christella dentata	downy wood fern	Non-native
Cyclosorrus interruptus	neke	Indigenous
Pneumatopteris sandwicensis	hoio kula	Endemic
Wikstroemia oahuensis var. *oahuensis*	akia kuahiwi	Endemic
Verbenaceae		
Stachytarpheta cayennensis	vervain	Non-native