ENVIRONMENTAL ASSESSMENT
FOR
KAWAILOA WIND POWER 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 six federally-listed threatened and endangered species and one state-listed endangered species during construction and operation of Kawailoa Wind facility, Island of Oahu, 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: Kawailoa Wind Power LLC

Permit Number: N/A

Funding Plan: Proposed monitoring and mitigation measures would be provided by Kawailoa Wind 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: Aaron Nadig, Pacific Islands Fish and Wildlife Office, U. S. Fish and Wildlife Service, 300 Ala Moana Boulevard, Room 3-122, Honolulu, HI.

SUMMARY

Kawailoa Wind Power LLC (Kawailoa Wind Power or the "Applicant"), a fully owned subsidiary of First Wind, proposes to construct and operate a new 70-megawatt (MW), 30-turbine wind energy generation facility (or wind farm) on Kamehameha Schools' Kawailoa Plantation lands, approximately 4 miles northeast of Haleiwa town on the north shore of the island of Oahu, Hawaii. Like the Kahuku Wind Power facility located to the east, Kawailoa Wind Power would supply wind-generated electricity to the Hawaiian Electric Company, Inc. (HECO).

Construction and operation of the Kawailoa Wind Power project has the potential to result in the incidental take of six federally-listed threatened and endangered species: the Hawaiian stilt or aeo (*Himantopus mexicanus knudseni*), Hawaiian coot or alae keokeo (*Fulica alai*), Hawaiian duck or koloa maoli (*Anas wyvilliana*), Hawaiian moorhen or alae ula (*Gallinula chloropus sandvicensis*), Newell's shearwater or ao (*Puffinus auricularis newelli*), and Hawaiian hoary bat or opeapea (*Lasiurus cinereus semotus*). One state-listed endangered species, the Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*), is also believed to have potential to collide with the proposed wind turbine generators (WTGs) or other project infrastructure. These seven Covered Species are known to fly in the vicinity of the project area and could be injured or killed if they collide with WTGs, permanent meteorological (met) towers, overhead lines, and other project components. The 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, Kawailoa Wind Power 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, a State 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. Upon issuance of the ITP and ITL, Kawailoa Wind Power would be authorized for the incidental take of the six 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. This Draft EA describes the existing environment in the Kawailoa Wind Power project area; discusses alternatives to the Proposed Action; and evaluates the potential impacts of the alternatives. If no significant impacts are identified during preparation of this EA, USFWS would issue a Finding of No Significant Impact (FONSI). If potentially significant impacts are identified, an Environmental Impact Statement (EIS) would be prepared.

The Proposed Action (Alternative 1) is the issuance of an ITP and approval of an HCP to authorize the potential incidental take of six federally listed threatened and endangered species during the construction and operation of the Kawailoa facility, and to adequately avoid, minimize, and mitigate the anticipated incidental take. Construction of the proposed project would disturb approximately 335.1acres of the approximately 4,200 acre leased project area. The permanent project footprint would be 21.7 acres. In addition to the wind turbine generators and appurtenant facilities at the proposed wind farm on Kawailoa Plantation lands, the project may also require installation of communications equipment at existing facilities on Mt. Kaala, roughly nine miles southwest of the proposed Kawailoa wind farm site. This communication equipment would provide a link between the wind farm and the existing Hawaiian Electric Company substations that would be receiving the power.

This EA also evaluates the potential impacts of issuing an ITP and approving an HCP for the Communications Site Layout (Alternative 2). This alternative requires attaching the proposed antennae to two new communication towers at the Mt. Kaala site instead of attaching them to existing towers at Mt. Kaala. The wind farm layout is otherwise identical under Alternative 2. Overall, disturbance is the same as Alternative 1 except for an additional 0.006-acre disturbance at the communication sites. 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 Kawailoa Wind Power. This alternative represents a "no build scenario" because Kawailoa Wind Power would not construct the wind energy facility due to the risk of the facility causing unauthorized incidental take of listed species.

Table i. Summary of Impacts by Resource.

<table>
<tr><th>Resource</th><th>Proposed Action (Alternative 1)</th><th>Communications Site Layout (Alternative 2)</th><th>No Action (Alternative 3)</th></tr>
<tr><td>Climate</td><td colspan="2">Construction and operations would not impact local weather conditions, such as temperature, rainfall, or humidity. Relative to global climate change, operation would have a beneficial impact by providing 70 MW/year of renewable energy in place of fossil fuel-generated energy, thereby reducing emissions of CO_2 by 134,400/year.

HCP measures: No impact on climate.</td><td>No change in existing conditions and no impacts to climate.</td></tr>
<tr><td>Air Quality</td><td>Estimated emissions during construction in tons per year would be 123.1 for $PM_{2.5}$, 26.2 for PM_{10}, 1.2 for HC, 21.5 for CO, 8.0 for NO_2, 1493 for CO_2, and 0.05 for SO_2. Estimated emissions during operations in tons per year would be 0.003 for $PM_{2.5}$, 0.002 for PM_{10}, 0.09 for HC, 0.83 for CO, 0.06 for NO_2, 146.5 for CO_2, and 0.0004 for SO_2. Because construction emissions would be temporary, relatively small, and operations would replace fossil fuels with renewable energy, impacts to air quality are not expected to be significant.

HCP measures: Minor adverse impacts from vehicle exhaust associated with seabird, waterbird, and bat mitigation.</td><td>Same impacts as Alternative 1, plus 0.006 acres of additional disturbance with associated fugitive dust and other emissions.</td><td>No change in existing conditions and no impacts to air quality, including long-term beneficial air quality impacts of fossil fuel alternatives.</td></tr>
<tr><td>Geology, Topography, and Soils</td><td>Construction would disturb approximately 335.1 acres, of which approximately 21.7 acres would be within the permanent project footprint. Impacts to major topographic features (including the gullies and streams) would be avoided. During operation, minimal grading would occur. No significant impacts are expected.

HCP measures: Minor adverse impacts to topography and soil resources due to trampling during monitoring, removal of invasive vegetation, and fence construction. In the long-term, wetland/forest restoration and and ungulate control would benefit soils.</td><td>Same impacts as Alternative 1, plus 0.006 acres of additional ground disturbance.</td><td>No change in existing conditions and no impacts to geology, soils, or geologic hazards.</td></tr>
<tr><td>Hydrology and Water Resources</td><td colspan="2">Construction would result in no direct interaction with groundwater and surface water features have been generally excluded from the project footprint, except where water features intersect existing onsite roads; these are generally culverted and road improvements would be conducted to avoid impacts. One unculverted crossing would be impacted by limited repair and maintenance within the existing footprint of the road. Increased sediment and other pollutants in stormwater runoff could affect water quality in receiving waters. Following construction, all temporarily disturbed areas would be revegetated to stabilize exposed soils, and the onsite roadways would be maintained with gravel surfaces and rock-lined swales. No significant impacts are expected.

HCP measures: Monitoring, fencing, ungulate control, predator control, and weed control may impact hydrology and water resources but no significant impacts are expected.</td><td>No change in existing conditions and no impacts to water resources.</td></tr>
<tr><td>Biological Resources (Flora)</td><td>Approximately 335.1 acres (21.7 acres in the permanent project footprint) of predominantly non-native, common species would be adversely impacted. No</td><td>Same impacts as Alternative 1, plus 0.006</td><td>No change in existing conditions and no</td></tr>
</table>

Resource	Proposed Action (Alternative 1)	Communications Site Layout (Alternative 2)	No Action (Alternative 3)
	State or Federally listed threatened, endangered, or candidate plant species occur within the wind farm site, and no wind farm site areas have been designated as critical habitat for listed plant species. At the Mt. Kaala sites, nine plant species have critical habitat designations (but are those species are not present at the site and existing infrastructure at Mount Kaala is excluded from critical habitat designation). No ground disturbance would occur at the Mt. Kaala sites, but limited vegetation trimming may be required. During operations, vegetation clearing would occur in designated areas. No significant impacts are expected. HCP measures: Trampling during monitoring and fencing construction would create minor adverse short-term impacts but in the long-term provide beneficial impacts to native vegetation through invasive species management, wetland/forest restoration, and ungulate control.	acres of additional vegetation disturbance.	impacts to botanical resources.
Biological Resources (Fauna)	Impacts associated with construction and operations to non-listed species and species not covered by the HCP are expected to be minor and adverse. At the Mt. Kaala communication sites, no impacts are expected to *Achatinella* species, *Drosophila substenoptera*, or Oahu elepaio. Incidental take of Federally and/or State listed species could occur as a result of collision with the turbines, equipment, vehicles, and other project components during construction and operations. Seven listed species could be impacted; these include: Newell's shearwater, Hawaiian duck, Hawaiian stilt, Hawaiian coot, Hawaiian moorhen, Hawaiian short-eared owl, and Hawaiian hoary bat. With the mitigation measures proposed by the HCP, impacts to listed species are not expected to be significant. HCP measures: Non-listed species- Avoidance and minimization measures will reduce collision risk with project components for wildlife and avoid impacts to mollusks and introduction of new species of ants at the off-site antennae locations. Fencing, ungulate control, and predator control associated with seabird, waterbird, bats, and owl mitigation could adversely impact non-listed non-native fauna. Listed non-covered species- No impacts are expected to *Achatinella* species, *Drosophila substenoptera*, or Oahu elepaio. Newell's Shearwater- Avoidance and minimization measures would minimize collision risk of seabirds. Mitigation at Tier 1 (self-resetting cat traps) is expected to yield improvements in protection, reproductive success and survival of the species. Mitigation at Tier 2 (translocation protocol and/or restoration fund) is expected to increase the population and range of the species.	Same impacts as Alternative 1, plus 0.006 acres of additional vegetation disturbance. If *Achatinella* species are detected at the location of the proposed Mt. Kaala sites, the towers would not be erected.	No change (net gain or loss) in existing conditions and no adverse impacts to wildlife from project construction or operations. No beneficial impacts from mitigation, such as habitat improvements and research knowledge.

Resource	Proposed Action (Alternative 1)	Communications Site Layout (Alternative 2)	No Action (Alternative 3)
	Hawaiian Duck- Avoidance and minimization measures are likely to minimize collision risk of waterbirds. Removal of feral ducks, mallards, and Hawaiian duck hybrids at Ukoa Pond will prevent the continued dilution of the Hawaiian duck gene pool. Wetland restoration, fencing, and predator control at the pond is also expected to protect any pure Hawaiian ducks that may utilize the pond in the future. Hawaiian Stilt, Hawaiin Coot, and Hawaiian Moorhen- Avoidance and minimization measures are likely to minimize collision risk of waterbirds and waterbird disturbance while conducting waterbird mitigation measures. Predator exclusion and eradication, weed control, and monitoring at Ukoa Pond are expected to increase species productivity. Predator trapping poses some risk of capture to Hawaiian moorhens but overall increased productivity and beneficial effects. Hawaiian Hoary Bat- Low wind speed curtailment will be implemented at night as an avoidance and minimization measure benefitting bats. Tree clearing timing and a barbless wire fence design will also avoid and minimize impacts. Wetland or forest habitat restoration is expected to increase and improve bat foraging and roosting habitat which will lead to increased survival and productivity of the species.		
Historical, Archaeological, and Cultural Resources	Seventeen historic period archaeological sites were identified within the wind farm site project footprint. Three sites meet two significance criteria. Impacts to these sites would be avoided and no significant impacts are expected. No archaeological or historic resources are known to occur at the Mt. Kaala communication sites. HCP measures: Impacts will be avoided.		No change in existing conditions and no impacts to historical, cultural, or archaeological resources.
Visual Resources	During construction, equipment and project components (during transport and assembly) would be visible, creating minor and short-term adverse impacts. Once operational, the most visible component of the project would be the 30 turbines. Although the turbines would be visible from several locations outside the project area, in many cases views would be mitigated by distance from populated areas and avoided due to vegetation, existing structures, and topographical features as described in the line-of-sight analysis. Installation of the equipment at the Mt. Kaala sites would not be readily visible from public vantage points, except the Mt. Kaala summit access road and nearby hiking trails; however, the equipment is visually consistent with the existing communication facilities. HCP measures: The marking of guy wires to reduce bird collisions may make these structures more visible, but these structures are not adjacent to populated areas and the visual impact of these structures is likely to be insignificant. Only the construction of fences and fence corridors for waterbirds (and possibly bat mitigation) have the potential to have visual impacts. However, a portion of the Ukoa Pond fenceline (the mitigation site for waterbirds and possibly bats) could be visible from the Kamehameha		No change in existing conditions and no impacts to visual resources.

Resource	Proposed Action (Alternative 1)	Communications Site Layout (Alternative 2)	No Action (Alternative 3)
	highway. However, an existing fence is already present and the construction of the new fence (while removing the old one) would not add to the existing visual landscape.		
Noise	Construction would produce short-term adverse noise impacts associated with graders, excavators, trucks, and other heavy equipment. At the Mt. Kaala sites, installation would involve trucks and a helicopter to transport the components and necessary tools to the site. Noise generated by these activities and would be intermittent and very short in duration. During operations, the only project component expected to generate sound on a regular basis would be the wind turbines. Turbine noise would not be expected to exceed the HDOH maximum permissible noise limits in areas zoned for agriculture. Noise levels would likely exceed the limits where the project site borders preservation land, and may require a variance. Turbine noise is expected to increase the ambient sound levels by less than 3 decibels at Waimea Valley, which is the nearest sensitive receptor. During days, modeling results indicate that turbine sounds would be completely masked by ambient noise sources; at night, turbine sounds are expected to be just barely perceptible at Waimea Valley. Noise from the turbines is expected to be less than the ambient levels measured in the communities surrounding the project site and would not likely be audible at these locations. Operation of the equipment at the Mt. Kaala communication sites would not be expected to generate any noticeable noise. Given these considerations, no significant impacts are expected. HCP measures: Noise associated with monitoring and mitigation would be of short duration and low intensity and is not anticipated to significantly increase noise levels at the site.		No change in existing conditions and no noise impacts.
Land Use	No impacts to current agricultural operations are anticipated. Approximately 21.7 acres are within the permanent project footprint, and would no longer be available for agricultural purposes; however, given the amount of land available for cultivation in this area, this is not expected to significantly affect future agricultural production. The unused areas surrounding the wind farm components are currently being fenced for pasture by Kamehameha Schools, and will be actively grazed. As such, the proposed project is not expected to have more than a minimal adverse impact on agricultural production. Land use at Mt. Kaala sites are for communication facilities and therefore no adverse impact would occur. No significant impacts are expected. HCP measures: For mitigation occurring at Ukoa Pond, former ranching that occurred in the area would no longer be allowed if restoration and fencing of the wetland occurs. Ranching would no longer be allowed at the entire 150 acres of wetland and possibly up to 80 acres of forest in the periphery of the pond may also be fenced off and restored.		No change in existing conditions and no impacts to land use.
Transportation and Traffic	The major components would be offloaded at Kalaeloa Harbor are not expected to adversely impact harbor facilities. The proposed state and county routes for the delivery of project components have been evaluated and the existing infrastructure is expected to be of sufficient capacity and dimension to accommodate the oversized loads. Potential impacts include traffic delays and delays in emergency services caused by periods where traffic flow must be stopped to allow oversized trailers to navigate turns. Police escorts and transport of large components when local traffic is typically light would mitigate these impacts. Other traffic would be associated with delivery of other project-related equipment and employee trips. These activities would increase traffic levels during project construction, but in general, the impacts would be short-term and localized in nature. The amount of vehicular traffic during operation		No change in existing conditions and no impacts to transportation and traffic.

Resource	Proposed Action (Alternative 1)	Communications Site Layout (Alternative 2)	No Action (Alternative 3)
	would be minimal and the proposed project is not anticipated to noticeably increase traffic volumes on Kamehameha Highway or roadways in the area over the long-term. No significant impacts are expected. HCP measures: Vehicles and vehicular trips required for monitoring and implementation of mitigation measures would involve too few vehicle trips (weekly to monthly trips) to significantly impact transportation and traffic.		
Military Operations	Construction-related impacts to military operations and training include a safety risk from the construction crane to helicopters operating in the low-level training area. Impacts during operations include: various helicopter and flight zone safety risks and the functional impairment of some security and navigation equipment. No significant impacts are expected. HCP measures: No impacts.		No change in existing conditions and no impacts to military operations.
Hazardous Substances and Materials	Construction would involve the use, transportation, or storage of small amounts of several hazardous materials that require special handling and storage. At the Mt. Kaala communications sites, an underground storage tank release was previously reported but no impacts are expected during construction. Operations would require onsite use and storage of several materials that require special handling. No significant impacts are expected. HCP measures: Fuel would be used to transport staff and equipment to the mitigation sites and fuel may be used to carry out mitigation measures. Herbicides may be used as part of vegetation control. Monitoring and implementation of mitigation measures is not expected to result in any significant impacts.		No change in existing conditions and no impacts from hazardous substances and materials.
Socioeconomic Characteristics	Potentially beneficial effects of the proposed project include increased employment, business activity, and lease and tax revenue. During the construction phase, Kawailoa Wind Power may employ an average of 75 people per day, with an anticipated maximum level of 129 employees. The project is not expected to result in new residents moving to the area due to increased energy availability and would therefore not be considered growth inducing. Operation would result in employing a regular staff of approximately eight people and generating ongoing expenditures for materials and outside services. No disproportionate adverse health or environmental impacts would occur to any low-income or minority population. No significant impacts are expected. HCP measures: The implementation of mitigation measures will likely result in the hiring of local contractors or subcontractors. These may be long-term or short-term employments. Overall, mitigation measures may have a small positive effect on the socioeconomics of Oahu. No impact (beneficial or adverse) is expected for minorities or low-income persons.		No change in existing conditions and no impacts to socioeconomic conditions including beneficial impacts of employment.
Natural Hazards	Neither construction nor operation of the proposed project is expected to impact the incidence rate of a natural hazard, with the exception of an increased potential for wildfires associated with use of vehicles and electrical equipment. The wind farm site would be supported by an external fire hydrant, supplied by onsite water tanks. No significant impacts are expected. HCP measures: No impact.		No change in existing conditions and no impacts to natural hazards.

Resource	Proposed Action (Alternative 1)	Communications Site Layout (Alternative 2)	No Action (Alternative 3)
Public Safety	The wind farm (including communication towers) is more than one mile from the nearest residence and is not publicly accessible. As such, the unlikely event of an accidental fire, tower collapse, blade throw, shadow flicker, stray voltage, or lightning impacting public safety is minimal. No significant impacts are expected. HCP measures: Measures would not have adverse impacts on public safety. Fencing and the eradication/control of ungulates and introduced mammals are likely to improve the safety of the mitigation site when accessed by people.		No change in existing conditions and no impacts to public safety.
Public Infrastructure and Services	Project activities would not adversely impact utilities or public services during construction or operations due to the use of onsite facilities and minimal staffing. Therefore, no significant impacts are expected. HCP measures: No impact.		No change in existing conditions and no impacts to public infrastructure and services.
Cumulative Impacts	The cumulative contribution of impacts of the Proposed Action varies from beneficial to adverse and negligible, depending on the resource. As discussed in Section 4.18.1, beneficial impacts would occur to these resources: Climate, Socioeconomics, and Public Infrastructure and Services. Adverse or negligible impacts would occur to these resources: Air Quality, Geology, Topography, and Soils, Hydrology and Water Resources, Biological Resources, Historical, Archaeological, and Cultural Resources, Visual Resources, Noise, Land Use, Transportation and Traffic, Military Operations, Hazardous Substances and Materials, Natural Hazards, Public Safety. HCP measures: Cumulative adverse impacts may occur, though the proposed mitigation is expected to more than offset the anticipated take and provide a net benefit to Covered Species.		No cumulative impacts.

ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
AG	Attorney General
ALISH	Agricultural Lands of Importance to the State of Hawaii
APE	area of potential effects
AWEA	American Wind Energy Association
BA	biological assessment
BCR	Bird Conservation Region
BESS	Battery Energy Storage System
BLNR	Board of Land and Natural Resources
BMPs	Best Management Practices
BO	biological opinion
CAA	Clean Air Act
CDP	Census Designated Place
CDUP	Conservation District Use Permit
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CUP-M	Conditional Use Permit-Minor
CWA	Clean Water Act
CZM	Coastal Zone Management
DBEDT	Department of Business, Economic Development, and Tourism
DEIS	Draft Environmental Impact Statement
DLNR	Department of Land and Natural Resources
DOA	Department of Agriculture
DOD	Department of Defense
DOE	Department of Energy
DOFAW	Department of Forestry and Wildlife
DOH	Department of Health
DOT	Department of Transportation
DPP	Department of Planning and Permitting
EA	Environmental Assessment
EF	emission factors
EHSD	Environmental Health Service Division
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EPA	Environmental Protection Agency
EPO	Environmental Planning Office
ESA	Endangered Species Act
ESRC	Endangered Species Recovery Committee
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FONSI	Finding of No Significant Impact
GHG	greenhouse gas
HAR	Hawaii Administrative Rules
HC	hydrocarbons
HCEI	Hawaii Clean Energy Initiative
HCP	Habitat Conservation Plan
HECO	Hawaiian Electric Company, Inc.
Hg	mercury
HIOSH	Hawaii Occupational Safety and Health
HRS	Hawaii Revised Statutes
IPCC	Intergovernmental Panel on Climate Change

IRS	Interconnection Requirement Study
ITL	Incidental Take License
JUCC	Joint Use Coordination Committee
KOP	Key Observation Point
kV	kilovolt
KWP	Kaheawa Wind Power
MBTA	Migratory Bird Treaty Act
mg/l Cl^-	milligrams per liter chloride
MOU	Memorandum of Understanding
mph	miles per hour
MW	megawatt
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_X	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NSSCP	North Shore Sustainable Communities Plan
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O&M	operations and maintenance
O_3	ozone
OCCL	Office of Conservation and Coastal Lands
OISC	Oahu Invasive Species Committee
OHA	Office of Hawaiian Affairs
OSHA	Occupational Safety and Health Administration
PCE	Primary Constituent Element
Phase I ESA	Phase I Environmental Site Assessment
PM_{10}	particulate matter smaller than 10 microns
$PM_{2.5}$	particulate matter smaller than 2.5 microns
POI	Point of interconnection
PPA	Power Purchasing Agreement
RCRA	Resource Conservation and Recovery Act
rpm	revolutions per minute
RSZ	Rotor Swept Zone
SARA	Superfund Amendment Reauthorization Act
SCADA	Supervisory Command and Data Acquisition
SCP	Sustainable Communities Plan
SHA	Safe Harbor Agreement
SHPD	State Historic Preservation Division
SHPO	State Historic Preservation Officer
SMA	Special Management Areas
SO_2	sulfur dioxide
SO_X	sulfur oxides
SPCC	Spill Prevention, Countermeasure, and Control
TMK	Tax Map Key
TSCA	Toxic Substances Control Act
U. S.	United States
USACE	U. S. Army Corps of Engineers
USDA	U. S. Department of Agriculture
USFWS	U. S. Fish and Wildlife Service
USGS	U. S. Geological Survey
UST	underground storage tank
WEOP	wildlife education and observation program
WTG	wind turbine generator

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CHAPTER 1: INTRODUCTION

1.1 Proposed Development and Location

Kawailoa Wind Power LLC (Kawailoa Wind Power or the "Applicant") is proposing to develop a new 70-megawatt (MW) wind energy generation facility within the Kawailoa Plantation in the northern portion of the Island of Oahu, Hawaii (Figure 1-1). The proposed project is situated east of Haleiwa Town and south of Waimea Valley in the District of Waialua. It is bounded on all sides by agricultural lands. The western portion abuts residences makai (seaward) of Kamehameha Highway and military training land is present east of the property. All parcels are owned by Kamehameha Schools and designated as an Agricultural District. The primary access road is Kawailoa Road off Kamehameha Highway (Hwy 83). Temporary construction disturbance would occur on 335.1 acres within the approximately 4,200 acre project area with 21.7 acres of permanent disturbance. The project may also include installation, operation, and maintenance of communication equipment at two existing Hawaiian Telcom facilities near the summit of Mt. Kaala.

The proposed project consists of construction of 30 Siemens 2.3-MW wind turbine generators (WTGs), electrical collector lines, an electrical substation, a possible Battery Energy Storage System (BESS)[1], two interconnection facilities, two communication towers, an operations and maintenance (O&M) building and laydown areas, meteorological (met) monitoring equipment, onsite access roads and the implementation of the HCP. The project may also include installation, operation, and maintenance of up to four microwave dish antennae on two existing Hawaiian Telcom facilities near the summit of Mt. Kaala. The communication equipment would provide a link between the wind farm and the existing Hawaiian Electric Company (HECO) substations that would be receiving the power.[2] The site layout for the proposed project is shown in Figure 1-1 and 1-2.

1.2 Purpose and Need for Action

The U. S. Fish and Wildlife Service is reviewing a voluntarily permit application from Kawailoa Wind Power for an Incidental Take Permit (ITP) under Section 10(a)(1)(B) of the Endangered Species Act (ESA). This permit is being sought to authorize the incidental take of six 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 stilt or aeo (*Himantopus mexicanus knudseni*), Hawaiian coot or alae keokeo (*Fulica alai*), Hawaiian duck or koloa maoli (*Anas wyvilliana*), Hawaiian moorhen or alae ula (*Gallinula chloropus sandvicensis*), Newell's shearwater or ao (*Puffinus auricularis newelli*), and Hawaiian hoary bat or opeapea (*Lasiurus cinereus semotus*). Hereafter, these six federally-listed species and the one state-listed species, the short-eared owl (*Asio flammeus sandwichensis*), are collectively referred to as the "Covered Species." If granted, an ITP would authorize the incidental take of the six federally listed species identified above during construction and operation of the Kawailoa facility. Kawailoa Wind Power 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 six federally listed species, as well as one state-listed endangered species, the Hawaiian short-eared owl or pueo. The ITL is issued by the State Department of Land and Natural Resources (DLNR).

1.2.1 Purpose of the Proposed Action for the USFWS

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

[1] Based on an analysis of their system requirements, HECO has recently indicated that a BESS may or may not be required for integration of wind-generated power into the existing electrical grid. The specific requirements will be determined through ongoing coordination between Kawailoa Wind and HECO, but a BESS has been included as part of the Proposed Action in this EIS to allow for analysis of the maximum extent of potential impacts.

[2] HECO has also indicated that the communication equipment may or may not be required for integration into the existing electrical grid. Similar to the BESS, the communication equipment has been included as part of the Proposed Action in this EIS to allow for analysis of the maximum extent of potential impacts.

- Respond to Kawailoa Wind Power'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;

Figure 1-1. Kawailoa Wind Power Location and Site Layout.

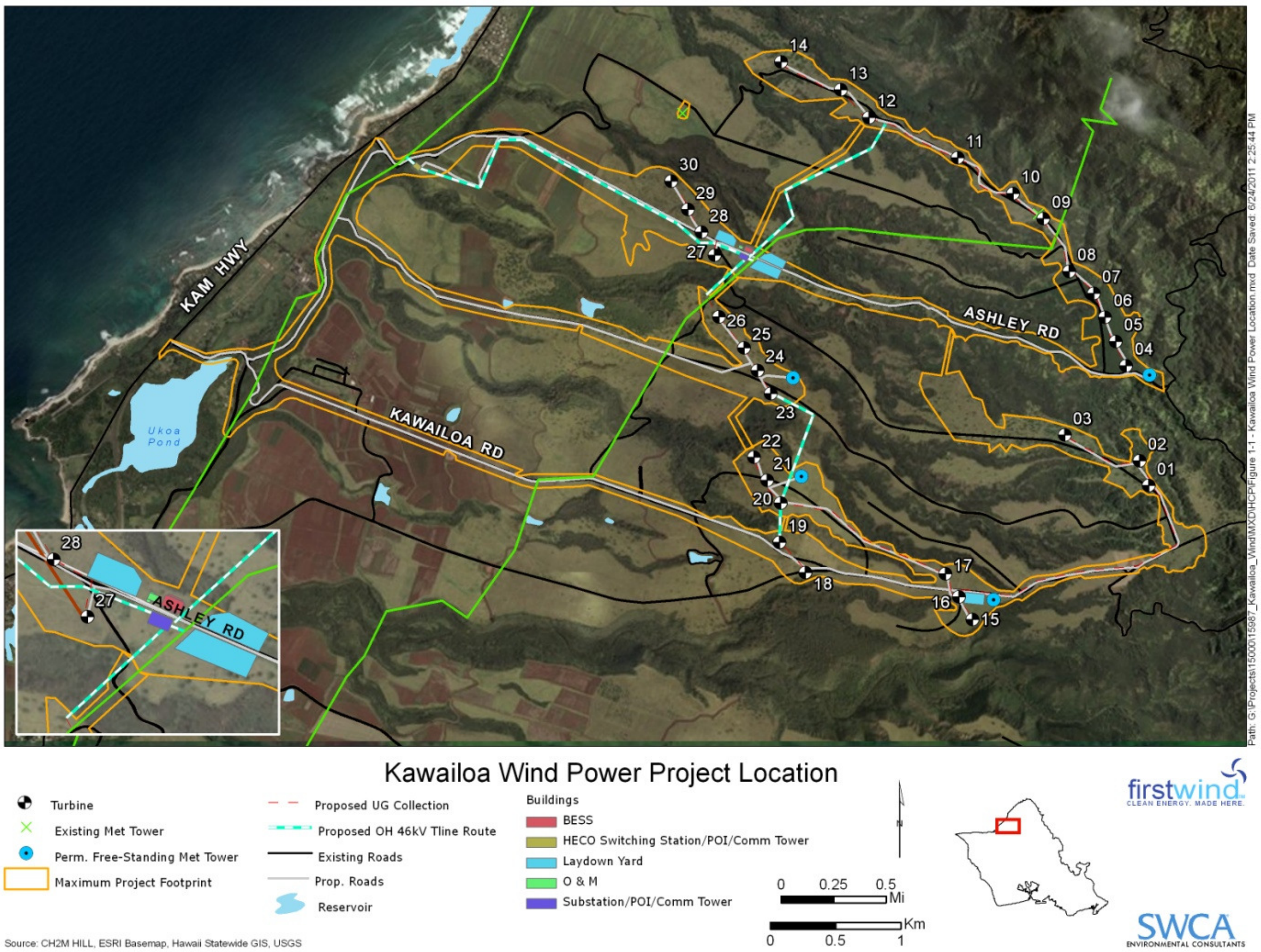
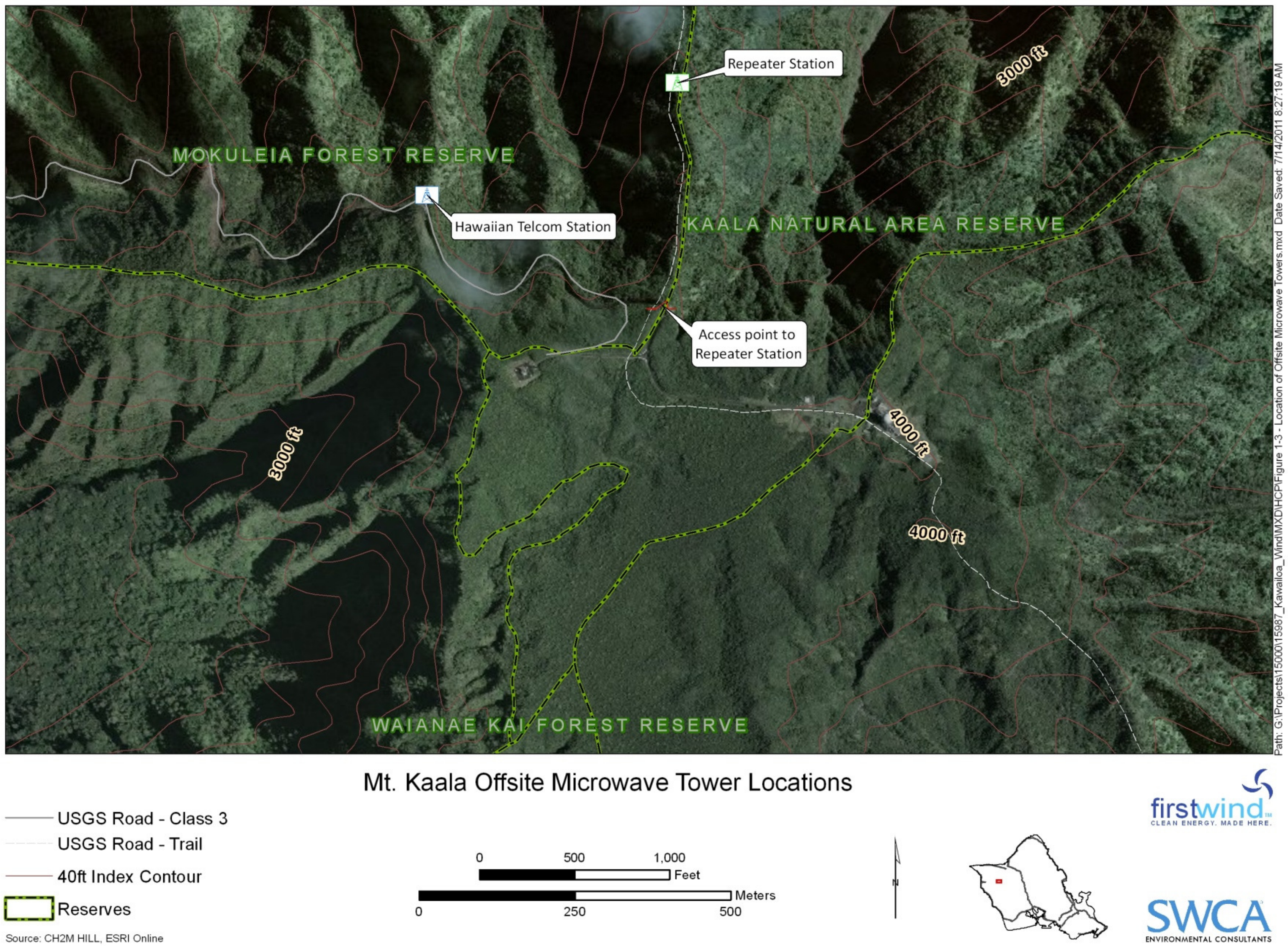


Figure 1-2. Location of Offsite Communication Towers.



- 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.

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 Kawailoa Wind Power's Proposed Action (Alternative 1), the Alternative Communications Site Layout (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 would 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 would issue the ITP. In such case, the USFWS would 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, and the covered activities are summarized below to assist the reviewer by adding additional context for the Kawailoa Wind Power HCP. Section 4.10.1.2 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 five 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 Kawailoa Wind Power, the terms and conditions of that ITP would also constitute a Special Purpose Permit under 50 CFR 21.27 and any take of the 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. Kawailoa Wind Power 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.

Because the project is being permitted pursuant to the State's HRS Chapter 201N Energy Facility Siting Process, an EIS is being prepared for the project with the Department of Business, Economic Development and Tourism (DBEDT) as the accepting authority. An EIS Preparation Notice (EISPN) was released for public comment on September 23, 2010. Following the end of the 30-day public review period for the EISPN, Kawailoa Wind Power addressed comments on the EISPN in the DEIS which discussed the likely direct, indirect, and cumulative impacts of the proposed project, as well as mitigation measures. The DEIS was released on February 23, 2010 and the public comment period lasted for 45-days as provided by law. The Final EIS (FEIS) incorporated and responded to all the comments on the DEIS and was submitted to DBEDT for review and accepted on June 27, 2011.

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.

Most of the Kawailoa Wind Power project area is designated as an Agricultural District; however, portions of some of the parcels are designated as General and Limited subzones of the State Conservation District. The mauka (inland) portion of the project area is also designated as Conservation. Both of the proposed offsite communication towers are located on Conservation District land. 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). Kawailoa Wind Power is required to obtain a Conservation District Use Permit (CDUP) from the Office of Conservation and Coastal Lands (OCCL) to operate in a Conservation District.

1.3.2.5 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 feet from the shoreline. The proposed project area is not located within a SMA, although SMAs do occur along portions of the project boundaries. The project may require a SMA permit (CH2M Hill 2011b).

1.3.2.6 City and County of Honolulu General Plan

The General Plan for the City and County of Honolulu, revised in 1992, is a comprehensive document with long-range social, economic, environmental, and design objectives, as well as broad policies to facilitate the attainment of those objectives. The General Plan is divided into 11 subject areas including population, economic activity, the natural environment, housing, transportation and utilities, energy, physical development and urban design, public safety, health and education, culture and recreation, and government operations and fiscal management (DPP 2006). The General Plan designated the North Shore as a rural area and specifies that agricultural lands along in the area be maintained for diversified agriculture.

1.3.2.7 Community Plans

The county is divided into eight regional areas that are guided by Development Plans or Sustainable Communities Plans (SCP). Kawailoa is located in the North Shore Sustainable Communities Plan (NSSCP) area. The area is bounded on the west by Kaena Point, on the east by Waialee Gulch near Kawela Bay in the east, and the north by Oahu's shoreline, and on the south by Helemano and the slopes of the Waianae and Koolau Mountain Ranges. The plan area includes the country towns of Haleiwa and Waialua and the rural residential communities of Mokuleiia, Kawailoa, and Sunset/ Pupukea. In cooperation of the General Plan, the NSSCP is designed to guide public policy, investment, and decision-making over a 20-year period. The Plan states that the role of the NSSCP area is "to maintain the rural character, agricultural lands, open space, natural environment, recreational resources and scenic beauty of Oahu's northern coast, in contrast to more urbanized areas of Oahu …"(Helber Hastert & Fee Planners 2009). Land use maps within the NSSCP area depict the project area as Agriculture (Helber Hastert & Fee Planners 2009).

1.3.2.8 County Zoning

Land use on Oahu is also dictated by the Land Use Ordinance from the City and County. The City and County of Honolulu zoning ordinance defines the project area as AG-1 Restrict Agricultural District. Adjoining land is also zoned AG-1 Restricted or AG-2 General. The AG-1 designation is intended to preserve "important agricultural lands" for agricultural functions, such as the production of food, feed, forage, fiber crops and horticultural plants (City and County of Honolulu, Land Use Ordinance, Chapter 21). A wind energy project is permitted in this zoning area with acquisition of a Conditional Use Permit (City and County of Honolulu, Land Use Ordinance, Chapter 21, Section 5.700). Because turbine foundations physically occupy only a small fraction of the project area's land area, development of wind energy is generally considered compatible with some agricultural uses, such as grazing (Global Energy Concepts LLC 2006). The offsite communication towers site is zoned as P-1 Preservation District by the City and County of Honolulu. Further information on land use policies and plans will be provided in the State DEIS (CH2M Hill 2011b).

Four temporary 197 feet guy wire-supported met towers were installed in the project area between August and December 2009 to collect wind resource data. In order to construct these structures, the project was granted a Temporary Use Approval by the City and County of Honolulu's Department of Planning and Permitting (DPP) in August 10, 2008, September 18, 2009, and April 21, 2010.

1.3.2.9 Hawaii Agricultural Land Use Map (ALUM)

Agricultural land use designations have been developed for Hawaii. The State of Hawaii Agricultural Land Use Map (ALUM) depicts the majority of the project area as sugarcane. Smaller areas are classified as Dairy and Grazing land. The remainder of the project area is not classified within the ALUM. Neither of the communication tower sites is classified by ALUM.

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 project would be located in soils classified as Categories B, C, D, and E. Turbine and tower facilities would be distributed as follows: 15 of the turbines and one meteorological tower would be located in B soils, 8 turbines and one meteorological tower would be located in C soils, and 7 turbines and two meteorological would be located in D soils. Other facilities associated with the project may be located in soils classified as Categories B, C, D, or E. Although Class B rated soils exist in the project area, wind energy facilities are permitted uses on agricultural areas, per HRS Chapter 205-4.5. The offsite communication tower sites are classified as E rated soils.

1.3.2.11 Agricultural Lands of Importance to the State of Hawaii's

The State Department of Agriculture's Agricultural Lands of Importance to the State of Hawaii (ALISH) system also ranks areas based on soil agricultural suitability. Designed to inventory prime farmlands, the system divides agricultural lands into three classes (Unique, Prime, and Other). Prime agricultural land is defined as land with soil temperature, soil pH, moisture supply, and growing season needed to produce high yields of crops when treated and managed according to modern farming methods. The Other designation refers to land that is important to agriculture, but lacks properties to be Prime or Unique; this land usually has slopes less than 35% and has been used or could be used for grazing. A large portion of the project area is located on land classified under the ALISH system as prime agricultural land. Neither of the communication tower sites is classified by ALISH.

1.4 Public Involvement and Agency Coordination

Under the USFWS's NEPA implementing procedures, public scoping is not required to prepare an EA. However, public scoping 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 EISPN which was released on September 23, 2010. The 30-day comment period was held from September 23 to October 23, 2010. Subsequently, a DEIS was released to the public on February 23, 2011 for a 45-day comment period (CH2M Hill 2011a). Feedback and comments on the proposed project were incorporated into the FEIS, which was submitted to DBEDT for review and accepted on June 27, 2011 (CH2M Hill 2011b).

The State HCP process also provides the opportunity for public involvement. The Draft HCP will be made available from the State Office of Environmental Quality Control (OEQC) during the fall of 2011. The Final State HCP will be reviewed by ESRC and, if approved, issuance of ITL is expected concurrently with the Federal ITP.

Furthermore, Kawailoa Wind Power also conducted community outreach to discuss wind power at Kawailoa through meetings and site visits with members of the public, including representatives of the community. These meetings provided Kawailoa Wind Power with the opportunity to incorporate feedback into the project design and mitigation measures. Details of these outreach efforts are available in the State EIS (CH2M Hill 2011b).

Kawailoa Wind Power 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 on: September 16, 2010 and December 6, 2011. ESRC visited the site on December 7, 2010. Consultations with USFWS and DOFAW occurred on October 4, 2010, January20, 2011, March 4, 2011, April 20, 2011, June 7,2011, June 13, 2011, to discuss and address comments on the proposed take levels, avoidance and minimization, mitigation measures and monitoring protocols. A draft HCP prepared by Kawailoa Wind Power and their consultant (SWCA Environmental Consulting) was submitted for review to DOFAW and USFWS on November 6, 2010. DOFAW and USFWS comments on the draft HCP were received on January 18, 2011. These comments were addressed in subsequent drafts presented on March 8, 2011 and March 23, 2011. Additional meetings with USFWS only were held on June 27, 2011. USFWS prepared the draft Environmental Assessment. The draft Habitat Conservation Plan and Environmental Assessment were published in the Federal Register on August 24, 2011, and the public comment period closed on October 11, 2011. ESRC was consulted on Septermber 7, 2011 and October 21, 2011 for comments on the HCP.

CHAPTER 2: ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter identifies and describes the Proposed Action 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 Project Locations, Alternate Siting Areas at Kawailoa, Greater or Fewer Number of WTGs, and Alternative WTG Size or Design. Only impacts anticipated as a result of the Proposed Action (Alternative 1), Communications Site Layout Alternative (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.

2.1 Alternative 1 (Proposed Action)

2.1.1 Construction and Operation of Kawailoa Wind Power Facility

The Proposed Action is the issuance of an ITP and approval of an HCP for the Kawailoa Wind Power facility to authorize the potential incidental take of six federally listed threatened and endangered species and one state-listed endangered species during the development, construction, and operation of Kawailoa Wind Power, and to adequately avoid, minimize, and mitigate the anticipated incidental take.

If the required land use approvals and environmental permits are granted, Kawailoa Wind Power would:

- Land Use Agreement: Obtain a lease from the Kamehameha Schools for approximately 4,200 acre of land within the former Kawailoa Plantation. Kawailoa Wind Power is also applying for a license agreement with Hawaiian Telcom and will coordinate with the State of Hawaii Division of Land and Natural Resources Land Division for use of lands at the proposed Mt. Kaala communication sites.

- Road Network: Upgrade existing cane haul roads and create new internal service roads, as needed, to connect to the WTGs, other project components, and to Kawailoa Road (which would serve as the primary access road). The proposed new roads would be approximately 40 feet wide, of which only 16 to 20 feet would be graveled; the remainder of the road would be earthen. Approximately 4.3 miles of existing access roads would be widened and 6.8 miles of access roads would be constructed.

- WTG Sites: Install30 Siemens SWT-2.3-101 turbines. The turbines would be arranged in several arrays along the northeastern and southeastern boundaries of the project area (Figure 1-2). Each turbine site would consist of a turbine pad, pad-mounted transformer, power distribution panel, turbine tower and rotor, and gravel access drive and buffer area. An area roughly 135 feet in radius surrounding each turbine site would be temporarily disturbed during construction of the turbine components. A gravel perimeter would be provided around each foundation at the completion of construction to facilitate access and maintenance. Disturbed areas outside the gravel perimeter would be revegetated to stabilize the soil. In addition, a 429,285 square-foot area (9.9 acres based on 75% of 493 foot tower height) around each turbine would be maintained in a mowed condition for the life of the project in order to facilitate detection of downed wildlife. The poured concrete foundation for each tower is approximately 46 square feet.

  The towers proposed for the project are approximately 328 feet in height. The proposed rotor has a diameter of 332 feet, and when the blade is at the top of its arc, the maximum height of the structure is 493 feet from ground elevation.

- Meteorological Monitoring Towers: Before construction, up to six new 328-foot meteorological towers would be installed for the calibration of the wind farm equipment. Four of these towers would be temporarily installed within the work areas for the wind turbines, and would be removed after an initial calibration period of approximately 3 to 4 months. The other two towers would be installed in a subset of the four potential locations, and would be used for ongoing data collection and certification of the wind turbines over the operational life of the project. Each would be an unguyed lattice tower, approximately 328 feet in height, with a 35-foot-by-35-foot concrete foundation.

Table 2-1. Characteristics of Siemens SWT-2.3-101 Turbine.

Description	Measurement
Power Generation	2,300 kilowatts (2.3 MW)
Tower Height	328 feet (100 meters)
Rotor Diameter	332 feet (101 meters)
Total Height (Tower + ½ Rotor)	493 feet (150.5 meters)
Rotor Swept Area	8,000 square meters
Rotor Speed	6 – 16 rotations per minute
Minimum Operational Wind Speed	4 m/s (8 mph)
Maximum Operational Wind Speed	25 m/s (55 mph)

NOTES: kW = kilowatt, m/s = meters per second, mph = miles per hour

Electrical Collection System: Electrical power generated by the turbines would be transmitted to a transformer located at the base of each tower, where the voltage would be increase from 690 V to 23 kV. The 23 kV power would be carried from each turbine to an onsite substation via an electrical collector system, comprised of a network of underground and overhead collection circuits. In general, most of the collector lines would be located underground along the access roads; in general, only those lines that cross gulches would be located overhead.[3] The overhead lines would be installed on 45-foot-high wooden poles, typically spaced at 200- to 300-foot intervals. The underground lines would be direct-buried in trenches, each approximately 3 feet wide and 4 feet deep; once backfilled, these areas would be hydromulched to stabilize the soil and facilitate revegetation. The collector system lines would also accommodate fiber optic cable to facilitate communication between the individual turbines and other project components. The electrical collector cables would be routinely monitored, inspected, and maintained by qualified personnel and maintenance technicians over the lifetime of the project. These activities would be accomplished with small trucks; heavy construction or excavation equipment would only be required if an underground cable needed replacement.

Electrical Substations: An electrical substation would transform the voltage of electricity to allow integration into the existing 46 kV HECO sub-transmission system. Two HECO sub-transmission lines currently cross the site: the Waialua-Kuilima and Waialua-Kahuku 46 kV sub-transmission lines. These lines each have an available transmission capacity of 50 MW and 20 MW, respectively. It is anticipated that the substation would be located along Ashley Road, near the Waialua-Kuilima sub-transmission line. One set of overhead 46 kV connector lines would be constructed from the substation to the interconnection facility and POI (point of interconnection) for the Waialua-Kuilima line, which would be located just east of the substation. A second set of overhead 46 kV connector lines would run from the substation, west along Ashley Road to the interconnection facility and POI for the Waialua-Kahuku line sub-transmission line. These higher-voltage connector lines would be installed on approximately 60-foot-high poles, as specified by HECO, and would be spaced at an average interval of approximately 250 to 350 feet. Both lines may also accommodate fiber optic cable to facilitate communications, as well as a low-voltage secondary line to provide power to the control house at each switching station. The substation would be an open switchrack design, with free-standing steel structures up to a maximum height of approximately 50 feet. It would have a gravel base and a fully fenced perimeter, with a maximum footprint of approximately 200 feet by 300 feet, for a total area of 1.4 acres (60,000

[3]The 46kV sub-transmission lines that would deliver the wind-generated energy from the substation to the POIs would also be located overhead.

square feet). The substation would provide for the termination of the 23 kV collection lines, two 23-46 kV step-up power transformers, and connection for the 46 kV lines that would deliver the energy to the respective interconnection facilities.

BESS: Because of the technical requirements of interconnecting to the HECO system, the project may include a BESS to stabilize energy output during extreme wind fluctuations.[4] The BESS provides short-term storage (essentially charging during periods of sustained wind and discharging into the grid when the wind falls off suddenly), thereby mitigating variations in output. The BESS, if required, would be sized according to the Interconnection Requirement Study (IRS) currently being conducted by the utility, and may have a capacity of approximately 20 MW with 14 megawatt hours (MWh) of energy storage capability.

The BESS would be installed immediately adjacent to the substation and would be enclosed in a four-wall structure with an angled pitched roof, up to 25 feet in height and totaling approximately 25,000 square feet (0.6 acre) in area. The BESS enclosure would house the power cell components and electrical equipment, including control and switching panels, direct current/alternating current (DC/AC) inverters, and external pad-mounted transformers to connect to the substation.

Interconnection Facilities: Near each of the two POIs, the required interconnection facilities would be constructed to connect the 46 kV connector lines to the existing 46 kV HECO sub-transmission lines. A fenced yard would contain steel switchrack structures, ring bus, utility poles and both overhead and underground electrical lines; the construction methods would be similar to those described for the electrical substation. The yard would be a maximum of approximately 200 feet by 200 feet and surfaced with gravel. Inside the yard, a pre-fabricated control room (approximately 10 feet by 20 feet) would house equipment for controls, metering and communication, all of which are required for interconnection of the wind farm. In addition, each yard would accommodate a communication tower with up to two microwave dish antennae, as further discussed below.

O&M building: The O&M building would be a prefabricated metal building, approximately 7,000 square feet (0.16 acre) and up to 25 feet in height. It would house the wind farm management system, which monitors the performance of the overall system and the operational status and performance of individual turbines and wind monitoring equipment; an emergency back-up propane generator would be located at the facility to provide operating power for the management system in the event of a power outage. The facility would also provide for an indoor shop and a storage area for spare parts, as well as an office for the site manager and operations and environmental staff. Outdoor parking would be provided for five to eight vehicles.

Open space in the vicinity of the O&M building would be used as a lay-down area for storage of large equipment (such as spare turbine blades and gear boxes). In addition, two other areas would be temporarily used for construction laydown. Following construction, temporary laydown areas would be revegetated using a hydroseed mixture to stabilize the soil and prevent erosion. A portion of the laydown area adjacent to the O&M building would be used over the lifetime of the project for parking at the O&M building, water tank storage, and a septic system.

The project facilities have very low onsite water requirements. As a result, it is not anticipated that a direct connection to the municipal water supply system would be required. However, several water tanks would be installed in the vicinity of the O&M building; these would be periodically filled with non-potable water trucked onto the site (or obtained from the onsite irrigation ditches). One tank would supply water for plumbing for the restrooms in the O&M building; a septic tank would be used to collect the wastewater, which would be collected and transported to an appropriate wastewater treatment facility or other approved location for disposal. The other tanks would have a total capacity of approximately 60,000 gallons and would be used primarily to supply an exterior fire hydrant, as needed to meet the requirements of the City and County of Honolulu Fire Department.

[4] As previously noted, HECO has recently indicated that a BESS may not be required for integration into the existing electrical grid. However, a BESS has been included as part of the Proposed Action in this EA to allow for analysis of the maximum extent of potential impacts.

Communication equipment: Communication equipment may be installed as part of the project to provide a secure high-speed communication link between the wind farm and the HECO substations that would be receiving the power.[5] The communication equipment would include up to eight microwave dish antennas installed in four different locations. Two new towers (60 feet and 150 feet tall) would be installed at the Kawailoa wind farm site substation and at the interconnection facility near the highway. Each would have a concrete foundation approximately 144 square feet in area. Up to two antennae, approximately 11 feet in diameter, would be mounted horizontally on each tower.

The remaining antennae would be installed on existing structures at two different Hawaiian Telcom communication sites, both located on the north slope of Mt. Kaala, approximately 5 miles southwest of Waialua town. One of the sites would enable transmission to and from the existing HECO substation in Waialua; the other would enable transmission to and from the existing HECO substation in Wahiawa.

The two Hawaiian Telcom communication sites each include structures that have been in place for several decades. The first site has a small building and is adjacent to the paved access road at an elevation of approximately 3,600 feet. The building supports a metal scaffold tower and several antennae. The second site is located on an adjacent mountain ridge at an elevation of approximately 3,200 feet, and is accessed from the paved road via an existing concrete stairway and trail (approximately 0.25 mile from the paved road). This site has two metal scaffold towers, each approximately 15 feet tall, one of which supports two dish antennae. Up to two new antennae (one for receiving and one for transmitting signals) would be installed on the existing structures at each of these sites. Similar to those currently in place, each antenna would be approximately 11 feet in diameter; the antennae at the Hawaiian Telcom building would be connected via waveguide cable to existing radio equipment inside the building. The antennae to be installed at the Hawaiian Telcom building would be transported via the existing paved access road, then carried on foot; the antennae to be installed at the repeater site would be transported via helicopter to minimize vegetation trimming along the access trail. In both cases, the antennae would be mounted to the existing structures; no ground disturbance is expected at either site.

Access for radar and communications activities within the Mt. Kaala area are managed by the multi-agency Kaala Joint Use Coordination Committee (JUCC), which includes representatives from the U.S. Armed Services. A Conservation District Use Permit will also be required for the mounting of the antennae.

Onsite Access Roads: A network of roads currently exists on the Kawailoa property, most of which were designed to accommodate large cane haul trucks. These include Kawailoa Road, Cane Haul Road, Ashley Road, Mid-Line Road, and Bull's Boulevard. The site layout has been designed to focus access within the site along these roadways to the maximum extent possible. Other unnamed roads occur along or between the main onsite roads; use of these roads would generally be limited to periodic access by small construction and maintenance vehicles (for example, 4-wheel-drive pickup trucks). No improvements are planned along the unnamed roadways.

The primary access to the proposed facility would be via either Ashley Road or Kawailoa Road, both of which intersect with Kamehameha Highway. Other existing onsite roadways that would be used during construction and operation of the project are Cane Haul Road, Mid-Line Road, and Bull's Boulevard. In general, these existing roadways leading up to the turbine strings (a total of approximately 8.5 miles of roadway) are wide enough to accommodate the vehicles transporting the turbine equipment, but would require resurfacing and localized improvements to the grade and/or turning radius (for example, along the inner horseshoe turn on Kawailoa Road and segments of Cane Haul Road).

The existing roads between the turbine strings, which include Ashley Road, Mid-Line Road, and Bull's Boulevard, would require widening to approximately 40 feet. Of this width, approximately 16 to 20 feet would be a gravel surface, with 10- to 12-foot earthen shoulders on either side. This width is needed to accommodate the crawler crane used to erect the turbines; the crane would straddle the graveled portion of the road as it tracks to each turbine site. These existing roadways may also need

[5] As previously noted, HECO has recently indicated that communication equipment may not be required for integration into the existing electrical grid. However, this equipment has been included as part of the Proposed Action in this EIS to allow for analysis of the maximum extent of potential impacts.

improvements, including regrading and installation of drainage features. Widening and other improvements would be implemented along approximately 4.3 miles of existing onsite roadways.

In addition, several segments of new onsite roadway would be constructed, as needed, to connect the turbines to the existing onsite access roads. Approximately 6.8 miles of new roads would be constructed; these would also have a cleared and graded width of approximately 40 feet to accommodate the crawler crane. The road layout has been designed to avoid known cultural resources and the need for new crossings of gulches or ditches.

The roads would be cleared and graded using bulldozers and scrapers, followed by placement of gravel. Water trucks would be used as needed to apply water to minimize dust during construction. Stormwater runoff would be appropriately addressed through design features that incorporate best management practices (BMPs)[6] that minimize the quantity and water quality impacts of the runoff. Following construction, the road shoulders would be hydromulched to stabilize the soils, and a permanent road width of approximately 16 feet would be maintained. The onsite roadways would be periodically inspected over the lifetime of the project, with repair and maintenance efforts conducted as needed. It is likely that periodic maintenance consisting of surface dragging, blading, or grading would be required to remove vehicle ruts that may develop because of maintenance traffic or after periods of heavy rainfall.

[6] A best management practice (BMP) is an engineered structure, management activity, or a combination, that eliminates or reduces an adverse environmental effect of a pollutant (City and County of Honolulu 2006).

Table 2-2. Approximate Areas of Disturbance under Alternative 1.

Project Component	Quantity	Description of Area to be Disturbed (ft = feet, ft^2 = square feet)	Total Extent of Disturbance	Long-Term Vegetation Management	Permanent Footprint of Facilities
WIND FARM SITE					
Wind turbine generators	30 turbines	Wildlife search areas = 9.9 acres per turbine (370 foot radius) [a] Temporary work area = 2.9 acres per turbine (200 foot radius) Permanent foundation = 2,800 ft^2 per turbine (30 foot radius)	251.0 acres [a]	249.1 acres	1.9 acres
Electrical collector lines [b]	4.0 miles of overhead lines [c](approximately 78 poles)	Corridor width = 50 feet Footprint = 5 ft x 5 ft (25 ft^2) per pole	12.6 acres	5.5 acres	0.04 acre
	7.2 miles of underground lines [d]	Corridor width = 3 feet [d]	3.2 acres	--	--
Electrical substation	1	200 ft x 300 ft = 60,000 ft^2 (1.38 acre)	1.4 acre	--	1.4 acre
Battery energy storage system	1	100 ft x 250 ft = 25,000 ft^2 (0.57 acre)	0.6 acre	--	0.6 acre
Interconnection facilities (each includes a control house and communication tower)	2	200 ft x 200 ft = 40,000 ft^2 (0.9 acre)	1.8 acres	--	1.8 acres
O&M building	1	70 ft x 100 ft = 7,000 ft^2 (0.2 acre)	0.2 acre	--	0.2 acre
Laydown area	3	350 ft x 375 ft = 131,250 ft^2 (3.0 acres) 350 ft x 375 ft = 131,250 ft^2 (3.0 acres) 420 ft x 725 ft = 304,500 ft^2 (7.0 acres)	13.0 acres	--	0.5 acre [e]
Meteorological monitoring equipment	2 towers [f]	Wildlife search areas = 1.96 acre per tower (165 foot radius) Foundation = 35 ft x 35 ft (1,225 ft^2)	3.9 acre	3.8 acre	0.1 acre

Project Component	Quantity	Description of Area to be Disturbed (ft = feet, ft^2 = square feet)	Total Extent of Disturbance	Long-Term Vegetation Management	Permanent Footprint of Facilities
Onsite access roads	4.3 miles of existing access roads to be widened [g]	Width of straight sections = 40 ft Width around turns ≤ 85 ft Permanent width = 16 ft	14.5 acres	--	2.1 acres
	6.8 miles of new access roads		32.9 acres	--	13.2 acres
Subtotal			**335.1 acres**	**258.5 acres**	**21.7 acres**
MT. KAALA SITE					
Communication equipment at existing Hawaiian Telcom building	Up to 2 microwave antenna dishes	Dish mounted on existing tower (no ground disturbance, tree trimming if needed)	--	--	--
Communication equipment at existing Hawaiian Telcom repeater station	Up to 2 microwave antenna dishes	Dish mounted on existing tower (no ground disturbance, tree trimming if needed)	--	--	--
Subtotal			**0 acre**	**0 acre**	**0 acre**
ENTIRE PROJECT					
Total			**335.1 acres**	**258.5 acres**	**21.7 acres**

NOTES:

[a]Based on a radius of 370 feet for the search plot around each turbine, the total area of disturbance associated with the turbines would be approximately 296.2 acres. However, approximately 45.2 acres is considered to be unsearchable because of steep topography; therefore, total area within search plots is anticipated to be approximately 251.0 acres.

[b]The 46kV connector lines running from the substation to the points of interconnection (POIs) are quantified as part of this category.

[c]Of the 4.0 miles of overhead lines, approximately 1.9 miles associated with the 46kV connector lines would be located along access roads and presumably would fall within the footprint of those features. The calculation of total area disturbed by the overhead lines is based only on the remaining 2.1 miles of lines that are not located along access roads. It is possible that some of these overhead spans would instead be routed underground along access roads; the extent of disturbance associated with placing these lines underground would be equal to or less than those presented in this table.

[d]Of the 7.2 miles of underground lines, approximately 7.1 miles are along access roads, so no additional disturbance is anticipated beyond the 3-foot-wide trench. For the 0.1 mile of line that is not located along an access road, temporary disturbance is expected to occur within a 50-foot-wide corridor.

[e]The permanent footprint of the laydown areas would include the parking area for the O&M building, water tank storage, and septic system.

[f]A total of four potential meteorological monitoring tower locations have been identified; up to two permanent towers would be installed in a subset of these locations. In addition, four temporary towers would also be installed, but would be located within the work areas for the wind turbines, so there would be no additional disturbance area.

[g]The calculation of total area disturbed by the onsite access roads assumes the primary access roads leading up to the turbines (approximately 8.2 miles) would be improved, but not widened, and therefore would not have any additional area of disturbance. The existing access roads between the turbine strings would be temporarily widened up to 40 feet to allow for movement of the construction crane; these roads are assumed to have an average existing width of 12 feet. Therefore, the total area to be temporarily disturbed would be equal to the road length (4.3 miles) multiplied by an average increase in width of 28 feet (40 feet minus 12 feet). The permanent footprint would be equal to the road length (4.3 miles) multiplied by an average increase in the footprint of 4 feet (16 feet minus 12 feet).

2.1.2 ITP Avoidance, Minimization, Mitigation, and Management Measures

A summary of authorized take for Covered Species under a Federal ITP is provided in Table 2-3. Following the table is the associated avoidance, minimization, and management measures associated with the proposed take authorizations.

Table 2-3. Amount of Authorized Take Requested at Tier 1 and Above.

Covered Species	Level of Take	Requested Authorization 20-Yr Limit
Newell's Shearwater	Tier 1 Tier 2	3 adults/ immatures and 2 chicks/eggs 6 adults/ immatures and 3 chicks/eggs
Hawaiian Duck	Tier 1 Tier 2	4 adults/ immatures and 4 ducklings 6 adults/ immatures and 6 ducklings
Hawaiian Stilt	Tier 1 Tier 2	8 adults/ immatures and 4 fledglings 12 adults/ immatures and 6 fledglings
Hawaiian Coot	Tier 1 Tier 2	8 adults/ immatures and 4 fledglings 12 adults/ immatures and 6 fledglings
Hawaiian Moorhen	Tier 1 Take by capture from trapping Tier 2 Take by capture from trapping	8 adults/ immatures and 4 fledglings 50 individuals 12 adults/ immatures and 6 fledglings 50 individuals
Hawaiian Short-Eared Owl (State-listed)	Tier 1 Tier 2	4 adults/ immatures and 4 fledglings 6 adults/ immatures and 6 owlets
Hawaiian Hoary Bat	Tier 1 Tier 2 Tier 3	16 adults/ immatures and 8 juveniles 32 adults/ immatures and 16 juveniles 48 adults/ immatures and 24 juveniles

2.1.2.1 Avoidance and Minimization Measures

- Using “monopole” steel tubular turbine towers rather than lattice towers. Tubular towers are considerably more visible than lattice towers and should reduce collision risk.
- The use of unguyed instead of guyed permanent met towers for the project site.
- Marking guy wires on temporary met towers with high visibility bird diverters made of spiraled PVC and twin 12-inch white poly vinyl marking tape to improve the visibility of the wires.

- Utilizing a rotor with a significantly slower rotational speed (range of 6 – 16 rpm) compared to older designs (28.5 – 34 rpm). This increases the visibility of turbine blades during operation and decreases collision risk.
- Placement of all new power collection lines underground as far as practicable to minimize the risk of collision with new wires; overhead collection lines will be fitted with marker balls to increase visibility where appropriate. All overhead collection lines will be spaced according to Avian Power Line Interaction Committee (APLIC) guidelines to prevent possible electrocution of native species. Species most at risk are those likely to perch on power poles or lines (APLIC 2006). Only one species is identified to be at risk at Kawailoa Wind Power, the Hawaiian short-eared owl. Using the barn owl as a surrogate species, the horizontal spacing will be more than 20 inches to accommodate the wrist-to-wrist distance of the owl. If a vertical arrangement is chosen, a vertical spacing of more than 15 inches (head-to-foot length) will be used (APLIC 2006). Any jumper wires will be insulated.
- Overhead collection lines will be parallel to treelines whenever possible. Overhead lines spanning the gulches will be fitted with marker balls to increase their visibility to Covered Species and minimize risk of collisions.
- Improving drainage in areas as needed to eliminate the accumulation of standing water after periods of heavy rain to minimize potential of attracting waterbirds to the site.
- Where feasible, minimizing night-time construction activities to avoid the use of lighting that could attract seabirds and possibly bats.
- Use of minimal on-site lighting at buildings and using shielded fixtures that will be utilized only on infrequent occasions when workers are at the site at night. Onsite lighting will be fitted with motion-sensors, automatic shut-off timers or similar devices to limit lighting to periods when personnel are actively working.
- Clearing of trees above 15 feet in height for construction between June 1 and September 15 will not occur as it is the period when non-volant Hawaiian hoary bat juveniles may occur in the project area.
- Low wind speed curtailment will be implemented once the project is operational to reduce the risk of bat take: Recent studies on the mainland indicate that most bat fatalities occur at relatively low wind speeds, and consequently the risk of fatalities may be significantly reduced by curtailing operations on nights when winds are light and variable. Research suggests this may best be accomplished by increasing the cut-in speed of wind turbines from their normal levels (usually 3.5 or 4 m/s, depending on the model) to 5 m/s. Two years of research conducted by Arnett et al. (2009, 2010) found that bat fatalities were reduced by an average of 82% (95% CI: 52–93%) in 2008 and by 72% (95% CI: 44–86%) in 2009 when cut-in speed was increased to 5 m/s. No significant additional improvement over this level was detected when the cut-in speed was increased to 6.5 m/s.

  Based on data collected to date, the curtailment will initially occur during months of March to November, which is when bat activity has been relatively higher. Low wind speed curtailment will be implemented at night by raising the cut-in speed of the project's wind turbines to 5 m/s. Curtailment will be for the duration of the night (from sunset to sunrise). Curtailment will also be extended if fatalities are found outside the initial proposed curtailment period with concurrence from USFWS and DLNR. Curtailment may also be modified with the concurrence of DOFAW and USFWS if site-specific data demonstrate a lack of bat activity during certain periods, or if experimental trials are conducted that demonstrate that curtailment is not reducing collision risk at the project during the entire curtailment period.
- A speed limit of 15 mph will be observed while driving on site, to minimize collision with species listed in the HCP, in the event they are found to be utilizing habitat on site or injured.
- Vegetation clearing will be suspended within 300 feet of any area where distraction displays, vocalizations, or other indications of nesting by adult Hawaiian short-eared owls are seen or heard, and resumed when it is apparent that the young have fledged or other confirmation that nesting is no longer occurring.
- Measures will also be implemented to avoid impacts to native mollusks at the off-site

antennae locations. The antennae will be mounted on existing towers. A limited amount of tree trimming may be required during installation and ongoing maintenance, to provide adequate line-of-sight between the antennas. A helicopter will be used to transport the antennae to the repeater station to minimize the need for vegetation trimming along the access trail. In addition, all vegetation trimming activities will be directly coordinated with USFWS and DOFAW staff to minimize the potential for impacts to native vegetation. Because native vegetation at the site could potentially support native mollusk species (including at least one Federally and State listed species), additional mollusk surveys will be conducted before any vegetation trimming at either site, also in coordination with USFWS and DOFAW staff. If *Achatinella* spp. are detected during the surveys, no vegetation will be trimmed and the detections will be reported to USFWS and DOFAW. If no *Achatinella* are detected, then vegetation will be trimmed by hand. A post-construction report will be submitted to USFWS and DOFAW within a month of the installation of the antennae at the off-site communications towers.

- To minimize the potential for introduction of non-native invasive ant species at either of the Hawaiian Telcom sites, baseline surveys of ant fauna will be conducted before and following installation of the antennas, in coordination with DOFAW staff. In addition, all materials and vehicles will be inspected for the presence of ants before transport to the site. With implementation of these measures, impacts to native invertebrate species would be insignificant.

  The following avoidance and minimization measurs pertain to mitigation measures implemented for the Covered Species. These measures will be included in any management plans developed for the Covered Species:

- All ungulate fences built to implement mitigation measures for the Covered Species will have a barbless top-strand of wire to prevent entanglements of the Hawaiian hoary bat on barbed wire.

- In areas where Hawaiian waterbirds have been observed, nest searches will be conducted by a qualified biologist prior to any work being conducted and after any subsequent delay in work of three or more days (during which birds may attempt nesting).

- If a nest is discovered work will cease within a 150ft of the nest, for a minimum of seventy days (10 weeks); if a nest with chicks/ducklings is discovered, work will cease for a minimum of 49 days (7 weeks). These guidelines are intended to protect chicks/ducklings, and may be shortened if monitoring is conducted often enough to note when chicks/ducklings have fledged (usually five to six weeks after hatching). Work should not begin in the area until two weeks after chicks/ducklings have fledged.

- If an endangered Hawaiian waterbird is found in the project's action area during on-going work, then all activities within 50-ft of the bird will cease; work may continue after the bird leaves the area of its own accord. If a bird is seen in a similar location for more than two consecutive days, project managers should contact the USFWS for specific guidance.

2.1.2.2 Proposed Mitigation and Management Measures

Mitigation measures proposed by Kawailoa Wind Power 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 onsite surveys, modeling, and the results of post-construction monitoring conducted at other wind projects in Hawaii and elsewhere in the U. S. All required State and Federal permits will be obtained before the implementation of any mitigation measure.

Several levels of take for each Covered Species are used to identify possible levels of take that may occur over the life of the project. Take for each Covered Species will be classified as "Baseline" or Tier 1 and "Higher" or Tier 2. For bats, an additional higher tier, Tier 3, was added to account for the uncertainty surrounding the susceptibility of non-migrating Hawaiian hoary bats colliding with turbines. Table 2-4 lists the mitigation measures proposed for Kawailoa Wind Power, based on the level at which take is determined to be occurring. Take will be considered to have exceeded Tier 1 take limits and to be occurring at Tier 2 levels when the 5-year take limits for Tier 1 are exceeded within five years or if the 20-year take limit is exceeded at any time. For bats, which have an additional tier of take above Tier 2 (i.e., Tier 3), take will be considered to be occurring at Tier 3 levels when the 5-year take limits for Tier 2 are exceeded within five years of if the 20-year take limit for Tier 2 is exceeded at any time.

Table 2-4. Summary of Mitigation Measures Proposed for Kawailoa Wind Power

Species	Take Level	
	Tier 1	Tier 2 and Above
Seabirds	Development and testing of self-resetting cat trap, efficacy testing and implementation at a Newell's shearwater colony on Kauai.	Contribution to a restoration fund for predator control, social attraction and translocation of Newell's shearwaters to Kahoolawe.
Waterbirds	Predator control, fencing, and vegetation maintenance at Ukoa Pond or other site for five years plus MOA between First Wind and the landowner for long-term commitment to management of pond for waterbirds. Subsequent mitigation efforts to meet Tier 1 requested take as required.	Additional mitigation efforts at Ukoa Pond or at additional wetlands.
Hawaiian short-eared owl	Upfront contribution of $12,500 for research and rehabilitation and up to a maximum of $25,000 to implement management strategies if/as they become available.	Additional funding of $6,250 for research and rehabilitation and up to a maximum of $12,500 to implement management strategies.
Hawaiian hoary bat	Restoration of wetland or forest habitat to increase foraging capacity and provide additional roost trees. Research to evaluate the efficacy of wetland or forest mitigation.	Tier 2 and Tier 3: Additional restoration of wetland or forest habitat to increase foraging capacity and provide additional roost trees.

Mitigation will be adjusted to account for rates of take found to differ from Tier 1 so mitigation for the Tier 2 take level (or Tier 3 for bats). 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 Kawailoa, some uncertainty exists in the Proposed Action, 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 Kawailoa facility. Therefore, the HCP proposes to increase mitigation efforts, if monitoring demonstrates that incidental take is, or may be, occurring above Tier 1, but within the Tier 2 levels identified in the Kawailoa Wind Power HCP. Any changes in the mitigation measures would be at the direction of USFWS and DLNR. Similarly, an adaptive approach is also proposed for the specific type of mitigation to be implemented for each of the Covered Species.

The overall expenditure at the Tier 1 (excluding contingency funds) is not expected to exceed a total of $7.2925 million, but the budgeted amounts are estimates and are not necessarily fixed. Kawailoa Wind Power will provide the required conservation measures in full, even if the actual costs are greater than anticipated.
Kawailoa Wind Power 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 are not sufficient to provide the necessary conservation, Kawailoa Wind Power will nonetheless be responsible for ensuring that the necessary conservation is provided.

Seabird Mitigation Measures

For Tier 1, mitigation measures will support the development of improved traps for predators and in subsequent utilization at a Newell's shearwater colony on Kauai or Maui. Kauai is where the largest portion of the species' population is found, and where action is most likely to result in benefits to the species. DOFAW and USFWS have been working since 2002 to identify breeding colonies of Newell's shearwaters and Hawaiian petrels on Kauai.

Development of a Self-Resetting Cat Trap and its Implementation at a Newell's Shearwater Colony

The development of a more efficient cat trap is consistent with the one of the recovery milestones identified in the Hawaiian Dark-Rumped Petrel and Newell's Manx Shearwater Recovery Plan(USFWS 1983) and the 5-Year Work Plan for Newell's Shearwater (NESH Working Group 2005). The recovery plan states that one of the primary management objectives for the two species are: "Developing efficient predator control methods and techniques for use in and around isolated nesting sites." The Newell's Shearwater (NESH) Working Group developed a 5-Year Work Plan for Newell's Shearwater (NESH Working Group 2005) which outlines specific recovery objectives for the Newell's Shearwater that can be met within five years. The first recovery objective is also to "Minimize adult/breeder mortality and maximize fledgling production by developing and implementing effective predator control methods in colonies".

Goodnature Limited (http://www.goodnature.co.nz/), a New Zealand based company is currently seeking funding to develop a self-resetting cat trap. The funding is anticipated to result in a trap that specifically targets cats while excluding sensitive species. The trap will dispatch the cats humanely and then will self-reset multiple times so that the traps are active again without human intervention. The prototype will be commercially available 12 months after the funding is received. These traps will be tested in a location where cats are common in Hawaii, to demonstrate the effectiveness and efficiency of the trap above conventional traps. Concurrently, a Newell's seabird colony will be identified and a pilot study will be designed where these traps are deployed to provide localized control of cats over an area where birds are known to be breeding. The study will be designed by Goodnature Limited and Kawailoa Wind Power will be responsible for the implementation of the study by the first Newell's shearwater breeding season after the trap is commercially available. The cat trap will be deployed for one breeding season and based on modeling of a reduction from medium to mild predation (HT Harvey and Associates 2011), the cat trap deployment is expected to result in a 10% increased breeding probability, 7.5% increased breeding success and 1.5 - 2.5% increase in survival of adults and sub-adults that are protected within the trapped area from cats. Modeling shows that within one year, for 20 active burrows protected, the reduction of cat predation could potentially result in the additional survival of 0.5 adults, 4.1 juveniles and 2 fledglings. For 30 burrows, the accrual after one season is expected to be 0.8 adults, 6.1 juveniles and 2.9 fledglings (HT Harvey and Associates 2011). The seabird colony may be on Maui, Kauai or other islands. Seabird colonies currently under consideration include, but are not limited to, Wainiha Valley, Limahuli Valley and Hono O Na Pali on Kauai, or Makamakaole and a potential seabird colony at Upper Kahakuloa Valley on Maui.

Mitigation will be deemed successful if the self-resetting cat trap is successfully developed and is demonstrated to successfully function in the field at a Newell's shearwater colony for one breeding season, is efficient and effective in dispatching cats, with no adverse impact to the seabirds. With the low requested take at Tier 1, the proposed mitigation measures of the development of a self-resetting cat trap and its implementation at a seabird colony as part of a pilot study, are expected to produce a net benefit in the form of an increase in the species' population by increasing productivity and survival rates of the Covered Species. The pilot study will result in immediate increase in adult and sub-adult survival as well as increased reproductive output, above the unmanaged state. While the area managed is anticipated to be small, trap development is expected to more than compensate for the requested take at Tier 1. A more effective cat trap for Newell's shearwater predator management will help to meet a milestone identified as necessary for the recovery of the species, and the eventual implementation at additional colonies will increase survival and reproduction. The new trap is anticipated to have far reaching benefits beyond the mitigation measures implemented by the Applicant. The development of the trap will enable managers to conduct predator control at sites that are currently not suitable for trapping because of their remoteness and the intensive labor required to maintain a trapping grid. It is anticipated that the cat trap will be less labor intensive to operate and more effective than the cat traps currently available (current cat traps, once sprung, are inactive and need to be manually reset by a person) and will be utilized extensively by most parties involved in the management of Newell's shearwater colonies once developed. This is expected to yield improvements in protection, reproductive success and survival over current management methods, for many currently unmanaged colonies, with benefits extending years into the future.

Tier 2 mitigation will consist of contributing to a restoration fund for predator control, social attraction and translocation of Newell's shearwaters. Take will be considered to be occurring at Tier 2 levels when the 5-year take limits for Tier 1 are exceeded within five years or if the 20-year take limit is exceeded at any time.

Contribute to a Restoration Fund for Predator Control and Translocation or Social Attraction of Newell's Shearwater

If at the time when Tier 2 rates of take are determined, Kawailoa will contribute to a restoration fund for predator control, social attraction and translocation of Newell's shearwaters. Kahoolawe has been identified as a potential site where Kawailoa Wind Power would contribute $200,000 to the restoration fund. Kahoolawe and its surrounding waters were under control of the U.S. Navy from 1941 to 1994. Over fifty years of use as a live-fire training area have significantly impacted the landscape, although there were efforts to remove unexploded ordinance. Kahoolawe and its surrounding waters were conveyed back to the State of Hawaii in 1994, and since then, Kahoolawe and the waters within two nautical miles of its shores have been designated as a reserve, and the State of Hawaii has established the Kahoolawe Island Reserve Commission (KIRC). The commission is committed to environmental and cultural restoration of Kahoolawe, and with funding and partnership with various groups. With respect to the restoration of seabird colonies, KIRC identifies two main efforts in its 2010 report: the eradication of invasive mammals and the removal of marine debris. Feral cats are rampant on Kahoolawe, and have ravaged the island's seabird population. In partnership with the U.S. Fish and Wildlife Service (USFWS) and Island Conservation, the development of an operational and management plan is underway, and a feasibility study to remove invasive mammals has been completed. The contributions by Kawailoa Wind Power to predator control at the site and the eventual translocation of Newell's shearwater to a managed area within Kahoolawe are expected to aid in establishing a new Newell's shearwater seabird colony within Maui Nui.

Waterbird Mitigation Measures

Mitigation for potential impacts to the four endangered waterbird species is proposed to be conducted concurrently at one wetland site (Ukoa Pond) because of their similar habitat requirements, and because they face similar threats to their habitat and reproductive success. Ukoa Pond is identified as a supporting wetland on Oahu in the Draft Revised Recovery Plan for Hawaiian Waterbirds (USFWS 2005a). One of the downlisting criteria for the four endangered waterbird species is that 75% of the supporting wetlands are protected and managed according to the practices outlined in the recovery plan. A management plan for Ukoa Pond has existed since 1999, and was recently updated in 2011. The most recent plan identifies the long-term goals that the land owner Kamehameha Schools has for Ukoa Pond. Ukoa Pond is considered as a site with potential to be

a) a cultural resource center for students and the community;
b) an active site for environmental education;
c) a haven for native wildlife; and
d) an attraction for Hawaii residents and visitors.

Mitigation for the Tier 1 level of take of the four waterbirds at Ukoa Pond will consist of a five year plan that will contribute to fencing and managing a smaller unit of wetland (40 acre) within Ukoa Pond. The size of the unit to be managed was based on factors such as fence alignment, topography, location of open water bodies and other factors as well as the likelihood of achieveing mitigation obligations with a set timeframe. This 40 acre unit is currently overgrown by invasive species particularly water hyacinth (*Eichhornia crassipes*) and bulrush (*Schoenoplectus* varieties) but is still connected to a small body of open water (Kamehameha Schools, unpublished data).There is a source of flowing water nearby due to a previously capped well and the area is close to an access point where equipment and materials to manage the site can be staged. The removal of the invasive vegetation will increase the amount of open water available and should be attractive to waterbirds. The overall goals of the restoration and management of the 40 acre unit would be to attract waterbirds to the managed site and provide immediate protection from predators through fencing and predator control to encourage breeding and increase productivity. Partnerships between Kawailoa Wind Power, Kamehameha Schools and a third party contractor will be developed for the management of the site. The details of the management plan are still being discussed with the third party contractor. The third party contractor will submit a work plan that will be approved by USFWS and DOFAW before the commencement of the work. Kawailoa Wind Power will also be responsible for ensuring that Ukoa pond is managed for the permit term of the project (via partnerships or otherwise). Partnerships are currently being developed between Kawailoa Wind Power and Kamehameha Schools to ensure the long-term management of Ukoa pond when mitigation activities are completed. Components of the plan that Kawailoa Wind Power proposes to fund include:

- A one-time contribution of $77,000 toward the construction of a fence around the 40 acre unit (Year 1);
- $30,000 for costs associated with permitting for fence construction (Year 1);
- $30,000 for four years of fence maintenance (Year 2 to 5);
- $110,000 for four years of predator trapping and ungulate removal by a qualified contractor or personnel approved by USFWS and DLNR (Year 2 to 5);
- $80,000 for five years for monitoring of the management effort (Year 1 to 5);
- $85,000 for vegetation removal in the first two years;
- $150,000 for replanting of native flora in the first two years;
- $120,000 for four years of weed control (Year 2 to 5) and
- $24,000 for the biological oversight of third-party contractor work

The total funding allocated to the management efforts amounts to approximately $706,000. A waterbird Management Plan for the proposed area will be drafted within six months of permit issuance, to address the components of wetland management and will be approved by the USFWS and DOFAW before implementation. This wetland management as outlined in the Plan will be conducted for 20 years or the life of the Permit. At a minimum the Plan will include:

- Measures for invasive plant control and percentage of open water to remain unvegetated over the 20 years.
- Hawaiian duck hybrid management;

- Invasive rat, cat, dog, pig, and mongoose control;
- Fence maintenance; and
- Criteria to address any botulism outbreak in the wetland.

A timeline for predator control, vegetation maintenance, and monitoring of waterbird populations and reproductive activity, is proposed below:

a. Completion of a perimeter fence to keep out ungulates and dogs one year from permit issuance. Hog wire mesh with graduated vertical spacing (small mesh at the bottom and larger at the top) will be used to keep ungulates and dogs out.

b. Predator trapping and baiting will begin during the first breeding season after fence construction and vegetation removal and will be funded for four years. Predator trapping for dogs, cats and mongoose will be conducted year round using traps, leg holds, and/or snares. The trapping design will be approved by USFWS and DOFAW. Traps will be placed along the perimeter of the fences. Leg holds and snares will be placed deeper within the fenced area, depending on visual observations of predators. Traps will be checked every 48 hrs and snares and leg holds every 24 hrs in accordance with USFWS guidelines. Bait stations for rats will be deployed year-round following protocols set forth by the Department of Agriculture. All ungulates and dogs will be removed by the end of Year 2.

c. Regular monitoring for mammalian predators, ungulates and dogs will be conducted and any ungulates or dogs detected within the fenced area will be removed as soon as possible and breaches in the fence repaired within a month.

d. Vegetation removal of invasive species and replanting with native plants will be completed in the first two years.

e. Vegetation maintenance (beginning the year after fence completion and continuing for four years) will be conducted to further remove and prevent invasive species from encroaching on waterbird nesting habitat and to enhance available nesting habitat where possible.

f. Monitoring of reproductive activity and waterbird populations will establish a baseline and quantify the effectiveness of the predator and vegetation control methods (that are implemented after fence installation). Monitoring of reproductive activity and bird resightings will be conducted weekly from May through September for stilt and year round for the other Covered Species of waterbirds as nests are discovered. Total bird counts including specification of life stages, and the tracking of productivity of individual nests or broods to fledging will be conducted the maximum extent practicable. Banding of chicks or juvenile birds annually will be used to facilitate this, by qualified personnel with the appropriate banding and endangered species permits.

The predator control, vegetation maintenance and monitoring will be performed by a qualified contractor or personnel approved by DLNR and USFWS. After five years of management, the number of fledglings or adults accrued for the Covered waterbird species will be reviewed, and if they are at least one more than required to compensate for the Tier 1 requested take, the required mitigation will be considered fulfilled. Productivity and survival rates will be calculated annually, based on the results from the weekly monitoring and resighting data. This standard applies to the Hawaiian coot, Hawaiian stilt and Hawaiian moorhen. Currently, as few pure Hawaiian ducks are believed to exist on Oahu due to hybridization, mitigation for Hawaiian ducks may also consist of removal of feral ducks, mallards and Hawaiian duck hybrids at Ukoa Pond. Removals will be at the direction of DOFAW and USFWS. However, in the event duck hybrids are exterminated and pure Hawaiian ducks are reintroduced, mitigation will consist of increasing survival and productivity rates of the pure Hawaiian ducks present.

Currently only Hawaiian stilts and Hawaiian moorhen are occasionally observed at Ukoa Pond, and none of the four waterbird species have in recent years been observed nesting at the site. Therefore baseline population and productivity is zero. In the absence of a baseline population it is difficult to predict the number of birds that will become established at Ukoa Pond within the project life, but birds are expected to respond rapidly to the newly available nesting and foraging habitat. Hamakua Marsh, located on the windward side of Oahu, and similar to Ukoa Pond, characterized as seasonal floodplain and influenced by high tidal events, is used as a basis for the estimate of expected bird densities and fledgling production at Ukoa Pond. Between 2005 and 2009 the 22 acre Hamakua Marsh produced an average of 2.2 coot fledglings, 36.6 moorhen fledglings, and 11 stilt fledglings annually (SWCA 2010d). Considering the fact that the total habitat area at Ukoa Pond will be approximately double that of Hamakua Marsh, it is expected that the total number of fledglings produced over the project life will meet the mitigation requirements of Tier 1. Annual fledgling production rates at Ukoa Pond after habitat restoration and implementation of predator control measures is expected to be double that at Hamakua marsh and be approximately 4.4 coot, 65 moorhen, and 22 stilt fledglings, assuming the species composition at both sites are similar. Over four years the total accrual is expected to result in 17 coot, 260 moorhen and 88 stilt fledglings. The number of fledglings accrued, particularly for Hawaiian moorhen and Hawaiian stilt, are expected to far exceed the required number of fledglings required for Tier 1. Hamakua marsh has an unusually large number of moorhen at the site that are thought to displace the Hawaiian coot from nesting (Misaki pers comm., DOFAW 2010), therefore, if the species composition at Ukoa Pond is more balanced, the Hawaiian coot fledglings accrued are expected to compensate for the Tier 1 requested take as well. Consequently, as the fledglings accrued for each species may be uneven due to differences in pair abundance or reproductive success; more effort may be concentrated on enhancing the productivity of one species more than another in order to achieve the required number of fledglings to meet the Tier 1 requested level of take. In addition, mitigation will be continued till the required mitigation is achieved for the Hawaiian stilt, Hawaiian coot and Hawaiian moorhen.

If Tier 1 requirements have not been met through the management of 40 acres at Ukoa Pond, additional funding (estimated up to $272,000, for 4 yearsfor predator control, monitoring, fence maintenance and weed control) will be provided by the Applicant for additional mitigation measures to offset Tier 1 requested take for the Hawaiian coot, Hawaiian stilt and Hawaiian moorhen. This may also result in an extension of management past the 20-year term of the ITP/ITL. As the fledglings accrued for each species may be uneven due to differences in pair abundance or reproductive success, more effort may be concentrated on enhancing the productivity of a specific Covered waterbird Species in order to meet the Tier 1 requested take, provided the measures do not negatively affect the productivity of other Covered Species at the mitigation site. The design and scope of each year's effort will be determined by USFWS and DLNR in coordination with Kawailoa Wind Power and Kamehameha Schools. Coordination is necessary to ensure that the proposed management actions funded by Kawailoa Wind Power satisfy the mitigation criteria required of Kawailoa Wind Power by both DLNR and USFWS.

If monitoring indicates that factors other than predator control are a higher priority for the recovery of the endangered waterbird species covered in the HCP, Kawailoa Wind Power, as determined by USFWS and DLNR, will direct the specified funds toward whatever management action is deemed most appropriate at the time. Should another waterbird nesting site be identified as a more suitable location for mitigation measures, management actions may be conducted in an alternate site as appropriate. Other important management techniques for wetland habitat improvement in Hawaii could include water level control, disease prevention and monitoring of environmental contaminants (USFWS 2005a).

It is possible that bat mitigation (as described below) may also include wetland restoration at Ukoa Pond. If this occurs, the area proposed for wetland restoration will increase by another 40 acres and is likely exceed that required for Tier 1 mitigation for waterbirds. If the wetland restoration area is increased to accommodate bat mitigation, it is anticipated that the additional restored areas would also attract waterbirds. Therefore, the management measures outlined above (fencing, trapping, vegetation maintenance and monitoring) would correspondingly be increased to ensure that the entire restored area is also managed for waterbirds. Monitoring of waterbird productivity would document any mitigation accrued above the Tier 1 level.

Take will be considered to be occurring at Tier 2 levels when the 5-year take limits for Tier 1 are exceeded within a five year period or if the 20-year take limit is exceeded at any time. If Tier 2 take occurs for any of the waterbird species, no additional mitigation will be provided if the number of fledglings or adults accrued for that Covered Species is commensurate with the requested take at Tier 2 plus a net conservation benefit for the species. If this is not the case, mitigation actions will first be increased at Ukoa Pond. Activities will include intensifying the trapping effort or implementing additional vegetation management. If increased efforts at Ukoa Pond are not sufficient to increase adult survival or produce enough fledglings to be commensurate with the requested take at the Tier 2 level, and achieve a net conservation benefit for the species at the measured take levels, Kawailoa Wind Power will provide funding for a similar set of waterbird management measures at one or more additional sites. Selection of additional sites and identification of appropriate levels of effort will be determined by DLNR and USFWS. Mitigation measures will require the approval of USFWS and DOFAW prior to implementation.

Predator trapping poses some risk of harassment due to capture, and could result in injury or mortality to the Covered waterbird species. Moorhen are attracted to traps (DesRochers et al. 2006) and moorhen on Oahu have been documented entering live traps (DesRochers et al. 2006; Nadig/USFWS, pers. comm.). USFWS recommends additional take of not more than ten Hawaiian moorhen annually in the form of capture. The trapping at Ukoa Pond is anticipated to last five years and a total of take of 50 individuals in the form of capture is also requested. Minimal risk of injury or mortality is anticipated from this capture and the conservation strategy to implement wetland management including a predator control program will result in an overall increase in the baseline number of individuals of the endangered Hawaiian moorhen. Therefore, the implementation of live trapping will have beneficial effects through the control of nonnative predators and increased productivity of Hawaiian moorhen. As a beneficial effect no further mitigation would be required for the potential capture of Hawaiian moorhen. However, if the implementation of mitigation measures causes a waterbird capture that does result in mortality or injury, the take will be assessed as part of the 18 birds (Tier 2 total) estimated for injury or mortality as part of the Kawailoa Wind Power project.

Hawaiian Short-eared Owl Mitigation Measures

Mitigation for possible take of the Hawaiian short-eared owl by Kawailoa Wind Power will consist of two parts: funding research or rehabilitation of injured owls; and subsequently implementing management actions on Oahu as they are identified and as needed to bring mitigation ahead of take and provide a net benefit.

Prior to the start of operations, Kawailoa Wind Power will contribute a total of $12,500 to appropriate programs or facilities for research or rehabilitation of owls at Tier 1 rates of take. Three alternatives for rehabilitation or research are identified below.

Alternative 1 Owl Rehabilitation on Oahu

The Aloha Animal Hospital regularly receives injured Hawaiian short-eared owls on Oahu. A need identified by the veterinarian, Dr. Fujitani of Aloha Animal Hospital, to facilitate the rehabilitation of Hawaiian short-eared owls was the construction of a flight cage to house the owls prior to release. Flight cages allow for birds to exercise their flight muscles prior to release (Greene et al. 2004). The selection of this alternative is contingent upon finding a suitable site to construct the flight cage, as Aloha Animal Hospital currently does not have the space required. The facility that houses the flight cage will need to have qualified rehabilitators to provide the required husbandry and ensure that the owls continue to receive regular veterinary care.

Alternative 2 Owl Rehabilitation on the Island of Hawaii

The Hawaii Wildlife Center, located on the Island of Hawaii, is a facility that will be dedicated to the rescue and recovery of native wildlife in the State of Hawaii (http://www.hawaiiwildlifecenter.org/mission-statement.htm). A key component of this facility is a wildlife response and care unit that will provide medical and husbandry care for sick, injured and orphaned native wildlife, including those affected by natural and man-made disasters. Individuals that are successfully treated will be returned back to the wild. This center is currently under construction and is still fundraising to complete the facility. Needs identified by Linda Elliot (founder, president and center director) for the rehabilitation of raptors were funding to complete the outdoor aviaries in the recovery yard (each outdoor aviary is estimated to cost $2,500 to build) and funding for facilities such as the intake/exam room, laboratory, holding room or food preparation areas. This facility when completed will have the capacity to rehabilitate native raptors from the entire Hawaiian Archipelago. The Hawaiian short-eared owl is one of two native raptors in the State, the other being the Hawaiian hawk, or io (*Buteo solitarius*).

Alternative 3 – Funding for Basic Research

If funding is allocated to research, funding may be used for (but not limited to) the purchase of radio transmitters, receivers, or provide support for personnel to conduct research such as a population census. Research may be conducted on the Island of Oahu, or other islands based on feasibility.

Funding Management Actions

When practicable management actions that will aid in the recovery of Hawaiian short-eared owl populations are identified on Oahu, Kawailoa Wind Power will provide additional funding of $12,500 up to a maximum of $25,000 to implement a chosen management measure as approved by USFWS and DLNR. The level of funding provided for management will be decided by DLNR and USFWS and will be deemed appropriate to compensate for the Tier 1 requested take (adjusted for take already mitigated for in the rehabilitation program) and also provide a net benefit to the species. If the parties do not agree the appropriate level of funding will be determined by USFWS and DLNR.

Take will be considered to be occurring at Tier 2 levels when the 5-year take limits for Tier 1 are exceeded within five years of if the 20-year take limit is exceeded at any time. If monitoring indicates a Tier 2 take, Kawailoa Wind Power will provide additional funding of $6,250 for increased owl research and rehabilitation. Examples of possible research include studies of where Hawaiian short-eared owls are likely to breed, quantification of productivity, or developing and testing the effectiveness of management techniques. Additional support for owl rehabilitation on Oahu or other islands may be provided if identified. However, should research indicate that other areas of study are more important or pressing in aiding the recovery of the species, these funds will be used for whatever management or research activity is deemed most appropriate at the time by USFWS and DLNR.

This funding will be followed by an additional $6,500 up to a maximum of $12,500 for implementing chosen management actions as they become available, and as determined by USFWS and DLNR. If the parties do not agree the appropriate level of funding will be determined by USFWS and DLNR to be appropriate to compensate for the requested take at a Tier 2leveland also provide a net benefit to the species.

Bat Mitigation Measures

Mitigation for the Hawaiian hoary bat at Tier 1 levels was developed through discussions with USFWS, DLNR, and bat experts, and involved identifying the most immediate needs required for the recovery of the species. Based on the feedback received, the Applicant proposes a combination of measures consisting of:

1. On-site surveys to add to the knowledge base of the species' status on Oahu;
2. On-site research into bat interactions with the wind facility;
3. Implementation of bat habitat improvement measures to benefit bats as determined with DLNR, USFWS and ESRC;
4. Mitigation measures will receive the approval of USFWS and DOFAW prior to implementation.
5. Monitoring to verify increased use of restored and managed habitats; and,
6. Research to verify increased health, survivorship and/or productivity of local bats as a result of using the restored and managed habitats.

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

A critical component identified as essential to Hawaiian hoary bat recovery is the need to develop a standardized survey protocol for the Hawaiian hoary bat monitoring program to enable results collected by different parties to be directly comparable. The Applicant will join the Hawaii Bat Research Cooperative (HBRC) and as a contribution to the on-going research efforts in the State, will conduct its own surveys and monitoring at Kawailoa Wind Power and the vicinity. Survey protocols will be developed prior to start of project operations, in consultation with HBRC, with approval by USFWS and DLNR. Up to 12 anabat detectors will be deployed at Kawailoa Wind Power and the vicinity.

The Applicant will continue to survey for and monitor Hawaiian hoary bats within and in the vicinity of the Kawailoa Wind Power site. 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. These on-site surveys are also expected to advance avoidance and minimization strategies that wind facilities in Hawaii and elsewhere can employ in the future to reduce bat fatalities. Surveys will be conducted during years when systematic fatality monitoring is conducted, (i.e., during the first three years and at five year intervals thereafter, or as otherwise determined under the Adaptive Management provisions), to:

1. Correlate observed activity levels with any take that is observed. Thermal imaging or night vision technology may be used to assist acoustic monitoring as trends are detected. The use of additional techniques and technologies will also be considered;
2. Determine seasonal and nightly peak bat activity periods on-site; and,
3. Determine if bats are being attracted to the wind facility by comparing post-construction data with pre-construction activity levels.

Incidental bat observations will also be recorded under the wildlife education and observation program (WEOP).

Wetland Restoration Alternative

Kawailoa Wind Power’s preferred mitigation is to provide wetland restoration at Ukoa Pond. USFWS and DOFAW have recently required that upland forest restoration be provided as compensation for bat take by at the rate of 40 acres per pair of bats (one male and one female). The Tier 1 requested take of 16 adult bats and 8 juveniles equates to approximately 19 adults (with an estimated 30% survival rate of juveniles to adulthood) or roughly 10 pairs of bats (10 males and 10 females).

Based on existing data from other sites and in the vicinity of Ukoa Pond (the proposed wetland restoration site), it is expected that the foraging activity rates at a restored wetland will increase by seven to ten-fold above that occurring at forests in the area (Brooks and Ford 2005; Grindal et al. 1999). Hence, it is proposed that wetland restoration which will create high quality foraging habitat, will be five times more beneficial to foraging bats than forest restoration and that as a rough metric, 1 acres of wetland is equivalent to 5 acres of forest.

This wetland restoration proposal has received considerable support from Dr. Michael J. O’Farrell (O’Farrell Biological Consulting LLC), the bat expert Kawailoa Wind Power has consulted with and who estimates that this project will have a high probability of success based on his long-term observations in the field of *Lasiurus* species on the mainland and work on numerous published and technical reports (O’Farrell et al. 2004; Bradley et al. 2005; Williams et al. 2006; O’Farrell et al. 2000; Gannon et al. 2004; O’Farrell 2006a, 2006b, 2007, 2009).

Therefore, for wetland restoration, 1 acre of wetland is assumed to have the foraging potential of 5 acres of forest, thus the wetland area for restoration is calculated to be 80 acres (40 acres x 10 pairs / 5 acres). In addition to the restoration of 80 acre of Ukoa Pond, 40 acres of adjacent forest will be restored to provide day and night roosts as part of Tier 1 mitigation.

Ukoa wetland is surrounded by a thick canopy layer averaging 20-30 feet in height. The canopy is dominated by Chinese banyan (*Ficus microcarpa*), date palm (*Phoenix dactylifera*), kiawe (*Prosopis pallida*), Manila tamarind (*Pithecellobium dulce*), paperbark, Christmas berry, and Java plum (*Syzygium cumini*).The interior of the wetland is dominated by California bulrush (*Schoenoplectus californicus*), California grass (*Urochloa mutica*), neke fern (*Cyclosorus interruptus*), saltmarsh bulrush

(*Bolboschoenus maritimus paludosus*), ahuawa haole (*Cyperus involucratus*), and juncus (*Juncus polyanthemos*). Throughout the interior, there are also pockets of small shrubs and trees, dominated by paperbark and sourbush. The ground layer is dominated by aeae (*Bacopa monnieri*) and giant duckweed (*Spirodela polyrhiza*). Along the Kawailoa Road boundary of the wetland, the composition is almost completely water hyacinth. A small body of open water exists in the middle of the pond.

The wetland restoration to improve bat foraging habitat will consist of three components

1) Removal of invasive vegetation to re-create bodies of open water;
2) Control and removal of alien vegetation in the wetland interior to allow for the natural recruitment of native species that are already present. Suitable areas will replanted with native vegetation if necessary;
3) Managing 40 acres of trees around the periphery of the pond by the selective removal of alien trees and replanting to provide night roosts and potentially day roosts. Alien trees that have been frequently documented as suitable roost trees will be retained in consultation with bat experts in Hawaii. Tree replanting will consist of native or non-invasive species that will grow well in the soil type and moisture regime of the area, and are also species that are documented as suitable roost trees for the Hawaiian hoary bat;
4) Fencing of the restored wetland and forested area; and,
5) Removal of the ungulates within the restored and forested area. Predator control will also be conducted in the wetland areas to protect the waterbirds (see below).

The removal of invasive vegetation and allowing the establishment of native emergent vegetation around the periphery of open water is expected to create edge habitat rich in foraging potential. The restoration of edge habitat should provide a sufficient foraging base to increase the carrying capacity of the local area (O'Farrell pers comm. 2011). The availability of nearby roost trees should also enhance the quality of the habitat, by providing roost trees in close proximity to a high quality foraging habitat. Hence, the restoration of Ukoa Pond is considered to have a high potential to increase the quality of foraging habitat for the local bat population in the area. By increasing forage biomass and providing additional roost opportunities use of the area by Hawaiian hoary bats is expected to increase and also improve reproductive success through improved foraging opportunities. This hypothesis will be evaluated through a research project outlined below.

As stated, 40 acres of wetland will be restored as mitigation for waterbirds. If the wetland restoration area is increased to 80 acres to accommodate bat mitigation, the additional restored areas will also attract waterbirds. Therefore, the management measures for waterbirds (fencing, trapping, vegetation maintenance and monitoring) will correspondingly be increased to ensure that the entire restored area is also managed for waterbirds. Monitoring of waterbird productivity will document any mitigation accrued above the Tier 1 level.

Research and Monitoring Accompanying Wetland Restoration

In addition to the implementation of habitat restoration measures, research will be conducted to investigate whether increasing and improving foraging habitat for the Hawaiian hoary bat in wetland areas results in increased reproductive successor increased survival of adults or juveniles. The study will be designed by Kawailoa Wind Power, together with bat experts, and a detailed plan for the various aspects of the bat management will be written within three months of the issuance of the permit and an agreed upon baseline will be measured prior to the clearing of the vegetation. This Hawaiian Bat Research and Monitoring Plan for Kawailoa Wind Power will be approved by DLNR and USFWS before implementation. The study will be conducted by a primary investigator and a minimum of two technicians.

Bat detectors will also be placed within the portion of the pond identified for restoration one year prior to restoration to document baseline levels of bat activity rates. Concurrently, mist-netting and visual surveys will be conducted to census and capture bats to determine the age, sex and breeding status of bats utilizing the unrestored area. Tagging of bats and radio telemetry will also be conducted to gather life history information such as home range size and contribute to a population or density estimate for the mitigation site.

Telemetry, assessing bat activity, mist-netting, visual surveys will be conducted for three years post-restoration, and at subsequent five-year intervals. Research will quantify the success of the mitigation and components of the research could consist of documenting increasing bat activity from pre- to post-restoration, to support that wetland restoration improves foraging habitat for bats and results in greater survival and increased productivity. Documenting increased numbers of bats caught in mist-nets or seen during visual surveys will demonstrate that the restoration at Ukoa Pond has increased the number of individuals utilizing Ukoa Pond. If the number of pregnant bats or juveniles caught increases over time, this will also support that increased reproductive success is occurring at the restored wetland, as compared to baseline (pre-restoration) levels. Telemetry will provide information on home range sizes and time spent by individuals feeding and roosting at the restored site. All these data will be used to determine if the increase in survivorship and productivity at the wetland have been sufficient to compensate for the requested take in Tier 1. Due to the small amount of information currently available about the basic biology of the Hawaiian hoary bat, the exact metric or combination thereof, to be used to determine the effectiveness of the mitigation, will an integral part of the research that will have to be fulfilled as part of the mitigation.

If after 5 years of wetland restoration, the monitoring data and results from the research described above show that the mitigation measures are insufficient to mitigate for take occurring at Tier 1, additional mitigation measures will be implemented to compensate for the deficit. Mitigation measures will consist of additional forest or wetland restoration. However, if other methods for improving bat habitat are available at that point in time, these alternative management strategies will also be considered. The most appropriate mitigation measure to be implemented will be determined by DLNR, USFWS using the best available science and expertise. Mitigation measures may be extended beyond the term of the ITL/ITP if necessary to compensate for the requested take. Mitigation measures will require the approval of USFWS and DOFAW prior to implementation.

Reforestation

Alternatively, if wetland restoration is not selected, then Kawailoa Wind Power proposes to restore forest habitat to increase habitat available to bats. Based on the current recommendations of USFWS and DOFAW, 400 acres of native forest will restored, and restoration measures will include fencing, ungulate control, removal of invasive species and replanting of native species. The actual acreage to be restored may be modified with the approval of DOFAW and USFWS if future research indicates that 400 acres is likely to be either insufficient or excessive. Literature shows that hoary bats and *Lasiurus* species in general, prefer to forage along edges and gaps (e.g., Morris 2008; Hein et al. 2008; Menzel et al. 2002). It is therefore proposed that during restoration, the removal of alien species and the selective replanting of native species be used to create edge and gaps within the restored area. Mitigation for bats will be deemed successful if bat activity rates are greater in the restored forest in comparison to the unrestored forest.

Possible locations for native forest restoration and management on Oahu include forests currently managed by Kamehameha Schools or at Waimea valley, managed by Hiipaka LLC, a native Hawaiian non-profit organization. On Maui possible locations include native habitat plant restoration and management at Kahikinui Forest Reserve, managed by DOFAW or on private land owned by Ulupalakua Ranch. Other areas for forest restoration on Oahu, Maui or other islands will be considered as necessary and the final location for forest restoration and management will be will be determined in consultation with DLNR, USFWS and bat experts. Mitigation can be conducted on Maui only if the bats on Maui and Oahu are determined to be genetically similar and not distinct sub-populations.

It is anticipated that the measures outlined above or any others that are developed in the future will be conducted in partnership with other conservation groups or entities and that these activities will complement other restoration, reforestation or conservations goals occurring in that area at the time. Other sites may be chosen if they are determined to be more appropriate for the implementation of the mitigation measures, or if the originally identified mitigation measure does not come to fruition within three years from the start of project operations, with approval from USFWS and DOFAW. Funds will be directed toward whatever management or research activity is deemed most appropriate at the time with the approval of USFWS and DOFAW. Mitigation measures will require the approval of USFWS and DOFAW prior to implementation.

Research and Monitoring Accompanying Forest Restoration

In addition to the implementation of restoration measures, research will be conducted to investigate whether increasing and improving roosting and foraging habitat for the Hawaiian hoary bat in forested areas results in an increased productivity or increased survival of adults or juveniles. The study will be designed by Kawailoa Wind Power, together with bat experts, and a detailed plan for the various aspects of the bat management will be written within three months of the issuance of the permit and an agreed upon baseline will be measured prior to the clearing of the vegetation. This Hawaiian Bat Research and Monitoring Plan for Kawailoa Wind Power will be approved by DLNR and USFWS before implementation. The study will be conducted by a primary investigator and a minimum of two technicians.

Bat detectors will also be placed within the area identified for restoration one year prior to restoration to document baseline levels of bat activity rates. Concurrently, mist-netting and visual surveys will be conducted to census and capture bats to determine the age, sex and breeding status of bats utilizing the unrestored area. Tagging of bats and radio telemetry will also be conducted to gather life history information such as home range size and contribute to a population or density estimate for the mitigation site.

Telemetry, assessing bat activity, mist-netting, visual surveys will be conducted for three years post-restoration, and at subsequent five-year intervals. Research will quantify the success of the mitigation and components of the research could consist of documenting increasing bat activity from pre- to post-restoration, to support that forest restoration improves roosting foraging habitat for bats and results in greater survival and increased productivity. Documenting increased numbers of bats caught in mist-nets or seen during visual surveys will demonstrate that the forest restoration has increased the number of individuals utilizing the restored forest. If the number of pregnant bats or juveniles caught increase over time, this will also help support that increased reproductive success is occurring at the restored forest. Telemetry will provide information on home range sizes and time spent by individuals feeding and roosting at the restored site. All these data will be used to determine if the increase in survivorship and productivity at the restored forest have been sufficient to compensate for the requested take in Tier 1. Due to the small amount of information currently available about the basic biology of the Hawaiian hoary bat, the exact metric or combination thereof, to be used to determine the effectiveness of the mitigation, will an integral part of the research that will have to be fulfilled as part of the mitigation.

Take will be considered to be occurring at Tier 2 levels when the 5-year take limits for Tier 1 are exceeded within five years or if the 20-year take limit is exceeded at any time. Similarly, take will be considered to be occurring at Tier 3 levels when the 5-year take limits for Tier 2 are exceeded within five years of if the 20-year take limit for Tier 2 is exceeded at any time. If a Tier 2 or Tier 3 level of take occurs, additional research to investigate the reasons for the increased rate of take will be conducted, and additional measures to reduce the take will be implemented if possible. Additional mitigation measures will also be implemented to mitigate for the increased take.

Additional Research at Kawailoa Wind Power

In the event that take exceeds the threshold for Tier 1, Kawailoa Wind Power will review the fatality records in an effort to determine whether measures in addition to LWSC can be implemented that will reduce or minimize take. If causes cannot be readily identified Kawailoa Wind Power will conduct supplemental investigations that may include but not be limited to:

1. Additional analysis of fatality and operational data;
2. Deployment of acoustic bat detectors to identify areas of higher bat activity during periods when fatalities are occurring;
3. Using thermal imaging or night vision equipment to document bat behavior; and,
4. Determining whether certain turbines are causing most of the fatalities or if fatality rates are related to specific conditions (e.g., wind speed, other weather conditions, season).

Other measures to reduce bat fatalities will be implemented as identified and feasible and may include changes in project operations such as modifying structures and lighting. These data may also be used to refine low-wind speed curtailment criteria, such as revising the times of year when curtailment is implemented, or if curtailment can be confined to a subset of "problem" turbines. These additional measures will be implemented by Kawailoa Wind Power at the direction of USFWS and DLNR.

Additional Bat Habitat Management Measures for Tier 2 or Tier 3

Wetland restoration or forest restoration using the acreages described above will be conducted to mitigate for take requested at each higher tier (Tier 2 and Tier 3 level). Since the Tier 2 and Tier 3 requested take are multiples of the Tier 1 requested take (Tier 2 requested take is twice that of Tier 1 and Tier 3 requested take is three times), the mitigation effort for Tier 2 and Tier 3 will consist of implementing additional mitigation measures equivalent to the Tier 1 effort upon entering each higher tier.

Wetland Restoration

If wetland restoration is chosen as the mitigation measure, for each subsequent level, an additional 80 acres of wetland restoration and 40 acres of forest restoration as described in Tier 1 will be added to the on-going mitigation activities. The restoration may be modified depending on the outcome of the research that was conducted in Tier 1. Wetlands that may be restored include completing of the restoration of the 150 acre Ukoa Pond or conducting the wetland restoration at other locations such as Kawainui Marsh or other wetlands on Oahu.

Forest Restoration

If forest restoration is chosen as the mitigation measure, for each subsequent level, an additional 400 acres of forest restoration as described in Tier 1 will be added to the on-going mitigation activities. The actual acreage to be restored may be modified with the approval of DOFAW and USFWS if future research indicates that 400 acres is likely to be either insufficient or excessive.

Possible locations for native forest restoration and management on Oahu include forests currently managed by Kamehameha Schools or at Waimea valley, managed by Hiipaka LLC, a native Hawaiian non-profit organization. On Maui. possible locations include native habitat plant restoration and management at Kahikinui Forest Reserve, managed by DOFAW or on private land owned by Ulupalakua Ranch on Maui. Other areas for forest restoration on Oahu, Maui or other islands will be considered as necessary and the final location for forest restoration and management will be will be determined in consultation with DLNR, USFWS and bat experts. Mitigation can be conducted on Maui only if the bats on Maui and Oahu are determined to be genetically similar and not distinct sub-populations. Mitigation measures will require the approval of USFWS and DOFAW prior to implementation.

Other

If at the time of determination of Tier 2 or Tier 3 rates of take, more scientific information is available that indicates that the implementation of measures other than habitat restoration are more important or pressing in aiding the recovery of the Hawaiian hoary bat, Kawailoa Wind Power, with approval from USFWS and DLNR, will direct the specified funds toward whatever management action is deemed most appropriate at the time. No changes to Tier 1 mitigation measures are anticipated in the event that lower levels of take is determined.

Measures of Success

The success of the mitigation efforts will be determined as follows:

1. On-site research into Hawaiian hoary bat habitat utilization and bat interaction with wind facilities will be considered successful if Kawailoa Wind Power joins the HBRC and the specified survey and monitoring is carried out, including proper deployment and operation

of bat detectors, data reduction and analysis, and reporting of findings to DLNR, USFWS and ESRC.

2. Research at the either the wetland or forest restoration site will be considered successful if the study shows that the restoration increases bat productivity and survival to compensate for the requested take. The study design will be approved by USFWS and DOFAW and the results will be shared with USFWS and DOFAW within nine months of the completion of the study.
3. If wetland restoration is conducted (For Tier 1), mitigation will be considered successful if an increase in bat productivity is observed. If after five years it is determined that the wetland restoration is insufficient to meet Tier 1 obligations, then additional wetland restoration or forest restoration or other newer measures (see section 7.6.1.2) will be conducted to offset the deficit. This may extend the mitigation past the length of the ITP/ITL as necessary.
4. If forest restoration is conducted, mitigation will be considered successful if alien species control and ungulate control within the restored forest is successful and bat productivity activity rates are greater within the restored forest than in unrestored forest.
5. For Tier 2 and Tier 3 mitigation, which will consist of more wetland or forest restoration, mitigation will be deemed successful based on the same criteria established for the respective mitigation measure in Tier 1, with improvements incorporated as determined by the research conducted in Tier 1.

To ensure the success of the mitigation effort, Kawailoa Wind Power will establish a $350,000 Hawaiian Hoary Bat Contingency Fund. The fund will be compounded at 2.5% annually over the 20-year term of the HCP resulting in a maximum of $559,528 (if left unused through year 20). If the fund is drawn upon at any time, the interest will continue to accrue for the remaining balance. This fund will be available to implement adaptive measures to ensure that mitigation is commensurate with the requested take of the required tier. The fund may also be used to implement measures to reduce the likelihood of collisions on site as determined by USFWS and DOFAW. If at the end of the 20-year period the mitigation is still not commensurate with actual take, any remaining contingency funds will be used for further mitigation efforts. Mitigation measures will require the approval of USFWS and DOFAW prior to implementation.

2.2 Alternative 2 (Communications Site Layout Alternative)

2.2.1 Construction and Operation of Kawailoa Wind Power Facility

As described in Section 2.1, the project includes installation of up to eight microwave dish antennae in four different locations to provide a dedicated communication link between the wind farm and the HECO substations in Waialua and Wahiawa. Up to four antennae would be installed on two new communication towers at the Kawailoa wind farm site. The remaining antennae would be installed on existing structures at two different Hawaiian Telcom communication tower sites, both located on the north slope of Mt. Kaala.

In the event agreements cannot be made to use the existing structures, a new tower would be installed in an area adjacent to the existing structure at each site. The tower constructed adjacent to the Hawaiian Telcom building would be a 30-foot lattice steel tower supporting up to two antennae, which would be connected via waveguide cable to radio equipment inside the building. At the repeater site, a 20-foot lattice tower with up to two antennae would be constructed. Similar to the tower on the wind farm site, these would both have concrete foundations approximately 144 square feet in area (12 feet by 12 feet). The antennae, approximately 11 feet in diameter, would be mounted horizontally on the towers. This EA evaluates the impacts associated with the alternative of constructing a new tower at either one or both of the Mt. Kaala communication sites.

Compared to the Proposed Action, construction of the proposed project in the Communications Site Layout Alternative would require slightly more disturbance area at the Mt. Kaala Site (0.006 acres, Table 2-5). Wind farm site activities and disturbance would be the same as Alternative 1. Under Alternative 2, Covered Species are expected to be at the same risk of collision with WTGs and the additional met towers. Avoidance, minimization, mitigation, and management measures associated with the ITP are the same as Alternative 1.

Table 2-5. Approximate Areas of Disturbance under Alternative 2.

Project Component	Quantity	Description of Area to be Disturbed	Total Extent of Disturbance	Long-Term Vegetation Management	Permanent Footprint of Facilities
WIND FARM SITE					
Subtotal (Same as Alternative 1)			**335.1 acres**	**258.5 acres**	**21.7 acres**
MT. KAALA SITE					
Communication equipment at existing Hawaiian Telcom building	Up to 2 microwave antenna dishes	Dish mounted on new tower	0.003	--	0.003
Communication equipment at existing Hawaiian Telcom repeater station	Up to 2 microwave antenna dishes	Dish mounted on new tower	0.003	--	0.003
Subtotal			**0.003 acre**	**0 acre**	**0.003 acre**
ENTIRE PROJECT					
Total			**335.1 acres**	**258.5 acres**	**21.7 acres**

2.2.2 ITP Avoidance, Minimization, Mitigation, and Management Measures

Avoidance, minimization, mitigation, and management measures are the same at the wind farm site under Alternative 2 as described in Alternative 1. Measures at the Mt. Kaala site are described below. Details on the potential impacts of Alternative 2 compared to Alternative 1 are provided in Chapter 4.

2.2.2.1 Avoidance and Minimization Measures

In addition to Alternative 1 avoidance, minimization, mitigation, and management measures, in order to minimize direct impacts of the vegetation clearing on native mollusk species, additional mollusk surveys will be conducted, in coordination with USFWS and DOFAW staff, before any vegetation clearing or trimming at either site. No trimming of vegetation along the trails is anticipated. No vegetation will be cleared if the endangered *Achatinella* species are detected and the detections will be reported to USFWS and DOFAW. If *Achatinella* species are detected at the location of the proposed towers, the towers will not be erected.

2.2.2.2 Proposed Mitigation and Management Measures

Leaf litter will be collected before the area is graded and distributed to the surrounding area to allow any native snails in the leaf litter to move on to undisturbed ground. If a helicopter is used to deliver construction materials, it will remain 100 feet above ground level to avoid the impact of rotor wash on any *Achatinella* species that may be present in the vicinity. A post-construction report will be submitted to USFWS and DOFAW within a month of the installation of the off-site communications towers and will include survey methodology, results, and descriptions of minimization and avoidance measures implemented. No direct impacts to avian or mammalian species are expected to occur.

2.3 Alternative 3 – No Action Alternative

Under the No Action Alternative, the USFWS would not issue an ITP, as Kawailoa Wind Power 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 HECO’s obligation to meet these milestones. This scenario is also contrary to Kawailoa Wind Power’s fundamental purpose and objective as a business entity. Under the no build scenario, the entire project area would continue to be available for agricultural uses..

2.4 Alternatives Considered But Not Analyzed

2.4.1 Different Turbine Locations on Kamehameha School Property

Wind monitoring has been conducted to assess the strength and distribution of wind resources across Kamehameha Schools’ property. In combination with these data, several site constraints have been identified that affect project development. Cumulatively, these conditions were evaluated and used to determine which areas are suitable for project siting, resulting in the delineation of a series of corridors which defined the maximum project envelope. As such, the areas owned by Kamehameha Schools but not within the maximum project envelope were not considered to be feasible locations for project development, and were therefore eliminated from consideration.

As part of this effort, Kawailoa Wind Power specifically evaluated placement of wind turbines along the *mauka* (mountain-ward) portion of Opaeula Ridge, located immediately south of the current Kawailoa project site, below Anahulu Gulch. Accessible via Opaeula Road, the land is currently owned by Kamehameha Schools and, like Kawailoa, was also formerly used primarily for agriculture. However, assessment of the existing wind resources on Opaeula Ridge indicated an inadequate wind regime to support development on a wind farm. Therefore, the Opaeula lands were excluded from the maximum project envelope and have been eliminated from consideration.

2.4.2 Different Turbine Models and Sizes

Utility-scale wind energy production is now employed by many countries around the world, and the most common wind turbine design, by far, is the upwind, horizontal-axis wind turbine generator with a three-blade rotor. This design is the current industry standard, and is used at all the commercial wind farms operating in Hawaii. Proposals to provide equipment were received from several manufacturers, and these were reviewed and evaluated over several months to determine the most effective make and model for the project.

First, prospective turbines were analyzed for their suitability to the onsite wind resources, based on wind data collected over several months. Responses were narrowed to four turbine models that could generate the most energy in the constructible area available at the site. Second, these four models were screened for their electrical compatibility with the HECO grid, as part of their interconnection study. Only two models appeared capable of providing the various control features that would facilitate interconnection with the least negative impact to the transmission system. The third criterion was the consideration of turbine size and impacts. Of the two final turbine models, the General Electric (GE) 1.6 MW and the Siemens 2.3 MW machines, the smaller GE model would have required 43 turbines to be installed to generate the equivalent amount of energy output as 30 of the Siemens turbines. Installing fewer turbines is generally preferable, as it typically results in less site disturbance and fewer impacts in terms of visual, biological, and soil resources. Consequently, the Siemens 2.3 MW turbine was selected as the best suited for the Kawailoa Wind Power project.

2.4.3 Decreased Generating Capacity

Reducing the generating capacity for the project would decrease the project's contribution to Oahu's renewable energy portfolio and consequently reduce the benefits to the State. Furthermore, although requiring fewer turbines, a reduced capacity would not result in a proportionate reduction in permitting, construction and operation costs. The cost per megawatt increases as economies of scale are lost to fixed costs of transportation, logistics, mobilization, and other factors. Therefore, development of the project with a reduced generating capacity runs counter to the basic project objectives.

2.4.4 Increased Generating Capacity

The two existing HECO 46 kV sub-transmission lines that traverse the project site, the Waialua-Kahuku line and the Waialua-Kuilima line, have a combined available transmission capacity of 70 MW. Generating capacity exceeding 70 MW would require an additional POI to be established, possibly several miles away from the project site, requiring significantly more offsite infrastructure and improvements to the existing HECO system. Therefore, increasing the generating capacity of the Kawailoa wind farm to more than 70 MW has been eliminated from further consideration.

2.4.5 Wind Farm Development Elsewhere on Oahu

As described in Section 2.1, HECO issued an RFP for renewable energy projects for the island of Oahu in June 2008. A proposal was submitted to HECO that detailed the development of a 70 MW wind farm on the Kawailoa parcel of Kamehameha Schools' property; the proposal was subsequently selected by HECO to be one of several projects in its final award portfolio of renewable energy projects. Following the selection by HECO, Kawailoa Wind Power negotiated a Site Lease Development Agreement with Kamehameha Schools, allowing them exclusive rights to development of a wind farm at the site. As such, this is the only property on Oahu that Kawailoa Wind Power has rights to, and HECO has selected for development. Furthermore, in terms of wind resource availability and constructability, the Kawailoa property is believed to be one of the last few remaining parcels on Oahu that is suitable for development of a wind energy project. For these reasons, alternative sites on Oahu, to the extent they exist and may be available, are not being considered for development of a wind farm project at this time.

2.4.6 Delayed Implementation of Project

As part of its June 2008 RFP, HECO required that all selected renewable energy projects for the island of Oahu commence commercial operation between 2010 and 2014, with preference for those that achieve commercial operation before 2013. Kawailoa Wind Power's current agreement with HECO establishes a commercial operation date no later than December 2013. The parties are now engaged in power purchase negotiations and expect to submit the PPA to the State Public Utilities Commission in 2011. Consequently, Kawailoa Wind Power is not considering a delayed development schedule for the project.

2.4.7 Alternate Energy Storage Technologies

A variety of wind storage technologies can be used for wind farm projects; the effectiveness of each technology is typically dependent on site development and operation factors specific to the wind energy facility. A BESS was selected as the preferred technology for use at the Kawailoa wind farm. This technology offers both environmental and electrical advantages. These include the use of non-toxic materials and a small footprint, as well as an instantaneous response time and a reasonably long cell life (thus allowing thousands of charge and discharge events).

Other energy storage technologies that were considered include pumped water storage, superconducting magnetic energy storage, compressed air storage, thermal energy storage and flywheel storage. A brief description of each technology is provided below, along with the rationale for why it is not being pursued as part of the project.

- Pumped Water Storage: Pumped water storage (often called "pumped hydro") is probably the best known large-scale energy storage technology. It consists of pumping water to a high storage reservoir using available power that is not immediately needed. The stored water is then released through turbo-generators to produce electricity when it is most needed (in this case when the wind is not blowing). Pumped water storage recovers 80 to 90 percent of the energy consumed by the pumps (that is, the electrical generator that is driven by the water released from the reservoir produces 80 to 90 percent as much electricity as is consumed by pumping water into the storage reservoir). The chief challenge with pumped water storage is that it typically requires an adequate water supply, and two reservoirs of sufficient size at considerably different elevations; there are few locations on Oahu that are well-suited for water storage at this scale. Moreover, it often requires considerable capital expenditure and energy to pump the water, thus increasing the cost of the electricity that is produced. The lack of an available fresh water source combined with the lack of existing infrastructure precludes the use of pumped storage for this project.

- Superconducting Magnetic Energy Storage: Superconducting magnetic energy storage (SMES) systems store energy in a magnetic field created by the flow of direct current in a superconducting coil that has been cooled to a temperature below the point at which it becomes a superconductor. A typical SMES system includes three parts: (1) a superconducting coil, (2) a power-conditioning system, and (3) a cryogenically cooled refrigerator. Once the superconducting coil is charged, the current does not decay and the magnetic energy can be stored indefinitely. The stored energy can be released back to the network by discharging the coil. An SMES system loses less electricity in the energy storage process than other methods of storing energy (less than 5 percent). The advantage of having low losses is offset by the high energy requirements for refrigeration and of the superconducting wire. Because of this, SMES is typically used for short duration energy storage, such as that needed to improve power quality. An SMES system is not suitable for the Kawailoa wind farm project because of the very high costs, the energy requirements for refrigeration, and the limits in the total amount of energy that can be stored.

- Compressed Air Storage: A compressed air energy storage (CAES) plant stores electrical energy in the form of air pressure, then recovers this energy as an input for future power generation.[7]When applied to wind energy, this technology uses electricity from the wind turbines to compress air, which is then stored in airtight underground caverns. While it is a promising technology for some locations in the continental U. S., this technology is not suitable for Oahu because of a lack of suitable underground storage conditions.

- Thermal Storage: Several technologies are available that can store energy in a thermal reservoir for later reuse. The thermal reservoir may be maintained at a temperature above (hotter) or below (colder) than that of the ambient environment. The principal application today is the production of ice or chilled water at night which is then used to cool environments during the day. Thermal energy storage technologies are most useful for storing energy that originates as heat in an insulated repository for later use for space heating or for domestic or process hot water heating. They are generally not well suited for storing electrical energy and consequently are not considered to be viable energy storage options for the Kawailoa wind farm.

- Flywheel Storage: This form of storage uses electricity from the wind turbines to power an electric motor that accelerates a heavy rotating disc, which, in turn, acts as a generator on reversal, slowing down the disc and producing electricity. Mechanical inertia is the basis of this storage method, with electricity stored as the kinetic energy of the rotating disc. However, the range of

[7] Essentially, the CAES cycle is a variation of a standard gas turbine generation cycle. In the typical simple cycle gas fired generation cycle, the turbine is physically connected to an air compressor. Therefore, when gas is combusted in the turbine, approximately two-thirds of the turbine's energy goes back into air compression. With a CAES plant, the compression cycle is separated from the combustion and generation cycle. When the CAES plant regenerates the power, the compressed air is released from the cavern and heated through a recuperator before being mixed with fuel and expanded through a turbine to generate electricity. Because the turbine's output no longer needs to be used to drive an air compressor, the turbine can generate almost three times as much electricity as the same size turbine in a simple cycle configuration, using far less fuel per MWh produced. The stored compressed air takes the place of gas that would otherwise have been burned in the generation cycle and used for compression power.

power and energy storage technically and economically achievable with this technology are quite limited, making flywheel storage unsuitable for power system applications such as the Kawailoa wind farm.

None of the storage technologies listed above provides an effective and viable means of storing the large amount of wind-generated energy that would be produced by the Kawailoa wind farm, and therefore, was given further consideration in the FEIS (CH2M Hill 2011b).

2.4.8 Different Sources of Renewable Energy

The expertise of Kawailoa Wind Power is specific to wind energy generation. It has an extensive experience of implementing wind development projects in a cost-effective and environmentally friendly manner. The Kawailoa wind farm would not exclude or replace other renewable energy resources, but instead, would contribute to the growth and diversification of Oahu's renewable energy portfolio. Under the competitive bidding framework ordered by the State Public Utilities Commission, HECO must issue a Request for Proposals for any alternative energy projects larger than 5 MW in capacity on Oahu. Other than the expansion of the Honolulu Project of Waste Energy Recovery (H-Power) facility, no other renewable energy projects larger than 10 MW will be constructed on Oahu until HECO issues an RFP. For these reasons, no other sources of renewable energy are being considered by Kawailoa Wind Power.

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 Oahu vary as a result of several different factors in the physical environment (Juvik and Juvik 1998).

Local climatic conditions within the project area are characteristic of lowland areas (and mountain slopes at the offsite communication tower facilities) on the windward side of Oahu, with relatively constant temperatures and persistent northeast trade winds. Average monthly temperatures in the area range from 67.3 °F in January to 76.6 °F in August (Western Regional Climate Center 2005b). Annual mean precipitation in the area ranges from 22.5 inches near the makai (seaward) portion of the project area to slightly over 56 inches near the mauka (inland) portion of the project area (Western Regional Climate Center 2005a). Prevailing northeasterly trade winds in the area generally blow from 12.3 to 15.7 mph (AWS Truewind 2004). However, during "Kona" storm conditions, the prevailing winds change to a south/ southwesterly direction. 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 (Juvik and Juvik 1998).

The offsite communication towers at Mount Kaala are located in regions classified as rainy mountain slopes along the windward sides of the island. In these areas, rainfall and cloudiness are very high, with considerable rain during both the winter and summer months. Temperatures are equable, and humidity is higher than the other six Hawaii climatic regions (WRCC 2010).

3.1.1 Global Climate Change

According to the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), global climate change is very likely due to anthropogenic greenhouse gas (GHG) concentrations (IPCC 2007a, 2007b). Greenhouse gases, which include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), are chemical compounds in the Earth's atmosphere that trap heat. Of these gases, CO_2 is recognized by the IPCC as the primary greenhouse gas affecting climate change (IPCC 2007a, 2007b). Present atmospheric 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. It is also very likely that observed increases in CH_4 are also partially due to fossil fuel use (IPCC 2007a, 2007b). Effects of global climate change include increased global average air and ocean temperatures, rising sea levels, changing precipitation patters, growing frequency and severity of storms, and increasing ocean acidification.

The maritime location of the Hawaiian Islands makes the archipelago relatively well buffered climatically (Benning et al. 2002). However, climatic changes have been documented throughout the state. Average air temperature increases of 0.3196°F per decade have been recorded in Hawaii (Giambelluca et al. 2008), with higher elevations warming faster than lower elevations. Tide gauges at sea level at the Honolulu Harbor estimate that sea level has risen at 0.06 ± 0.1in/year over the past century (Caccamise et al. 2005). Some estimates forecast that a 3.3 feet rise in sea level is possible by the end of the century for Hawaii (Fletcher 2009). Sea surface temperatures near the islands have been increasing recently, showing an average 0.72°F rise between 1957 and 1987 (Giambelluca et al. 1996). Ocean acidification and its effects on marine ecosystems are also especially relevant to the Hawaii. Marine taxa, especially those with skeletons and shells, are vulnerable to seawater carbonate system changes as a result of rising atmospheric concentrations of CO_2 (Guinotte and Fabry 2008).

3.2 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 State of Hawaii also participates in the national $PM_{2.5}$ speciation and air toxics monitoring programs (DOH Clean Air Branch 2008, 2009). Six DOH air quality monitoring stations are present on the Island of Oahu. No air quality monitoring stations exist on the North Shore of Oahu. The closest station to the project area is located in Pearl City, roughly 14.5 miles to the south of the Kawailoa project area. This station monitors PM_{10}, $PM_{2.5}$, speciation, and air toxics. Average annual criteria pollutant levels at this station are generally well below the state and federal ambient air quality standards (DOH, Clean Air Branch 2008, 2009).

Air quality in 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. These include: dust that naturally arises when strong winds sweep across open fields or exposed slopes; vehicle emissions from nearby roads; wildfires or anthropogenic fires; agricultural sources; construction activities; and irregular volcanic emission from the Island of Hawaii.

3.3 Geology, Topography and Soils

The topography of Oahu is characterized by broad central valleys in the interior portions and tall, steep slopes on the coastal areas as a result of erosion from wind, rain and sea (Moore 1964, Polhemus 2007). The two mountain ranges, the Koolau Mountain Range in the east and the Waianae Mountain Range in the west, are roughly parallel and oriented on a northwest to southeast axis. The project area consists of various ridges gently sloping toward the ocean that are dissected by several small gulches (Hobdy 2010a, 2010b). Named gulches within the project area include: Kaalaea, Kawailoa, Laniakea, and Loko Ea. Elevations range from 200 feet above sea level at the western makai portion of the project area to approximately 1,280 feet above sea level at the eastern mauka side of the project area (CH2M Hill 2011b). No significant topographical features exist on any of the land parcels.

The offsite communication towers are located on flat areas immediately adjacent to steep slopes within the northern portion of the Waianae Mountain. The sites are near the summit of Mount Kaala, the tallest peak on Oahu at 4,020 feet. The Hawaiian Telcom site is located at roughly 3,675 feet elevation and the Repeater Station site is located at roughly 3,773 feet elevation (SWCA 2010c).

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. Oahu, the third largest island in the Hawaiian archipelago, was created by several geological processes. These include shield-building volcanism, subsidence, weathering, erosion, sedimentation, and rejuvenated volcanism (Hunt 1996). Oahu is mostly composed of the heavily eroded remnants of two large Pliocene shield volcanoes - Waianae and Koolau (Juvik and Juvik 1998). The extinct Koolau and Waianae Volcanoes were formed about 2.2 to 2.5 million years ago and 2.7 to 3.4 million years ago, respectively (Juvik and Juvik 1998; Lau and Mink 2006).

The project area is located on the Schofield Plateau, an alluvial fan of erosional unconformity that formed when lava flows from the Koolau Volcano banked against the eroded slope of the Waianae Volcano (Macdonald et al. 1983). The majority of the project area is underlain by Koolau Basalt lava flows that were active 1.8 to 3 million years ago. A narrow strip of alluvial sand and gravel is present in the southern portion of the project area. No unique or unusual geologic resources or conditions are known from the site.

Various soil types have developed throughout the Island of Oahu as the basaltic lavas and volcanic ash from the volcanoes have weathered and decomposed (Juvik and Juvik 1998). Soils on the Island of Oahu were classified and defined by the U. S. Department of Agriculture (USDA) Soil Conservation Service and Natural Resource Conservation Service (NRCS) (Foote et al. 1972).

The three primary soil types underlying the project area are Helemano silty clay, 30-90% slopes; Wahiawa silty clay, 3-8% slopes; and Leilehua silty clay, 2-6% slopes. The soils in the gulches are of the Rough Mountainous Lands and Rock Lands Series (Foote et al. 1972). According to the NRCS National Hydric Soils List, none of the soils in the project area is considered hydric (NRCS 2010).

Two soil types occur at the communication facility sites: Helemano silty clay, 30-90% slopes and Kemoo silty clay, 30-70% slopes (Foote et al. 1972). These soils are not considered hydric (NRCS 2010).

3.4 Hydrology and 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.

Executive Order 11990 requires federal agencies to ensure their actions minimize the destruction, loss or degradation of wetlands. In carrying out their actions, each agency shall preserve and enhance the natural and beneficial values of wetlands.

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.

3.4.1 Surface Water

Hydrologic processes in Hawaii are highly dependent on the climatic and geological features, and stream flow is influenced by rainfall and wind patterns. Permeable underlying rock may cause some streams on Oahu to have lengthy dry reaches under natural conditions. The majority of the perennial streams on Oahu are located in the windward Koolau Mountains which produce a larger amount of orographic precipitation compared to the leeward side (Polhemus 2007). The project area is located within six watersheds of the Waialua region on narrow east-west trending lands. The six watersheds from north to south are the: Waimea, Keamanea (includes Kaalaea and Laniakea), Kawailoa, Loko Ea, and Anahulu. Within these watersheds are several streams, ponds, and wetlands (DAR 2008, State GIS 2011). The Jurisdictional Wetland Boundary Determination provides additional detail on these resources (SWCA 2010b). Table 3.1 provides a list of streams within the project area.

Table 3-1. Streams within the Kawailoa Project Area.

Stream	DAR Watershed	Perennial /Intermittent	Total Length
Waimea	Waimea	Perennial	64.4 mi
Kaalaea	Kaalaea	Non-perennial	5 mi
Kawailoa	Kawailoa	Non-perennial	9.2 mi
Laniakea	Laniakea	Non-perennial	7.2 mi
Loko Ea	Loko Ea	Perennial	2.2 mi
Anahulu	Anahulu	Perennial	64.6 mi
Source: DAR (2008), SWCA (2011).			

Waimea: The Waimea River and its four tributaries – Elehaha, Kaiwikoele, Kamananui, and an unnamed tributary - flow near the northern boundary of the project area and discharge into Waimea Bay. Only the unnamed tributary of the Waimea River and the Waimea River mainstream occur within the project parcels. Waimea River is a jurisdictional perennial water body and the unnamed tributary is non-perennial probable jurisdictional stream.

Keamanea: The Kaalaea stream and its tributaries are non-perennial non-jurisdictional areas within the project area. The Laniakea stream and its major tributaries are non-perennial probable jurisdictional areas within the project area.

Kawailoa: The Kawailoa stream and its major tributaries are non-perennial probable jurisdictional areas within the project area.

Loko Ea: The Loko Ea stream is a perennial probable jurisdictional area within the project area.

Anahulu: The Anahulu River runs near the southern portion of the project area and discharges into Waialua Bay. The jurisdictional Anahulu River has two perennial tributaries, Kawainui and Kawaiiki Streams, which join the mainstream immediately mauka of the eastern boundary of the project area. Each of these tributaries is diverted once, supplying water to the Kaiwainui Ditch System (DAR 2008; SWCA 2008). There are several reservoirs associated with the ditch system. Two are located on Anahulu River at 968 feet and 781 feet (SWCA 2008).

A former Hawaiian fishpond, Ukoa Pond, occurs seaward and outside of the project parcels near the intersection of Kawailoa Drive and Kamehameha Highway. The extent of this basal, spring-fed pond was reduced due to dumping and filing within the old Kawailoa Landfill (Elliott and Hall 1977; Miller et al. 1989). Loko Ea is both the name of the waterway that historically drained Ukoa Pond to the sea at Haleiwa Harbor (Miller et al. 1989) and of the influent intermittent gulch above the pond.

3.4.2 Flooding

The Flood Insurance Rate Maps (FIRM) prepared by the Federal Emergency Management Agency's National Flood Insurance Program depicts flood hazard areas through the state. The maps classify land into four zones depending on the expectation of flood inundation. The project area is almost entirely within Flood Zone D where analysis of flood hazards has not been conducted and flood hazards are undetermined. Near the mouths of several streams (Kawailoa, Laniakea, Loko Ea, and Anahulu) the land is identified as Flood Zone X, an area defined as having less than 0.2% annual risk of flood inundation. The proposed mountaintop Mount Kaala communication tower sites are in an area designated by FEMA as unstudied, and therefore have not been classified for flood hazard.

3.4.3 Groundwater

Oahu has a vast amount of groundwater, which supplies most of the domestic water supply (Macdonald et al. 1983; Lau and Mink 2006). The project area is located over the north hydrologic sector of the Kawailoa aquifer system (as designated by DLNR 2010). The Kawailoa aquifer system is within the central Oahu groundwater flow system (Oki 1998). Groundwater in the Kawailoa aquifer system is thought to drain northwest toward the Waimea coast.

The northern aquifer on the island of Oahu includes three sub-aquifers: Mokuleia in the Waianae formation, as well as the Waialua and Kawailoa in the Koolau formation. These areas are underlain by a deep wedge of sedimentary caprock that creates thick basal lenses (Hunt 1996). However, the Hawaii Stream Assessment (CWRM 1990) notes that the Kawailoa System, which encompasses the Anahulu River, lacks an effective caprock. This absence of a caprock boundary allows free movement of the groundwater to the ocean (Oki et al. 1999).

In the late 1970s, the USFWS Division of Ecological Services biologists used orthophoto quadrangle maps and spot field checks to map wetlands in Hawaii as a part of the National Wetlands Inventory (NWI) Program according to the Cowardin et al. (1979) classification system. According to the USFWS definition, several wetland types are located within the project area including: Freshwater Pond (PUBH, PUBHh, PUBHx), Riverine (R4SBCx), Freshwater Emergent Wetland (PEM1Cx), and Freshwater Forested/Shrub Wetland (PFO3C) (SWCA 2010b).

SWCA biologists conducted a wetland assessment in the project area to identify any wetlands or other waters subject to U.S. Army Corps of Engineers (USACE) jurisdiction under Section 404 of the Clean Water Act. No wetlands meeting the three established criteria of hydrophilic vegetation, soils, and water regime were found to occur within the areas to be affected by construction and operation of the proposed wind power facility or offsite communication tower sites (SWCA 2010b).

3.5 Biological Resources - Flora

Botanical surveys of the project area were conducted by Robert Hobdy in February (Hobdy 2010a) and August 2010 (Hobdy 2010b). Hobdy walked multiple routes throughout the property and more intensively examined areas most likely to support native plants (e.g., gulches, steep slopes, and rocky outcrops). Hobdy recorded approximately 183 plant species within the project area in February (Hobdy 2010a) and an additional 40 species during the survey in August (Hobdy 2010b). No state or federally listed endangered, threatened, or candidate plant species, nor species considered rare throughout the Hawaiian Islands, were found in the project area by Hobdy. No portion of the project area has been designated as critical habitat for any listed plant species.

The vegetation in the project area is a mixture of aggressive weedy species that have taken over since the abandonment of sugar cane agriculture. Guinea grass (*Urochloa maxima*) is the most abundant species on the property, forming deep growth on all the ridge tops and in many of the gulches (Hobdy 2010a, 2010b). Other common species include: common ironwood (*Casuarina equisetifolia*), albizia (*Falcataria moluccana*), Formosan koa (*Acacia confusa*), koa haole (*Leucaena leucocephala*), Padang cassia (*Cinnamomum burmanni*), Java plum (*Syzygium cumini*), strawberry guava (*Psidium cattleianum*), cork bark passion flower (*Passiflora suberosa*) and swamp mahogany (*Eucalyptus robusta*). All of these species are non-native to the Hawaiian Islands (Hobdy 2010a, 2010b). Although the project area is believed to have been forested with a variety of native trees, shrubs, ferns, and vines in pre-contact times, few native species persist in the project area today. The lack of native species is attributed to years of agricultural activities and invasion by non-native plant and animal species (Hobdy 2010a, 2010b). Large remnants of native vegetation occur on steep slopes of the gulches in the upper parts of the property. Thirty native plant species were identified in the project area, of which 13 are endemic to the Hawaiian Islands (found only in Hawaii). Seven species that were introduced by Polynesians also occur in the project area (Hobdy 2010a, 2010b). Table 3-2 lists native plant species recorded in the project area by Hobdy (2010a, 2010b).

Table 3-2. Native Hawaiian Plants Observed in the Kawailoa Project Area.

Scientific Name	Hawaiian & Common Names	Status[1]
FERNS		
DENNSTAEDTIACEAE (Bracken Family)		
Pteridium aquilinum (L.) Kuhn var. *decompositum* (Gaud.) R. M. Tryon	kilau	E
DICKSONIACEAE (Dicksonia Family)		
Cibotium chamissoi Kaulf.	hapuu	E
GLEICHENIACEAE (False Staghorn Fern Family)		
Dicranopteris linearis (Burm.f.) Underw.	uluhe	I
LINDSAEACEAE (Lindsaea Fern Family)		
Sphenomeris chinensis (L.) Maxon	palaa	I
NEPHROLEPIDACEAE (Sword Fern Family)		
Nephrolepis exaltata (L.) Schott	nianiau	I
POLYPODIACEAE (Polypody Fern Family)		

Scientific Name	Hawaiian & Common Names	Status[1]
Lepisorus thunbergianus (Kaulf.) Ching	pakahakaha	I
PSILOTACEAE (Whisk Fern Family)		
Psilotum nudum (L.) P. Beauv.	moa	I
MONOCOTS		
ASPARAGACEAE (Asparagus Family)		
Pleomele halapepe St. John	halapepe	E
CYPERACEAE(Sedge Family)		
Carex meyenii Nees	--------------	I
Carex wahuensis C.A. Meyen	--------------	E
Cyperus polystachyos Rottb.	--------------	I
PANDACEAE(Screwpine Family)		
Freycinetia arborea Gaud.	ieie	I
POACEAE(Grass Family)		
Chrysopogon aciculatus (Retz.) Trin.	pilipili ula	I
DICOTS		
ASTERACEAE (Sunflower Family)		
Bidens sandvicensis Less	kookoolau	E
EBENACEAE (Ebony Family)		
Diospyros sandwicensis (A. DC.) Fosb.	lama	E
ERICACEAE (Heath Family)		
Leptecophylla tameiameiae (Cham. & Schlect.) C. M. Weiller	pukiawe	I
FABACEAE (Pea Family)		
Acacia koa A. Gray	koa	E
Vigna marina (J. Burm.) Merr.	nanea	I
GOODENIACEAE (Goodenia Family)		
Scaevola gaudichaudiana Cham.	naupaka kuahiwi	E
LAURACEAE (Laurel Family)		
Cassytha filiformis L.	kaunaoa pehu	I
MENISPERMACEAE (Moonseed Family)		
Cocculus orbiculatus (L.) DC.	huehue	I
MYOPORACEAE (Myoporum Family)		
Myoporum sandwicense A. Gray	naio	
MYRTACEAE (Myrtle Family)		
Metrosideros polymorpha Gaud. var. *polymorpha*	ohia	E
OLEACEAE (Olive Family)		
Nestegis sandwicensis (A. Gray) Degener, I. Degener & L. Johnson	olopua	E
ROSACEAE (Rose Family)		
Osteomeles anthyllidifolia (Sm.) Lindl.	ulei	I
RUBIACEAE (Coffee Family)		

Scientific Name	Hawaiian & Common Names	Status[1]
Psychotria mariniana (Cham. & Schlectend) Fosb.	kopiko	E
Psydrax odorata (G. Forst.) A.C. Smith & S.P. Darwin	alahee	I
SANTALACEAE (Sandalwood Family)		
Santalum freycinetianum Gaud. var. *freycinetianum*	iliahi	E
SAPINDACEAE(Soapberry Family)		
Dodonaea viscosa Jacq.	aalii	I
STERCULIACEAE (Cacao Family)		
Waltheria indica L.	uhaloa	I
THYMELAEACEAE (Akia Family)		
Wikstroemia oahuensis (A. Gray) Rock.	akia	E
(1) E= endemic (native only to Hawaii); I= indigenous (native to Hawaii and elsewhere).		
Source: Hobdy (2010a, 2010b).		

Hobdy conducted a botanical survey of the Mount Kaala offsite communication tower sites in August 2010. He surveyed the two 0.1 acre communication tower sites on the ridge top, as well as a 30 feet buffer downslope of the tower sites. No State- or Federally listed endangered, threatened or candidate plant species were observed during the survey, nor were any species considered rare throughout the Hawaiian Islands (Hobdy 2010c). A total of 63 plant species were recorded; 30 non-native and 33 native species. The non-native vegetation was limited to the two communication tower sites on the ridge top which were previously cleared and have been maintained in this condition for over 30 years. The native vegetation was mostly limited to the buffer outside and downslope of the proposed communication tower sites (Hobdy 2010c). A complete list of the plant species documented at the Mount Kaala site is included in the HCP.

Nine plant species have critical habitat designations that encompass the tower sites. The plant species are *Alsinidendron trinerve, Cyanea acuminate, Cyanea longiflora, Diplazium molokaiense, Hedyotis parvula, Labordia cyrtandrae, Phyllostegia hirsute, Tetramolopium lepidotum* ssp*. lepidotum, Viola chamissoniana* ssp*. chamissoniana.* None of the plant species with designated critical habitat that encompass the tower sites are present on-site at the two tower locations.

3.6 Biological Resources - Wildlife

Wildlife occurring on or flying over the project area has been investigated through a combination of pedestrian surveys (Hobdy 2010a, 2010b), visual bird surveys (SWCA 2010a), nocturnal radar surveys (Cooper et al. 2011, Cooper and Sanzenbacher 2011), and the use of bat detection devices (SWCA 2010a). Botanical surveys and a one-time avian survey were conducted at the off-site microwave facility sites (Hobdy 2010c). A mollusk survey was also conducted at the off-site microwave facility sites (SWCA 2010c). Endangered mollusks have only been documented in recent times in native forests at elevations greater than 1,312 feet on Oahu (USFWS 1992). As the project site is lower in elevation and dominated by non-native vegetation, these snails are not expected to be found at the project site. Thus, no mollusk survey was conducted at the project site.

Nocturnal radar surveys were conducted on site in an effort to identify seabirds that may potentially transit the project area during crepuscular and night periods from 1800-2100 h and 0400-0600 h. Surveys were conducted in June and October 2009 and June 2011. Radar surveys were conducted at four locations to provide representative coverage of the project site. The summer surveys coincide with the incubation periods of the Hawaiian petrel and Newell's shearwater and the fall surveys coincide the fledgling periods for both species. Criteria used to identify possible shearwaters/petrels consisted of radar targets moving at airspeeds greater than 30 miles per hour, of the appropriate size, flying inland or seaward only (not parallel to shore) and exhibiting directional flight (Cooper et al. 2011).

Point counts, playbacks and driving transects were conducted on and off-site to maximize the possibility of documenting native birds on-site and at nearby water bodies. SWCA began conducting avian point count surveys in the project area in October 2009. A total of 29 point count stations were surveyed from October 2009 to February 2011. A 0.6 mile (1 km) buffer around potential turbine locations was created and an "airspace envelope" developed around each turbine string. All flight observations occurring at point count stations within the 0.6 mile (1 km) airspace envelope were considered to be within the possible area of turbine interaction and were deemed "on-site." Point count stations outside the airspace envelope were considered to be "off-site." Point count stations were located to sample representative habitats within the project area, close to potential turbine locations. Additional point counts were also added at waterbodies in the vicinity of the project area, to document waterbird activity at the nearby waterbodies. The months during which individual point counts were sampled varied over the course of the year, depending on the proposed turbine configuration which changed over time. Two to nine200 m radius point count stations were surveyed during each session. Sessions were conducted in the morning (0600 – 1100 h), and evening (1400 – 1930 h). Each point count lasted15 minutes per station. Point counts at the nearby water features were chosen in an effort to gain a better understanding of the activity patterns of the threatened and endangered species covered by the HCP, as well as to document the arrival and activity patterns of non-listed migratory bird species.

Playbacks of moorhen calls at the ponds were also conducted from the end of May 2010 to the end of September 2010. Playbacks consisted of playing chick distress calls for 30 seconds, followed by 30 seconds of silence, then 30 seconds of moorhen territorial calls followed by another 30 seconds of listening for a response. The calls chosen were calls that are most likely to elicit a response from nearby moorhen (DesRochers et al. 2008). These calls were recorded from James Campbell Wildlife Refuge and obtained from Tufts University. Playbacks have been shown to increase detection by 30% on Oahu (DesRochers et al. 2008). Due to time constraints, point counts were shortened to 13 minutes (2 minutes of playback plus 13 minute point count observations) when playbacks were conducted. To increase the probability of detecting waterbirds, driving transects were conducted between April and July 2010. As sightings of waterbirds primarily occurred near the ponds, driving transects were conducted between ponds to document waterbird activity between ponds. Transects were also conducted along parts of the turbine string that were accessible by road. The vehicle was driven at speeds between 5 miles per hour and 15 miles per hour and occurrences of all native birds (waterbirds and owls) were recorded. Incidental sightings of all native birds were also recorded while biologists were onsite.

To quantify bat activity in the project area, two to eight Anabat detectors (Titley Electronics, NSW, Australia) were deployed at various locations at Kawailoa Wind Power from October 2009 to present. Anabat detectors record any ultrasonic sounds emitted by bats. These sounds are subsequently downloaded and analyzed by examining the sonograms of recorded sound files to confirm the presence of bats by identifying their echolocation (ultrasonic) calls. Anabat detectors were moved to new locations to increase the coverage of the area sampled at the project site.

3.6.1 Non-Federally Listed Species

Birds: Table 3-3 identifies all birds detected during the point count and radar surveys. Included in this table are scientific and common names of each species as standardized by the American Ornithologists' Union, biogeographical status of each species throughout Hawaii, State and Federal listing status, indication of whether the observed species is protected by the MBTA, and the location where the species were detected (i.e., onsite, offsite, or both). Key avian species (i.e., waterbirds and shorebirds) that are not Federally or State-listed, but occur onsite or in the vicinity of the project area, are discussed below.

Table 3-3. Bird Species within the Kawailoa Project Area, Nearby Ponds, and Vicinity.

Common Name	Scientific Name	Status[1]	MBTA	On-site	Off-site	Others
Newell's shearwater	*Puffinus auricularis newelli*	E, *T*	X	X[2]		
Great frigatebird	*Fregata minor*	I	X			X (WaimeaValley)
Cattle egret	*Bubulcus ibis*	NN	X	X	X	
Black-crowned night heron	*Nycticorax nycticorax*	I	X	X	X	
Mallard	*Anas platyrhynchos*	NN	X		X	
Hawaiian duck-mallard hybrids	*Anas* sp.	E	X	X[3]	X	
Muscovy	*Cairina moschata*	NN			X	
Domestic duck	*Anas platyrhynchos domestica*	NN			X	
Domestic geese	*Ana anser domesticus*	NN			X	
Gray francolin	*Francolinus pondicerianus*	NN		X	X	
Black francolin	*Francolinus francolinus*	NN		X	X	
Domestic chicken	*Gallus gallus*	NN		X	X	
Common peafowl	*Pavo cristatus*	NN		X		
Hawaiian coot	*Fulica alai*	E, *E*	X		X	
Hawaiian moorhen	*Gallinula chloropus sandvicensis*	E, *E*	X		X	
Pacific golden-plover	*Pluvialis fulva*	V	X	X	X	
Spotted dove	*Streptopelia chinensis*	NN		X	X	
Zebra dove	*Geopelia striata*	NN		X	X	
Barn owl	*Tyto alba*	NN	X	X	X	
Skylark	*Alauda arvensis*	NN				X (Opaeula Road)
Red-vented bulbul	*Pycnonotus cafer*	NN		X	X	
Red-whiskered bulbul	*Pycnonotus jocosus*	NN		X	X	
Japanese bush-warbler	*Cettia diphone*	NN		X	X	

Common Name	Scientific Name	Status[1]	MBTA	On-site	Off-site	Others
White-rumped shama	*Copsychus malabaricus*	NN		X	X	
Red billed leothrix	*Leiothrix lutea*	NN		X	X	
Japanese white-eye	*Zosterops japonicus*	NN		X	X	
Common myna	*Acridotheres tristis*	NN		X	X	
Red-crested cardinal	*Paroaria coronata*	NN		X	X	
Northern cardinal	*Cardinalis cardinalis*	NN	X	X	X	
House finch	*Carpodacus mexicanus*	NN	X	X	X	
Common waxbill	*Estrilda astrild*	NN		X	X	
Red avadavat	*Amandava amandava*	NN		X	X	
Nutmeg mannikin	*Lonchura punctulata*	NN		X		
Chestnut munia	*Lonchura malacca*	NN		X		
	Total species			**26**	**28**	**2**

1) E= endemic; I = indigenous, V = visitor, NN = non-native permanent resident; *E* = Endangered, *T* = threatened.
2) Based on radar data, not confirmed by visual assessment.
3) Presumed.

A total of 26 bird species were detected onsite, three were native species and one a winter migrant. The native species were the threatened Newell's shearwater (presumably detected during radar surveys), the black-crowned night heron and the Hawaiian duck-mallard hybrid and the one winter migrant, the Pacific golden-plover. An additional eight species were observed at nearby ponds and in the vicinity of the project area; native birds included the endangered Hawaiian coot, the endangered Hawaiian moorhen and the great frigatebird. The remaining species were introduced species.

<u>Birds (Herons and Egrets)</u>: The indigenous black-crowned night-heron (*Nycticorax nycticorax*) is a cosmopolitan species resident on the main Hawaiian Islands (Pratt et al. 1987; Hawaii Audubon Society 2005). The black-crowned night heron was identified as a species of "Moderate Concern" in *The North American Waterbird Conservation Plan* (Kushlan et al. 2002). Populations of species given this designation are declining with moderate threats or distribution, stable with known or potential threats and moderate to restricted distributions, or are relatively small with relatively restricted distributions. In Hawaii, this species is considered a nuisance by aquaculture farmers. A total of six sightings of the native black-crowned night heron have been recorded onsite (two during point count surveys, three incidental sightings, and one sighting during driving transects). All sightings were of single birds in flight. Birds were observed in flight at the ponds in the area or flying near the lower met tower on Kawailoa Road or in the area between the met tower and a nearby pond. No birds have been observed foraging at the irrigation ponds onsite. No birds were observed flying within the rotor swept zone of either turbine type.

Thirteen observations of the black-crowned night heron were recorded (nine during point count surveys and four incidental sightings) at the adjacent water bodies. Flock size ranged from one to two birds with an average of one bird. This species was observed in flight at various ponds. The black-crowned night heron is also frequently seen foraging (i.e., not in flight). The black-crowned night heron was present on-site or off-site for all months of the year except January and February. Based on observations, the black-crowned night heron is likely present on-site and in the vicinity year round.

The cattle egret was introduced to Hawaii from Florida for insect control in the mid-20th century and has become a widespread species across the main Hawaiian Islands. This species was identified as "Not Currently At Risk" in *The North American Waterbird Conservation Plan* (Kushlan et al. 2002). On Oahu, large concentrations of this species can be found at Pearl Harbor, Kaneohe Bay and Kahuku. Cattle egrets eat a wide variety of prey including insects, spiders, frogs, prawns, mice, crayfish, and the young of native waterbirds (Pratt et al. 1987; Telfair 1994; Robinson et al. 1999; Brisbin et al. 2002; Engilis et al. 2002; Hawaii Audubon Society 2005; USFWS 2005a). Cattle egrets were observed rarely on-site but were common at the adjacent water bodies and at the farmland farther seaward of the project site.

Birds (Other): For centuries, migratory ducks, geese and other waterfowl have wintered on the Hawaiian Islands. Shorebirds primarily utilize wetlands and tidal flats; however, estuaries, grasslands, uplands, beaches, golf courses, and even urban rooftops are important habitats for some species (Engilis and Naughton 2004). Oahu offers the most diverse shorebird habitat of all the Hawaiian Islands. Threats to shorebirds in the Pacific region include habitat loss (urban, industrial, military, agricultural, recreational development), invasive plants, non-native animals (predation, disease and competition), human disturbance, and environmental contaminants (Engilis and Naughton 2004).

The USFWS developed the *U.S. Pacific Islands Regional Shorebird Conservation Plan* over concerns of declining shorebird populations and loss of habitat (Engilis and Naughton 2004). This plan identifies three shorebird species of primary importance in Hawaii: the Hawaiian stilt, Pacific golden-plover, and bristle-thighed curlew (*Numenius tahitiensis*). The only permanent resident shorebird, the Hawaiian stilt, is discussed below. The other two species are of primary importance because Hawaii supports a substantial amount of Pacific golden-plovers during the winter (an estimated 15,000 to 20,000 individuals) and the bristle-thighed curlew is the only migratory species that winters exclusively in the Pacific. The wandering tattler is considered a species of importance and the ruddy turnstone is a species of secondary importance (Engilis and Naughton 2004).

The Pacific golden-plover is the only shorebird that was detected utilizing the project area during the avian surveys conducted by Kawailoa Wind Power and SWCA. Data suggests that these birds arrive in the vicinity of the project area in August and leave in May. No birds were recorded at flight altitudes within the rotor swept zone of the proposed turbines.

Mammals: The Hawaiian hoary bat is the only terrestrial mammal native to Hawaii; this species is discussed below. Several non-native mammals have been observed on the Kawailoa Wind Power project area incidental to avian surveys. Feral pigs (*Sus scrofa*) are common throughout the project area. Domestic dogs (*Canis familiaris*) were reported and the area is regularly used by hunters with dogs. Rats (*Rattus* spp.) and small Indian mongoose (*Herpestes auropunctatus*) were also observed. Although not seen, it is likely that feral cats (*Felis catus*) and mice (*Mus domesticus*) occur on site (Hobdy 2010a,b). A feral cat colony occurs used to occur at the gated entrance to Kawailoa Road.

Invertebrates: Hobdy specifically searched for the endangered Blackburn's sphinx moth (*Manduca blackburni*) within the project area. No moths or their larvae were observed (Hobdy 2010a, 2010b). Endangered mollusks have only been documented in recent times in native forests at elevations greater than 1,312 feet on Oahu (USFWS 1992). As the project site is lower in elevation and dominated by non-native vegetation, these snails are not expected to be found at the project site. Thus, no mollusk survey was conducted within the project area.

Non-federally listed species off-site: Only four species of non-native birds were observed or heard during the one-time survey of the off-site microwave facility sites (Hobdy 2010c). These include the Japanese bush warbler (*Cettia diphone*), red-vented bulbul (*Pycnonotus cafer*), the Japanese white-eye (*Zosterops japonicas*) and house finch (*Carpodacus mexicanus*). Another non-native bird that also would occur here is the red-billed leiothrix (*Leiothrix lutea*). Thus, birds that frequent the Mt. Kaala sites are non-native species common to altered rural environments on Oahu. Based on historical data, the following native birds may also occur: the Oahu amakihi (*Hemignathus flavus*) and the apapane (*Himantione sanguinea*). Much rarer occurrence would be the endangered Oahu elepaio (*Chasiempis ibidis*) and the iiwi (*Vestiaria coccinea*), which is listed as State endangered on Oahu (DOFAW 1990; Hobdy 2010c).

No State- or Federally listed candidate, threatened, or endangered mollusks or species of concern were found or are known to occur within the off-site microwave sites. One species of native snail was found at the Hawaii Telcom site and seven native species at the Repeater station. Six native species were also found en route to the Repeater station, of which *Kaala subrutila*, an endemic mollusk, may be assessed for candidate species listing in the near future (King pers. comm.). Many of the native species found were common at the sites and the majority of the native snail diversity was found on native plants along the edges of each site. Terrestrial species were found in the leaf litter and a boreal species were present on the foliage on trees and shrubs. Only two non-native mollusk species (*Oxychilus alliarius* and *Deroceras laeve*) were found during the survey. O*. alliarius* is known to feed on other mollusks and represents a potential ecological threat to native mollusks at Mt. Kaala. The invasive slug *D. laeve* competes with other mollusks and is also considered beneficial to native ecosystems in Hawaii.

3.6.2 Federally Listed Species (Non-Covered Species)

Although not observed during the survey, DOFAW has clarified that an additional native mollusk species (*Achatinella mustelina*) was historically found on olomea (*Perrottetia sandwicensis*) adjacent to the existing facilities, and a population is present approximately 164 feet away from the Hawaiian Telcom building site; *A. mustelina* is a Federally listed species (USFWS 1992).

One bird, the Oahu elepaio (*Chasiempis sandwichensis ibidis*), an invertebrate the Hawaiian picture-wing fly (*Drosophila substenoptera*) have critical habitat designations that encompass the tower sites. The Oahu elepaio designated critical habitat is unoccupied. None of the larval host plants for the fly; *Cheirodendron platyphyllum* ssp. *platyphyllum*, *C. trigynum* ssp. *trigynum*, *Tetraplasandra kavaiensis*, and *T. oahuensis*, are present on-site at the tower locations and no impacts to these species are expected.

As outlined by the 2003 critical habitat rule: existing man-made features and structures within the boundaries of the mapped units, such as buildings; roads; aqueducts and other water system features, including but not limited to pumping stations, irrigation ditches, pipelines, siphons, tunnels, water tanks, gauging stations, intakes, reservoirs, diversions, flumes, and wells; existing trails; campgrounds and their immediate surrounding landscaped area; scenic lookouts; remote helicopter landing sites; existing fences; telecommunications equipment towers and associated structures and electrical power transmission lines and distribution and communication facilities and regularly maintained associated rights-of-way and access ways; radars; telemetry antennas; missile launch sites; arboreta and gardens, heiau (indigenous places of worship or shrines) and other archaeological sites; airports; other paved areas; and lawns and other rural residential landscaped areas do not contain, and are not likely to develop, primary constituent elements and are specifically excluded from designation under this rule.

The Mount Kaala off-site communications location is an existing infrastructure and excluded from critical habitat designation, and impacts are not anticipated to indirectly affect nearby habitat containing the primary constituent elements.

3.6.3 Federally Listed Species (Covered Species)

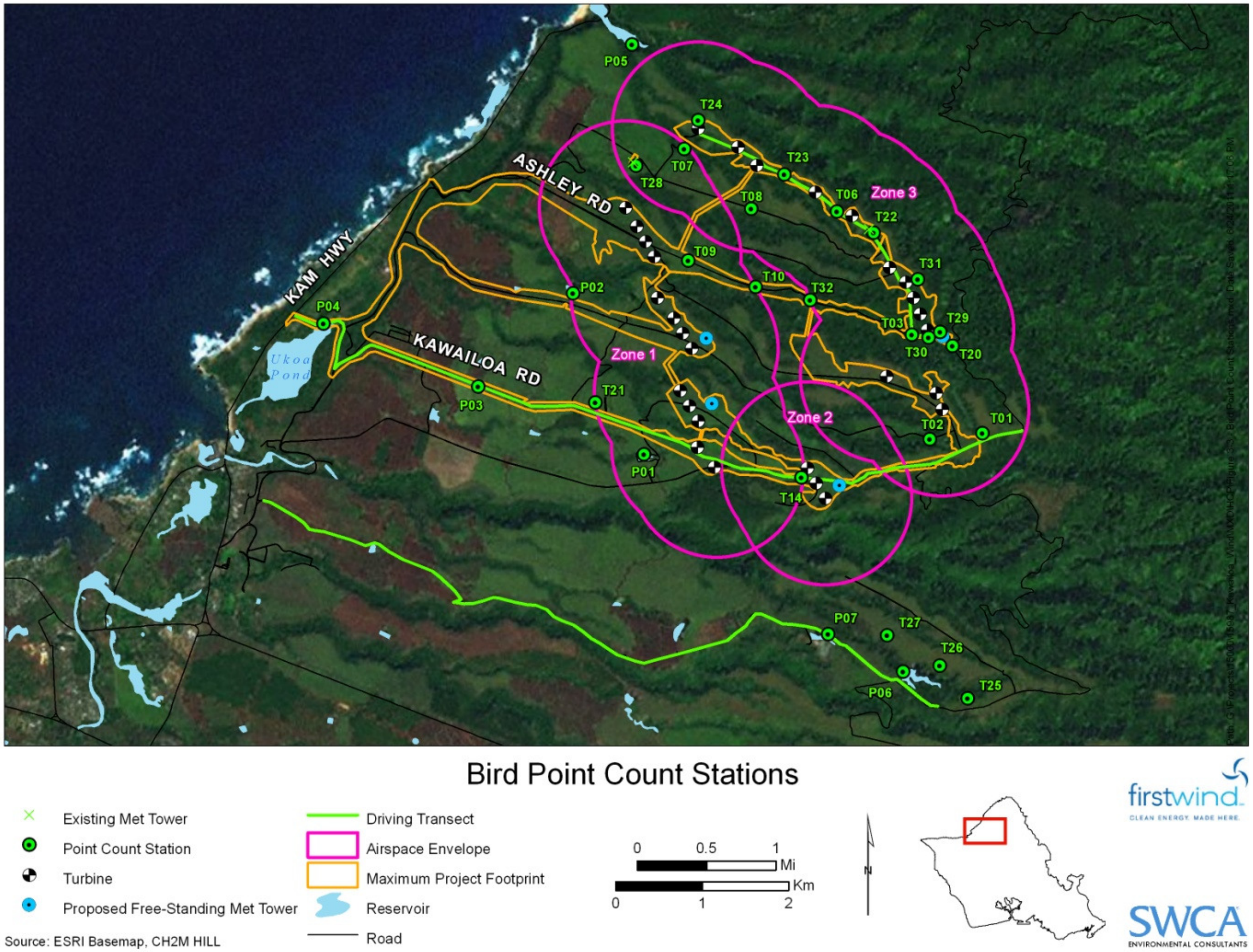
Only one Federally-listed species could be resident within the Kawailoa Wind Power project area. The endangered Hawaiian hoary bat has been documented flying within the project area during the radar surveys and bat activity, as evaluated using bat detectors, is higher between March and November. It is possible that the tree-roosting Hawaiian hoary bat roosts on site during the months when bats are detected. The presumed Hawaiian duck-mallard hybrid has been documented utilizing ponds within the “airspace envelope” of the turbines in Zone 1 (see Fig. 3-1). Radar studies in 2009 and 2011 have detected a low number of targets exhibiting flight speeds and flight patterns that fit the “shearwater-like” category. This suggests that the individuals are likely to be Newell’s shearwaters though no visual identification of these targets were obtained. It is therefore assumed that a small number of Newell’s shearwaters transit the Kawailoa Wind Power project during the seabird breeding season. No portion of the project area has been designated as critical habitat for any listed species. The Hawaiian moorhen occurs regularly at the stream at Waimea Valley. A Hawaiian coot was observed once foraging on Kawailoa Road. No Hawaiian stilts have been observed on site or at any of the nearby water bodies during the surveys conducted over the course of a year. One State-listed endangered species, the Hawaiian short-eared owl, has not been observed at the Kawailoa Wind Power project area, but could potentially be present as suitable habitat is available.

The proposed WTGs, onsite communication towers, met towers, overhead collection lines associated with the Kawailoa Wind Power project would potentially present collision hazards to the listed bird and bat species. These species may also collide with the two offsite antennae mounted on existing towers. Lighting some of these structures pursuant to Federal Aviation Administration (FAA) regulations may increase the risk of avian collisions. Table 3-4 lists the Federally and State-listed species with potential to be adversely impacted by operation of the Kawailoa Wind Power project and for which Federal or State authorization of incidental take is being sought.

Table 3-4. Covered Species That May Be Affected by the Proposed Project.

Scientific Name	Common, Hawaiian Name(s)	Date Listed	Status[1]
Birds			
Puffinus auricularis newelli	Newell’s shearwater, ao	10/28/1975	T
Anas wyvilliana	Hawaiian duck, koloa maoli	3/11/1967	E
Himantopus mexicanus knudseni	Hawaiian stilt, aeo	10/13/1970	E
Fulica alai	Hawaiian coot, ala keokeo	10/13/1970	E
Gallinula chloropus sandvicensis	Hawaiian moorhen, alae ula	3/11/1967	E
Asio flammeus sandwichensis	Hawaiian short-eared owl, pueo	--	SE
Mammals			
Lasiurus cinereus semotus	Hawaiian hoary bat, opeapea	10/13/1970	E
[1)]E = Federally endangered; T = Federally threatened; SE = State endangered			

Figure 3-1. Turbine Layout and Bird Airspace Envelope.



3.6.3 (a) 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.

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, Holmes (Planning Solutions, Inc. 2010) suggest a 75% population decrease between 1993 and 2008, based on radar surveys and Save Our Shearwater (SOS) data. This puts the 2008 total population estimate on the order of 21,000 birds. 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*.* 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 in small numbers (Day and Cooper 2008). On Maui, radar studies and visual and auditory surveys conducted over the past decade suggest that one or more small breeding colonies are present in the West Maui Mountains in the upper portions of Kahakuloa Valley (Spencer pers. comm. 2009).

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

First breeding occurs at approximately six years of age, after which breeding pairs produce one egg 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). It was estimated by Ainley et al. (2001) that 46% of all active burrows produced an egg. 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 (NESH 2005).

The flight of the Newell's shearwater is characterized by rapid beats interspersed with glides, although beats tend to be fewer in high winds. The birds avoid flying with tailwinds because it decreases control. Over land, ground speed of the species has been measured to average 38 mph (Ainley et al. 1997). The wing beat pattern of Newell's shearwater is somewhat similar to that of the Hawaiian petrel.

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, collision with powerlines and other anthropogenic structures, and fallout of juvenile birds associated with disorientation from urban lighting (Ainley et al. 1997; Mitchell et al. 2005; Hays and Conant 2007).

Occurrence in the Project Area and Offsite Communication Towers

Cooper et al. (2011) conducted 10 nights of surveillance radar and audiovisual sampling at the Kawailoa Wind Power project area in summer and fall 2009 to sample representative seabird passage rates over the site for use in estimating the risk of seabird take resulting from collisions with turbines and met towers. Supplementary radar surveys were conducted in June 2011 for 16 nights to measure passage rates over the north-eastern most turbine string (Cooper and Sanzenbacher 2011). Two new areas were sampled for five nights each to increase radar coverage of the project site. Sites sampled in 2009 were also resampled for three nights each. The 2011 data shows similar passage rates to those measured in 2009 both at the new sites and the resampled sites. The additional data do not significantly change the average passage rate over the site.

All three surveys found an extremely low number of targets exhibiting flight speeds and flight patterns that fit the "shearwater-like" category. The mean movement rate across all nights and all sites for 2009 and 2011 was 0.66 shearwater-like targets/h (Cooper and Sanzenbacher 2011).

No visual identification of these targets were possible for both the 2009 and 2011 surveys; however, Cooper et al. (2011) suggests that the individuals were more likely to be Newell's shearwaters than Hawaiian petrels due to the timing of movements and the available literature indicating that Newell's shearwaters but not Hawaiian petrels occur on Oahu. Based on surveys conducted on other islands, Newell's shearwaters appear to move to the interior portions of the islands starting about 30 min after sunset. Hawaiian petrel movements begin at sunset and go to about 60 min after sunset (Day et al. 2003b). Additionally, Cooper et al. (2011) indicated that the fall radar data were highly likely to include an unknown proportion of plovers (thus conservatively inflating movement rates used in the shearwater fatality models) based on observations of Pacific golden-plovers during fall sampling, the difficulty of separating plover targets from shearwater targets on radar, and the higher movement rates observed in fall when lower numbers of shearwaters are expected to occur. Due to the high possibility of high target contamination in the fall, the passage rates of Newell's shearwaters were modeled based on summer movement rates only resulting in an annual movement rate of 804 bird passes/year over the entire site.

The Newell's shearwater has not been confirmed as a nesting species on Oahu (Ainley et al. 1997) as no nesting colonies have been found. There have been infrequent incidental reports of downed fledglings in the last 50 years (roughly one a decade) for the Island of Oahu (Cooper et al. 2011). Assuming the detected birds were Newell's shearwaters, then their observed behavior of flying to and from the Koolau Range suggests that a small number of these birds are at least prospecting in these mountains. Because of the few detections obtained during the Day and Cooper study and lack of radar studies from adjacent lands, it is not known whether the Kawailoa Wind Power project area lies within the primary corridor used by these few birds as they move between their prospective nesting areas and the ocean. Observations of Newell's shearwaters in the Hawaiian Islands indicate that approximately 75% of shearwaters will fly at or below turbine height (Cooper et al. 2011).

No radar studies were conducted at the offsite communication tower sites because the proposed antennae would mounted on existing towers, the antennae are not expected to significantly increase the collision risk of any Covered Species if they should happen to transit the tower location.

3.6.3 (b) Hawaiian Duck

Population, Biology, and Distribution

The Hawaiian duck is a non-migratory species endemic to the Hawaiian Islands, and the only endemic duck extant in the main Hawaiian Islands (Uyehara et al. 2008). The Hawaiian duck is a small, mottled brown duck with emerald green to blue patches on their wings (speculums). Males are typically larger, have distinctive dark brown chevrons on the breast feathers, an olive-colored bill, and bright orange feet. Females are slightly smaller and lighter in color (Evans et al. 1994; USFWS 2005a). Compared to feral mallard ducks, Hawaiian ducks are more cryptic and about 20 to 30% smaller (Uyehara et al. 2007).

The historical range of the Hawaiian duck includes all the main Hawaiian Islands, except for the Islands of Lanai and Kahoolawe. Hawaiian ducks are strong flyers and usually fly at low altitudes. Intra-island movement has been recorded, where they may move between ephemeral wetlands or disperse to montane areas during the breeding season (Engilis et al.2002). Hawaiian ducks also fly inter-island and have been documented to fly regularly between Niihau and Kauai in response to above-normal precipitation and the flooding and drying of Niihau's ephemeral wetlands (USFWS 2005a). Hawaiian ducks occur in aquatic habitats up to an altitude of 10,000 feet in elevation (Uyehara et al. 2007). The only naturally occurring population of Hawaiian duck exists on Kauai, with reintroduced populations on Oahu, Hawaii and Maui (Pratt et al. 1987; Engilis et al. 2002; Hawaii Audubon Society 2005).

Hawaiian ducks are closely related to mallards (Browne et al. 1993). Due to this close genetic relationship, Hawaiian ducks will readily hybridize with mallards and allozyme data indicate there has been extensive hybridization between Hawaiian duck and feral mallards on Oahu, with the near disappearance of Hawaiian duck alleles from the population on the island (Browne et al. 1993). Uyehara et al. (2007) found a predominance of hybrids on Oahu and samples collected by Browne et al. (1993) from ducks and eggs at the Kii Unit of the James Campbell NWR found mallard genotypes. In 2005, a peak count of 141 Hawaiian duck x mallard hybrids was recorded on the Kii Unit of the James Campbell NWR (USFWS unpubl). Populations on Maui are also suspected to largely consist of Hawaiian duck x mallard hybrids. Estimated Hawaiian duck hybrid counts on these islands are 300 and 50 birds, respectively (Engilis et al. 2002; USFWS 2005a). The current wild population of pure Hawaiian ducks is estimated at approximately 2,200 birds. Approximately 200 pure individuals occur on the Island of Hawaii and the remainder resides on Kauai. Because of similarities between the species, it can be difficult to distinguish between pure Hawaiian ducks, feral hen mallards, and hybrids during field studies.

Habitat types utilized by the Hawaiian duck include natural and man-made lowland wetlands, flooded grasslands, river valleys, mountain streams, montane pools, forest swamplands, aquaculture ponds, and agricultural areas (Engilis et al. 2002; Hawaii Audubon Society 2005; USFWS 2005a). The James Campbell NWR provides suitable habitat for foraging, resting, pair formation, and breeding (Engilis et al. 2002). No suitable habitat for Hawaiian duck occurs on the Kawailoa Wind Power project area.

Breeding occurs year-round, although the majority of nesting occurs from March through June (USFWS 2005). The peak breeding season on Kauai Island occurs between December and May and the peak on Hawaii Island occurs from April to June (Uyehara et al. 2008). Nests are placed in dense shoreline vegetation of small ponds, streams, ditches and reservoirs (Engilis et al. 2002). Types of vegetation associated with nesting sites of Hawaiian duck include grasses, rhizominous ferns and shrubs (Engilis et al. 2002). The diet of Hawaiian ducks consists of aquatic invertebrates, aquatic plants, seeds, grains, green algae, aquatic mollusks, crustaceans and tadpoles (Engilis et al. 2002; USFWS 2005a).

<u>Current Threats</u>

Hybridization with mallards is the largest threat to the Hawaiian duck. Reintroduction of pure Hawaiian ducks to Oahu is being contemplated, although in order for pure Hawaiian ducks to continue to exist on Oahu following reintroduction, the removal of all hybrids and the elimination of all sources of feral mallard ducks will need to occur (Engilis et al. 2002). James Campbell NWR at Kahuku is expected to play a key role in any future reintroduction of pure Hawaiian ducks to Oahu (USFWS 2005a). At present it is uncertain when reintroduction would occur, but it is possible that reintroduction could occur during the 20-year life of the proposed wind energy project.

In addition to hybridization concerns, Hawaiian ducks are predated by mongoose, feral cats, feral dogs, and possibly rats (Engilis et al. 2002). Black-crowned night herons, largemouth bass

(*Micropterus salmoides*), and bullfrogs have been observed to take ducklings (Engilis et al. 2002). Avian diseases are another threat to Hawaiian ducks, with outbreaks of avian botulism (*Clostridium botulinum*) occurring annually throughout the state. In 1983, cases of adult and duckling mortality on Oahu were attributed to aspergillosis and salmonella (Engilis et al. 2002). As stated previously, the loss and degradation of coastal wetlands have been a significant factor in the decline of these birds in Hawaii.

Little is known about the interaction of Hawaiian ducks with wind turbines. Studies of wind energy facilities located in proximity to wetlands and coastal areas in other parts of the United States and the world have shown that waterfowl and shorebirds have some of the lowest collision mortality rates at these types of facilities, suggesting that these types of birds are among the best at recognizing and avoiding wind turbines (e.g., Koford et al. 2004; Jain 2005; Carothers 2008). In support of these findings, systematic incidental observations of nene or Hawaiian goose (*Branta sandvicensis*) in flight at the Kaheawa Wind Power facility on Maui indicate this species is capable of exhibiting deliberate avoidance of wind turbines under prevailing conditions (Kaheawa Wind Power 2008).

<u>Occurrence in the Project Area and Offsite Communication Towers</u>

Ducks resembling Hawaiian ducks (but likely to be hybrids) have been seen flying over Zone 1 (corresponding to airspace envelopes of turbines 18-30) of the Kawailoa Wind Power project area. A total of 10 sightings of the Hawaiian duck-mallard hybrids have been recorded onsite (five during point count surveys, four incidental sightings and one sighting during driving transect). Flock sizes ranged from one to 15 birds with an average size of four birds. Similar to the black-crowned night heron, birds were observed in flight at the ponds in the area or flying near the lower met tower on Kawailoa road or in the area between the met tower and nearby pond. However, one incidental sighting was also reported along the road southwest of turbine 11. No flocks were seen within the altitude of the rotor swept zone (RSZ) of the proposed turbine (approximately 164 feet altitude or above).

Thus, while flying over the Kawailoa Wind Power project area, ducks may be vulnerable to colliding with the WTGs, and met towers. The risk is probably highest in Zone 1 and likely negligible in Zone 2 and 3 (Zone 2 corresponds to airspace envelopes of turbines 12-14 and Zone 3 to turbines 1-11 and 31-33), given that no waterbird activity (ducks or otherwise) was observed in these zones. Passage rates of ducks were only applied to Zone 1 and the estimated passage rate area is 0.054 birds/ha/hr. The passage rate of ducks in Zone 2 and 3 is presumed to be zero (SWCA 2010a).

There are no open water features near the proposed location of the offsite communication towers, and waterbirds have not been historically documented at Mt. Kaala (DOFAW 1990). In addition, none of the listed waterbird species have been observed at the site (Hobdy 2010c; Mosher 2010).

Because of the hybridization of Hawaiian ducks with feral mallards, it is questionable whether any pure Hawaiian ducks are resident on the Island of Oahu (Browne et al. 1993; Uyehara et al. 2007; USFWS 2005a). Given the dispersal capabilities of the species, it is possible for pure Hawaiian ducks to occasionally fly over from Kauai. However, genetic research in 2007 showed presence of several Hawaiian ducks at James Campbell National Wildlife Refuge, and a bird struck by a plane at Honolulu International Airport in 2007 was found to be Hawaiian duck (A. Nadig, USFWS, pers comm.). Therefore, take coverage is being requested for Hawaiian ducks in the event that genetic analysis of downed ducks on site result in the assessment of take of a pure Hawaiian duck. Take coverage is also requested in the event that pure Hawaiian ducks are reintroduced to the island of Oahu during the project permit duration.

<u>*3.6.3 (c) Hawaiian Stilt*</u>

<u>Population, Biology, and Distribution</u>

The Hawaiian stilt is a non-migratory endemic subspecies of the black-necked stilt (*Himantopus mexicanus mexicanus*). The black-necked stilt occurs in the western and southern portions of North America, southward through Central America, West Indies, to southern South America and also the Hawaiian Archipelago (Robinson et al. 1999). Hawaiian stilt and black-necked stilt are part of a super species complex of stilts found in various parts of the world (Pratt et al. 1987; Robinson et al. 1999). The *U. S. Pacific Islands Regional Shorebird Conservation Plan* considers the Hawaiian stilt as highly imperiled because of its low population level (Engilis and Naughton 2004). Over the past 25 years, the Hawaiian stilt population has shown a general upward trend statewide. Annual summer and winter counts have shown variability from year to year. This fluctuation can be attributed to winter rainfall and variation in reproductive success (Engilis and Pratt 1993; USFWS 2005a). The state population size has recently fluctuated between 1,200 to 1,500 individuals with a five-year average of 1,350 birds (USFWS 2005a). Adult and juvenile dispersal has been observed both intra- and inter-island within the state (Reed et al. 1998).

Oahu supports the largest number of stilts in the state, with an estimated 35 to 50% of the population residing on the island. Some of the largest concentrations can be found at the James Campbell NWR, Kahuku aquaculture ponds, Pearl Harbor NWR, and Nuupia Ponds in Kaneohe (USFWS 2005a). The Kii Unit of the James Campbell NWR, and the Waiawa Unit and Pond 2 of the Honouliuli Unit of the Pearl Harbor NWR are the most productive stilt habitats, with birds numbering near 100 or above during survey counts (USFWS 2002; USFWS unpubl. data). Hatching success of stilt nests has been greater than 80% in the Kii Unit, but chick mortality rates are high (USFWS 2002).

Hawaiian stilts favor open wetland habitats with minimal vegetative cover and water depths of less than 9.4 inches, as well as tidal mudflats (Robinson et al. 1999). Stilts feed on small fish, crabs, polychaete worms, terrestrial and aquatic insects, and tadpoles (Robinson et al. 1999; Rauzon and Drigot 2002). Hawaiian stilts tend to be opportunistic users of ephemeral wetlands to exploit the seasonal abundance of food (Berger 1972; USFWS 2005a). Hawaiian stilts nest from mid-February through late August with variable peak nesting from year to year (Robinson et al. 1999). Nesting sites for stilts consist of simple scrapes on low relief islands within and/or adjacent to ponds. Clutch size averages four eggs (Hawaii Audubon Society 2005; USFWS 2005a).

Current Threats

The most important causes of decline of the Hawaiian stilt and other Hawaiian waterbirds is the loss of wetland habitat and predation by introduced animals. Barn owls and the endemic Hawaiian short-eared owl are known predators of adult stilts and possibly their young (Robinson et al. 1999; USFWS 2005a). Known predators of eggs, nestlings, and/or young stilts include small Indian mongoose, feral cat, rats, feral and domestic dogs, black crowned night-heron, cattle egret, common mynah, ruddy turnstone, laughing gull (*Larus atricilla*), American bullfrog (*Rana catesbeiana*), and large fish (Robinson et al. 1999; USFWS 2005a). A study conducted at the Kii Unit of the James Campbell NWR between 2004 and 2005 attributed 45% of stilt chick losses to bullfrog predation over the two breeding periods (USFWS unpubl. data). The Kii Unit has on-going control programs for mongoose, feral cats, rats, cane toads (*Bufo marinus*), and bullfrogs (Silbernagle pers. comm. 2008). Other factors that have contributed to population declines in Hawaiian stilts include altered hydrology, alteration of habitat by invasive non-native plants, disease, and possibly environmental contaminants (USFWS 2005a). Although the Hawaiian stilt is considered imperiled, it is believed to have high recovery potential with a moderate degree of threat.

Little is known about the interaction of black-necked stilt with wind turbines in the United States. One black-necked stilt fatality was reported at the Altamont Pass Wind Resource Area from 2005-2007 (Altamont Pass Avian Monitoring Team 2008). The annual adjusted fatality per turbine was 0.00193 stilt per turbine. In general, low mortality of waterbirds has been documented at wind turbines situated coastally despite the presence of high numbers of waterbirds in the vicinity (Kingsley and Whittam 2007; Carothers 2008). Many studies of coastal-wind energy facilities have shown that waterbirds and shorebirds are among the birds most wary of turbines and that these birds readily learn to avoid the turbines over time (Carothers 2008).

Occurrence in the Project Area and Offsite Communication Towers

No Hawaiian stilts were seen flying over the proposed Kawailoa Wind Power facility during the avian point count surveys conducted by SWCA or Hobdy (SWCA 2010; Hobdy 2010a, 2010b). No stilts have been observed occupying the waterbodies that were surveyed. Two irrigation ponds occur within the 1 km airspace envelope around the lowest turbine string (Zone 1) that may potentially be attractive to Hawaiian stilt. No other coastal wetlands are present within the airspace envelope of the turbine strings. Waimea River is a perennial stream, and is within the airspace envelope of the upper most turbine sting (Zone 3), however, stilt are not expected to be present in Waimea River as they require early successional marshlands for nesting and foraging (USFWS 2005). However, because of the known dispersal capabilities of these birds (Reed et al. 1998), it is expected that individual stilts can fly over the Kawailoa Wind Power project area on a very irregular basis while moving between wetlands or islands.

There are no open water features near the communication sites; therefore, no waterbirds are expected. There are no open water features near proposed location of the offsite communication towers, and waterbirds have not been historically documented at Mt. Kaala (DOFAW 1990). In addition, none of the listed waterbird species have been observed at the sites (Hobdy 2010c; Mosher pers. comm. 2010)

3.6.3 (d) Hawaiian Coot

Population, Biology, and Distribution

The Hawaiian coot is an endangered species endemic to the main Hawaiian Islands, except Kahoolawe. The Hawaiian coot is non-migratory and believed to have originated from migrant American coots (*Fulica americana*) that strayed from North America. The species is an occasional vagrant to the northwestern Hawaiian Islands west to Kure Atoll (Pratt et al. 1987; Brisbin et al. 2002).

The population of Hawaiian coot has fluctuated between 2,000 and 4,000 birds. Of this total, roughly 80% occur on Oahu, Maui, and Kauai (Engilis and Pratt 1993; USFWS 2005a). The Oahu population fluctuates between approximately 500 to 1,000 birds. Hawaiian coots occur regularly in the Kii Unit of the James Campbell NWR, with peak counts in 2005 and 2006 reaching nearly 350 birds (USFWS 2002, 2005a; unpubl. data). Population fluctuations in these areas are attributed to seasonal rainfall and variation in reproductive success. Inter-island dispersal has been noted and is presumably influenced by seasonal rainfall patterns and food abundance (USFWS 2005a).

Coots are usually found on the coastal plain of islands and prefer freshwater ponds or wetlands, brackish wetlands, and man-made impoundments. They prefer open water that is less than 11.8 inches deep for foraging. Preferred nesting habitat has open water with emergent aquatic vegetation or heavy stands of grass (Schwartz and Schwartz 1949; Brisbin et al. 2002; USFWS 2005a). Nesting occurs mostly from March through September, with opportunistic nesting occurring year round depending on rainfall. Hawaiian coots will construct floating nests of aquatic vegetation, semi-floating nests attached to emergent vegetation or nests in clumps of wetland vegetation (Brisbin et al. 2002; USFWS 2005a). False nests are also sometimes constructed and used for resting or as brooding platforms (USFWS 2005a). Coots feed on seeds, roots and leaves of aquatic and terrestrial plants, freshwater snails, crustaceans, tadpoles of bullfrogs and marine toads, small fish, and aquatic and terrestrial insects (Schwartz and Schwartz 1949; Brisbin et al. 2002).

Current Threats

The USFWS *Second Draft Recovery Plan for Hawaiian Waterbirds* (2005a) lists the Hawaiian coot as having high potential for recovery and a low degree of threats (USFWS 2005a). Introduced feral cats, feral and domestic dogs, and mongoose are the main predators of adult and young Hawaiian coots (Brisbin et al. 2002; Winter 2003). Other predators of young coots include black-crowned night heron, cattle egret and large fish. Coots are susceptible to avian botulism outbreaks in the Hawaiian Islands (Brisbin et al. 2002). Wetland loss and degradation has also been noted as contributing to the decline of this species, as stated previously. Low numbers of American coot fatalities have been reported at two wind facilities in California and Minnesota, although in these cases standing or ponded water within the project area was an attractant (Erickson et al. 2001).

Occurrence in the Project Area and Offsite Communication Towers

One observation of the Hawaiian coot was made at an adjacent water body in September 2010. This individual was foraging in the pond when observed and did not take flight. The individual was of the rare color morph, with a red frontal shield instead of white. Only 1-3% of the Hawaiian coot has the red frontal shield like the American coot, *Fulica americana* (Engilis and Pratt 1993). This individual was not present when subsequent observations were made later in September. Two irrigation ponds also occur within the 0.6 miles (1 km) airspace envelope around the lowest turbine string (Zone 1) and may be attractive to Hawaiian coots. No other coastal wetlands are present within the airspace envelope of the turbine strings. Waimea River is a perennial stream, and is within the airspace envelope of the upper most turbine string (Zone 3), however, Hawaiian coots are not expected to be present in Waimea River as they are primarily a species of the coastal plains (USFWS 2005a). Hawaiian coots are known to disperse between islands and coupled with the one-time observation of a foraging coot at Pond 03, there is potential for coots to occasionally fly over the lower elevations of Kawailoa Wind Power project area if moving between foraging sites or islands. No suitable habitat for Hawaiian coot occurs on the Kawailoa Wind Power project area.

There are no open water features near proposed location of the offsite communication towers, and waterbirds have not been historically documented at Mt. Kaala (DOFAW 1990). In addition, none of the listed waterbird species have been observed at the site (Hobdy 2010c; Mosher pers. comm. 2010).

3.6.3 (e) Hawaiian Moorhen

Population, Biology, and Distribution

The Hawaiian moorhen is an endemic, non-migratory subspecies of the cosmopolitan common moorhen (*Gallinula chloropus*). It is believed that the subspecies originated through colonization of Hawaii by stray North American migrants (USFWS 2005a). Originally occurring on all of the main Hawaiian Islands (excluding Lanai and Kahoolawe), the Hawaiian moorhen is currently limited to regular occurrence on the Islands of Kauai and Oahu (Hawaii Audubon Society 2005; USFWS 2005a). A population was reintroduced to Molokai in 1983, but no individuals remain on the island today.

Hawaiian moorhen are very secretive; thus, population estimates and long-term population trends are difficult to approximate (Engilis and Pratt 1993; Hawaii Audubon Society 2005; USFWS 2005a). The population of Hawaiian moorhen appears to be stable, with an average annual total of 314 birds estimated between 1977 and 2002. Approximately half of this population occurs on Oahu. Seasonal fluctuations in population have been recorded, although this is believed to be an artifact of sparser vegetation allowing greater visibility in fields in winter than in summer (USFWS 2005a). In 2006, a peak of over 90 moorhen was recorded at the Kii Unit of the James Campbell NWR.

In Hawaii, moorhen largely depend on agricultural and aquaculture habitats. They prefer freshwater marshes, taro patches, reservoirs, wet pastures, lotus fields, and reedy margins of water courses. The habitats in which they occur are generally below 410 feet in elevation (Pratt et al. 1987; Engilis and Pratt 1993; Hawaii Audubon Society 2005; USFWS 2005a). According to the *Second Draft Recovery Plan for Hawaiian Waterbirds* (2005a), the key components of moorhen habitat are: 1) dense stands of emergent vegetation near open water; 2) slightly emergent vegetation mats; and 3) shallow, freshwater areas. No such habitat is present on the Kawailoa Wind Power project area.

Hawaiian moorhens will nest on open ground and wet meadows, as well as on banks of waterways and in emergent vegetation over water (Bannor and Kiviat 2002). Typically, nesting areas have standing water less than 24 inches deep. Nesting occurs year-round with the majority of nesting activity occurring from March through August (Bannor and Kiviat 2002; USFWS 2002). Timing of nesting by the Hawaiian moorhen is dependent on water levels and growth of suitable emergent vegetation (USFWS 2002).

Although the specific diet of the Hawaiian moorhen is not known, it is presumed the birds are opportunistic feeders (USFWS 2005a). Moorhens are very closely related to coots, and it is presumed that the diet of Hawaiian moorhens is generally similar to that described above for Hawaiian coot.

Current Threats

As previously stated, coastal wetland loss and degradation as a result of commercial, residential, and resort developments have been identified as a key threat to the Hawaiian moorhen (Evans et al. 1994; USFWS 2005a). Feral cats, feral and domestic dogs, mongoose, and bullfrogs are known predators of Hawaiian moorhen. Black-crowned night herons and rats are also as possible predators (Byrd and Zeillemaker 1981; Bannor and Kiviat 2002; USFWS 2005a). The Hawaiian moorhen is highly susceptible to disturbance by humans and introduced predators (Bannor and Kiviat 2002). The moorhen is considered to have a high potential for recovery with a moderate degree of threats (USFWS 2005a).

There have only been a few published reports of the closely related common moorhen colliding with turbines in Europe; Ireland (Percival 2003) and Netherlands (Hotker et al. 2006); none in the United States. This is despite the fact that common moorhen are frequently found around wind turbines located near wetlands. However, one study in Spain lists the common moorhen at "some" collision risk with power lines due to their flight performance and also records one instance of mortality due to collision (Janss 2000).

Occurrence in the Project Area and Offsite Communication Towers

No Hawaiian moorhens were detected during the year of avian point count surveys on the Kawailoa Wind Power project area. However, Hawaiian moorhen have been seen regularly at nearby water bodies and may potentially be attracted to the two irrigation ponds within the airspace envelope of the lower turbine string (Zone 1). Hawaiian moorhen were observed in flight only once in December, where two individuals made a short flight 23 feet below the stream bank northwest of Zone 3. A total of three individuals have been seen/heard at Pond 05 (Figure 3-1) and have responded to moorhen call playbacks on three occasions. These moorhen are likely resident. Hawaiian moorhen were also seen at two locations at Ukoa Pond during a site visit by SWCA biologist on November 30, 2010. Hawaiian moorhen have not been seen at any of the other water bodies and moorhen playbacks have not elicited any response in any of these areas.

A total of 10 moorhen are also resident in the lotus ponds in Waimea Valley (Pool 2010). Three moorhen adults and two chicks were seen by SWCA biologists on a visit conducted on April 23, 2010. However, Hawaiian moorhen are not expected to be present in the upper reaches of Waimea River, within the airspace envelope of Zone 3, due to the lack of suitable habitat. Given their ability to fly and their occurrence at Waimea Valley, it is possible that individual Hawaiian moorhens will fly over the project area, especially the lower elevation portion.

There are no open water features near proposed location of the offsite communication towers, and waterbirds have not been historically documented at Mt. Kaala (DOFAW 1990). In addition, none of the listed waterbird species have been observed at the site (Hobdy 2010c; Mosher pers. comm.. 2010).

3.6.3 (f) Hawaiian Hoary Bat

Population, Biology, and Distribution

The Hawaiian hoary bat is the only native land mammal present in the Hawaiian archipelago. It is a sub-species of the hoary bat (*Lasiurus cinereus*), which occurs across much of North and South America. Both males and females have a wingspan of approximately one foot, although females are typically larger-bodied than males. Both sexes have a coat of brown and gray fur. Individual hairs are tipped or frosted with white (Mitchell et al*.* 2005).

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). It is thought that the islands of Kauai and Hawaii support the largest populations (Mitchell et al. 2005). The Hawaiian hoary bat is believed to occur primarily below an elevation of 4,000 feet. This subspecies has been recorded between sea level and approximately 9,050 feet in elevation on Maui, with most records occurring at or below approximately 2,060 feet (USFWS 1998). Elevations within the Kawailoa wind project area range from 200-1,280 feet above sea level (CH2M Hill 2011b).

Hawaiian hoary bats roost in native and non-native vegetation from 3 to 29 feet above ground level. They have been observed roosting in ohia, 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. Hawaiian hoary bats have been known to use both native and non-native habitats for feeding and roosting (Mitchell et al. 2005). The vegetated areas within the project area for the wind farm site consist mostly of agricultural land, alien grassland and forest. The forest habitat is fairly homogenous and comprised of non-native, invasive species, including stands of albizia, ironwood and eucalyptus trees; these trees may provide roosting habitat for bats. Bat activity has been detected in essentially all habitats, including in clearings, along roads, along the edges of treelines, in gulches, and at irrigation ponds; monitoring to date indicates that bats use all of these features for travelling and foraging. The species has been rarely observed using lava tubes, cracks in rocks, or man-made structures for roosting. While roosting during the day, Hawaiian hoary bat are solitary, although mothers and pups roost together (USFWS 1998).

Preliminary study of a small sample of Hawaiian hoary bats (n=18) on the Island of Hawaii have estimated short term (1-2 weeks) core range habitat sizes of 84.3 acre (34.1ha; n=14) for males and 41.2 acre (16.7 ha; n=11) for a female bat (USGS, unpublished data). The size of home ranges and core areas varied widely between individuals. Core areas included feeding ranges that were actively defended, especially by males, against conspecifics. Female core ranges overlapped with male ranges. Bats typically feed along a line of trees, forest edge or road and a typical feeding range stretches around 300 yd (275 m). Bats will spend 20 to 30 minutes hunting in a feeding range before moving on to another (Bonaccorso 2011).

It is suspected that breeding primarily occurs between April and August. Lactating females have been documented from June to August, indicating that this is the period when non-volant young are most likely to be present. Breeding has only been documented on the Islands of Hawaii and Kauai (Baldwin 1950; Kepler and Scott 1990; Menard 2001). Seasonal changes in the abundance of Hawaiian hoary bat at different elevations indicate that altitudinal movements occur on the Island of Hawaii. During the breeding period (April through August), Hawaiian hoary bat occurrences increase in the lowlands and decrease at high elevation habitats. In the winter, bat occurrences increase in high elevation areas (above 5,000 feet) especially from January through March (Menard 2001; Bonaccorso 2011).

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

<u>Current Threats</u>

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). Roost trees are not expected to be limiting as the Hawaiian hoary bat roost in a variety of native and non-native trees (see above), many of which are abundant and some non-native species are considered invasive (such as kiawe and eucalyptus).

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 US. At the Kaheawa Wind Power facility on Maui, two Hawaiian hoary bat fatalities have been observed since the start of project operations. The fatalities occurred in September 2008 and April 2011.

Occurrence in the Project Area and Offsite Communication Towers

Two to nine Anabat detectors have been deployed at various locations on the Kawailoa Wind Power project area beginning in October 2009. These studies are presently on-going, with detectors being moved to new locations from time to time to increase the area sampled. Anabat detectors detect the presence of bats by recording ultrasonic sounds emitted by bats during echolocation.

A total of 2,466 detector nights were sampled from October 2009 to January 2011 at 19 locations. During this period, bat activity over the entire site occurred at an average of 0.12 bat passes/detector night. The bat activity rates on site were divided into higher and lower activity periods. Higher activity periods were months with an average bat activity greater than 0.1 passes/detector night. Lower activity periods were months with an average of less than 0.1 passes/detector night. The higher activity period for Kawailoa Wind Power was between the months of March to November with an average activity rate of 0.15 passes/detector night for that period. February was excluded as a month with higher bat activity as 95% of the call sequences were detected on February 28. June and October were included in the higher bat activity period as these months are bracketed by months that are considered "higher activity" (Figure 3-2). The low activity period occurs during the months of December through February with an average activity rate of 0.045 passes/detector night. The data suggest that bat activity is higher from March through November and is lowest or absent in the winter. Bat calls are also distributed throughout the night (Figure 3-3). The overall detection rates at Kawailoa Wind Power are approximately five times lower than the detection rates at Hakalau National Wildlife Refuge (0.66 passes/detect or night) (Bonaccorso 2011) but are ten times the rates at Kaheawa Wind Pastures on Maui and Kahuku Wind Power on Oahu, both of which have an activity rate of approximately 0.01 bat passes/detector night (SWCA 2010d).

The actual number of bats represented by the detections made by the Anabat detectors on the Kawailoa Wind Power site is not known. Bat activity rates are not necessarily indicative of the number of bats (Kunz et al. 2007) as Anabat detectors cannot differentiate between many bats passing the detector once and one bat passing the detector multiple times. Thus, the higher activity rates observed at Kawailoa Wind Power could be due to an increase in bat numbers in the area or an increase in usage of the area by the same number of individuals or a combination thereof. The reported bat activity rates are also relative, rather than absolute measures of bat activity at the site. While the Anabats were placed in a variety of locations and vegetation types to ensure good representation of the site, these Anabats were not randomly placed at each location but situated in spots sheltered from wind, along roads or edges of vegetation to maximize the probability of detecting a bat. Hence the average bat activity over the Kawailoa Wind Power site is likely to be much less than the measured rate.

Cooper et al. (2011) visually observed two Hawaiian hoary bats on-site incidental to the seabird radar survey in June 2009, but no bats in October 2009. Those observations translated to an estimated summer occurrence rate of 2 bats in 84 25-min observation sessions (i.e., 0.057 bats/hour or approximately 0.68 bats/night (assuming 12 hrs of night)). Both bats were flying at an altitude of ≤5 m (Cooper et al. 2009). In June 2011 only one bat was recorded in 16 nights of observations (0.010 bats/hour or 0.12 bats/night). Given these results, it is presumed that a number of Hawaiian hoary bats forage over the Kawailoa Wind Power project area on a somewhat regular, though possibly seasonal, basis. These bats may also roost in the area.

No surveys for Hawaiian hoary bats were conducted at the microwave facility sites. Given the native forest that surrounds the microwave facility sites, bats may be expected to forage in the area at least occasionally.

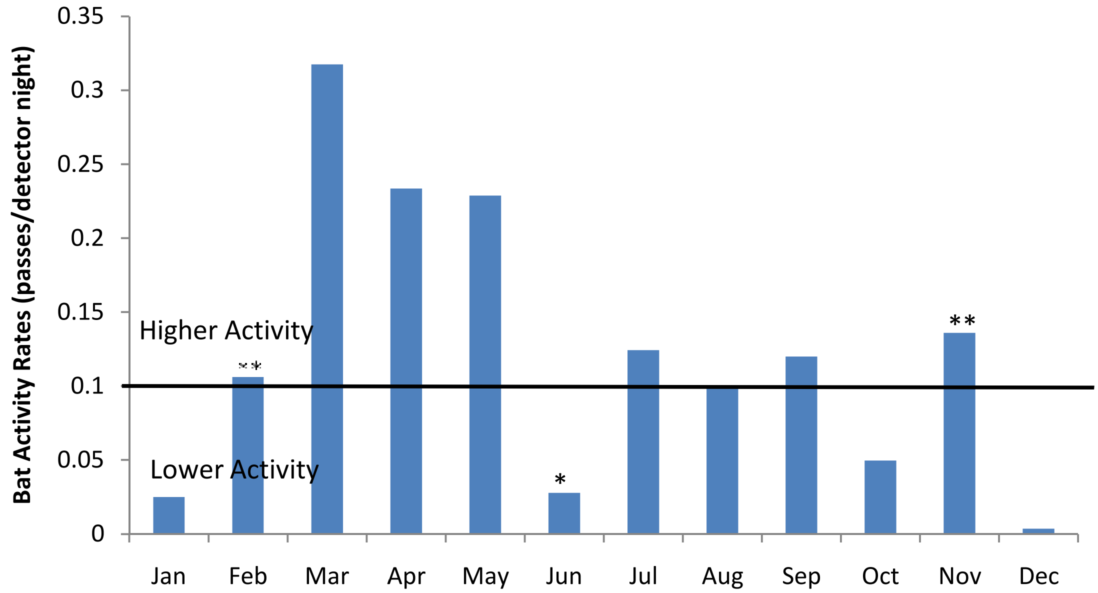


Figure 3-2. Distribution of Bat Passes Over Survey Period.

Higher activity month = 0.1 passes/detector night or greater; Lower activity month= less than 0.1 passes/detector night

*the drop in June was probably due to the low sampling effort for that month (37 detector nights) which occurred due to operator error and equipment shortage

**the increases in November and February were due to a large number of calls recorded in one night (on November 15, 30 of 49 call sequences were recorded in a span of 30 minutes; on February 28, 36 of 39 call sequences were recorded in a span of 1.5 hrs)

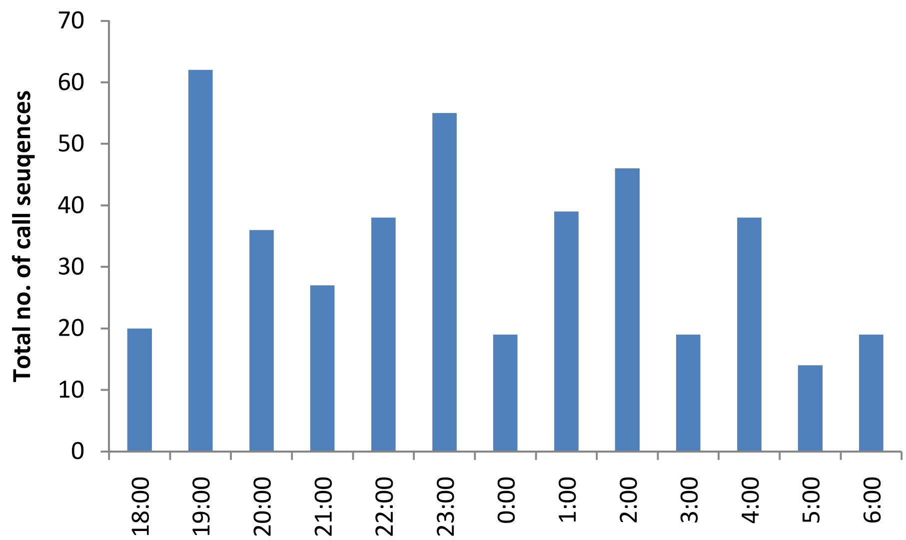


Figure 3-3. Time Distribution of All Bat Calls Detected.

3.6.4 State of Hawaii Listed Covered Species

3.6.4 (a) Hawaiian Short-eared Owl

Population, Biology, and Distribution

The Hawaiian short-eared owl is an endemic subspecies of the nearly cosmopolitan short-eared owl (*Asio flammeus*). This is the only extant owl native to Hawaii and is found on all the main islands from sea level to 8,000 feet. The Hawaiian short-eared owl is listed by the State of Hawaii as endangered on the Island of Oahu and is included as a Covered Species.

Unlike most owls, Hawaiian short-eared owls are active during the day (Mostello 1996; Mitchell et al. 2005), though nocturnal or crepuscular activity has also been documented (Mostello 1996). Hawaiian short-eared owls are commonly seen hovering or soaring over open areas (Mitchell et al. 2005).

No surveys have been conducted to date to estimate the population size of Hawaiian short-eared owl. The species was widespread at the end of the 19thcentury, but numbers are thought to be declining (Mostello 1996; Mitchell et al. 2005).

Hawaiian short-eared owl occupy a variety of habitats, including wet and dry forests, but are most common in open habitats, such as grasslands, shrublands and montane parklands, including urban areas and those actively managed for conservation (Mitchell et al. 2005). Evidence indicates the owls became established on Hawaii in relatively recent history, with their population likely tied to the introduction of Polynesian rats (*Rattus exulans*) to the islands by Polynesians.

Pellet analyses indicate that rodents, birds and insects, respectively, are their most common prey items of Hawaiian short-eared owls (Snetsinger et al. 1994; Mostello 1996). Birds depredated by Hawaiian short-eared owl have included passerines, seabirds and shorebirds (Snetsinger et al. 1994; Mostello 1996; Mounce 2008). The Hawaiian short-eared owl relies more heavily on birds and insects than its continental relatives (Snetsinger et al. 1994), likely because of the low rodent diversity of the Hawaiian Islands (Mostello 1996).

Hawaiian short-eared owls nest on the ground. Little is known about their breeding biology, but nests have been found throughout the year. Nests are constructed by females and consist of simple scrapes in the ground lined with grasses and feather down. Females perform all incubating and brooding, while males feed females and defend nests. The young may leave the nest on foot before they are able to fly and depend on their parents for approximately two months (Mitchell et al. 2005).

Current Threats

Loss and degradation of habitat, predation by introduced mammals, and disease threaten the Hawaiian short-eared owl. Hawaiian short-eared owls appear particularly sensitive to habitat loss and fragmentation. Ground nesting birds are more susceptible to the increased predation pressure that is typical within fragmented habitats and near rural developments (Wiggins et al. 2006). These nesting habits make them increasingly vulnerable to predation by rats, cats and the small Indian mongoose (Mostello 1996; Mitchell et al. 2005).

Some mortality of Hawaiian short-eared owls on Kauai has been attributed to "sick owl syndrome," which may be caused by pesticide poisoning or food shortages. They may be vulnerable to the ingestion of poisoned rodents. However, in the one study on mortality that has been conducted, no evidence was found that organochlorine, organophosphorus, or carbamate pesticides caused mortality in Hawaiian short-eared owls (Thierry and Hale 1996). Other causes of death on Maui, Oahu, and Kauai have been attributed to trauma (apparently vehicular collisions), emaciation, and infectious disease (pasteurellosis) (Thierry and Hale 1996). However, persistence of these owls in lowland, non-native and rangeland habitats suggests that they may be less vulnerable to extinction than other native birds. This is likely because they may be resistant to avian malaria and avian pox (Mitchell et al. 2005), and because they are opportunistic predators that feed on a wide range of small animals.

Little information is available on the impacts of wind facilities on owls. However, four fatalities of short-eared owl (*Asio flammeus flammeus*) have been recorded at McBride Lake, Alberta, Canada, Foote Creek Rim, Wyoming, Nine Canyon, Wyoming, and Altamont Wind Resource Area, California (Kingsley and Whittam 2007). Hawaiian short-eared owls are present year-round and observed regularly in the vicinity of the Kaheawa Wind Power facility on Maui, with one turbine related fatality reported since the start of project operations. In the vicinity of turbines, most observations of Hawaiian short-eared owl have been below the rotor swept zone of the turbines and thus their susceptibility to collision appears to be low (Spencer pers. comm. 2009). At Wolfe Island, Ontario, it was observed that short-eared owls were most vulnerable to colliding with turbine blades during predator avoidance and during aerial flight displays (Stantec Consulting Ltd. 2007). Short-eared owls on Oahu have no aerial predators and thus may only be vulnerable to colliding with turbines during flight displays.

Occurrence in the Project Area and Offsite Communication Towers

Hawaiian short-eared owls were not detected at the Kawailoa Wind Power project area or at the nearby water bodies. Because these owls are active during daytime and crepuscular periods, it seems probable that they would have been detected during the avian point counts if resident onsite. Regurgitated owl pellets of rodent hair and bones were observed on a trail on a grassy ridgetop in the upper part of the site (Hobdy 2010a) and numerous pellets have been found during the monitoring of the met towers at Kawailoa (SWCA, personal observations). However, it is probable that these belong to the barn owl (*Tyto alba*) which does occur on site. Despite these observations, as suitable grassland habitat does occur at the project site, the Hawaiian short-eared owl may occasionally be present.

No Hawaiian short-eared owls were seen during the wildlife surveys at the Mt. Kaala communication tower sites. It has not been historically documented at Mt. Kaala (DOFAW 1990).

3.7 Historical, Archaeological, and Cultural Resources

The archaeological integrity of the tablelands and the coastal plain behind Waialua Bay have for the most part been compromised by historic period ranching, cultivation, silviculture, military activities, and modern habitation, though nearby river valleys contain intact remnants of prehistoric and historic period Hawaiian occupation and use. The following section summarizes the historical, archaeological, and cultural resources.

3.7.1 Pre-Historic and Historic Context and Land Uses

The proposed wind farm site is located within the Kawailoa *ahupuaa*. The Kawailoa *ahupuaa*, and many of the places named within it, have traditional legends and historical accounts associated with them. In particular, the Waimea River valley to the north and the Ukoa Pond *makai* of the project area are associated with legends, most of which relate to this area's long-standing association with very old lines of prominent priests on Oahu. Historical accounts reference the *heiau* at Waimea, one being Puu O Mahuka, on a high bluff north of where the river enters the ocean, and the other being Kupopolo, near the beach south of the river mouth (Takemoto 1974).

Numerous caves within the high cliffs that separate the bluff-sides of Waimea Valley from the ocean below contained human remains and associated burial goods, including canoes and tapa cloth (Takemoto 1974). The seaside cliffs marked the line of transition between the land of the living and the land of the dead, the latter being the ocean. The fertile soils of the valley and the water of the river were modified through human action to form cultivatable terraces and irrigation channels. Before the arrival of Europeans to the area, the valley was known for its taro, sweet potatoes, *awa*, and breadfruit. Following his visit to the Waimea River Valley, McAllister (1933) reported the remains of agricultural terraces on both sides of the river for up to a distance of two miles inland from the bay. Irrigation ditches and numerous housing enclosures support historic observations that the valley around Waimea Bay was once heavily populated. According to the records of Thrum (1906) and McAllister (1933), the broader and flatter landscape around Waialua Bay was marked by ponds, irrigated pond fields, irrigation ditches, various *heiau*, and *akua* stones (Kirch 1992).

3.7.2 Archaeological and Historical Accounts

Soon after going ashore at Waimea Bay in 1779, Captain Clerke walked up the Waimea River valley, which he described as "well cultivated and full of villages" (Kuykendall 1938). Generally speaking, the coastal lands southwest of the project area and southeast of Waimea Bay were occupied by houses, occasional fishponds, and small cultivation plots containing taro and sweet potato (Pfeffer and Hammatt 1992). *Mauka* of the coastal plain, irrigated taro fields were created in the bottoms of river valleys, such as those within the Anahulu River valley. Higher up the valley slopes were hillside, or *kula*, cultivation of crops and trees. Isolated pockets of planted areas occurred even higher up in the narrower confines of the valleys and their numerous tributaries. Families owned plots in these different zones so that they could use the diverse resources. At the very high end of the river valleys Hawaiians collected a variety of wild plants and hunted birds.

It is only after the armed forces of Kamehameha I permanently occupied Oahu in 1804 that the interior of the Anahulu River valley became used and modified more intensively, which included the construction of irrigation canals and terraced fields for as much as three miles up the valley. A variety of stone features have been identified on the colluvial and talus slopes of the Anahulu valley uplands. Among these are stone piles, stone walls, stone-lined planting circles, small stone-walled garden plots, and terraces cleared of talus; these features were probably related to the growing of sweet potato, paper mulberry, yam, and banana (Kirch 1992).

Handy et al. (1972) maintain that the dry gulches between Anahulu and Waimea Rivers (those within the project area) probably never watered taro. It is likely that cultivators within the Anahulu valley used the rich tablelands on both sides for shifting cultivation even before the settlement of Europeans in the area. In *Mahele* land claims, for example, some of the upper valley claimants refer to swidden-like garden plots in the flat portions of mountains, which could refer to the surrounding tablelands (Kirch 1992). Moreover, maps of land claims in upper portion of the valley, known as Kawailoa-uka, show winding trails connecting valley bottom residences and terraced fields with tableland top ridge spurs (Kirch 1992).

As part of the *Mahele* of 1848, Kawailoa *ahupuaa* was awarded to Victoria Kamamalu, thus ownership eventually fell to the Bishop Estate (now Kamehameha Schools). According to the Waihona Aina database there were 95 *kuleana* claims made for Kawailoa *ahupuaa*. Most of these were for land *makai* of the project area and in Anahulu Valley. However, Cane Haul Road, which follows a former railway alignment, traverses four small *kuleana* parcels.
Between 1850 and 1900, substantial portions of the project area were planted in sugarcane (Pfeffer and Hammatt 1992). Early in the plantation history sugarcane did not extend higher than the 200 feet contour above sea level. Above this elevation, pineapples were grown. However, sometime after that date, with increased technology sugarcane supplanted pineapples in the upper fields. By 1936, irrigation reservoirs, wells, and canals were introduced, an infrastructural development that drastically increased production output. The sugar and pineapple companies modified and used most of the land within the project area, clearing original vegetation, leveling original landforms, digging ditches, constructing reservoir walls, and building roads and railroads. These alterations virtually obliterated material traces left by both traditional Hawaiian and early historical agricultural modification of the tablelands. Substantial amounts of foreign laborers (mostly Chinese, Filipino, and Japanese) were imported to work the fields, with labor camps dotting the landscape (Pfeffer and Hammatt 1992). As far as can be ascertained, the Kawailoa plantation field camp partly overlapped the Kawailoa Road corridor. The largest of the camps in this area, the Kawailoa Camp, included over 500 homes, an elementary school, a gym, a swimming pool, a theater, two stores, two barber's shops, three community baths, a Japanese-language school, and a Buddhist temple (the Kawailoa Ryusenji Soto Mission) (Clark 2007).

By 1920, the Oahu Railway and Land Company, originally started in 1886, built tracks that skirted the island's shoreline (Dorrance and Morgan 2000); a rail line zigzags across the lower portion of the project area. As early as World War I, the U. S. Army considered using the railway system in the event of an enemy attack on the northern side of the island; over the course of time, several military operations were undertaken in the vicinity of the project area. In 1942, the U. S. Army-built Battery Carroll Riggs on a plantation workers camp in an area currently known as Opaeula Ranch, southwest of the project area. South of Battery Riggs, Brodie Camp No. 4 had a cable hut and a 100-pair cable installed (Bennett 2002), as part of a circum-island command and fire control communication system. Northeast of the project area, the Waimea Battery Battle Position serves as the southernmost perimeter of the Waimea Battery, with gun emplacements constructed on a bluff above Kaiwikoele Stream. In addition, Drum Road, which runs from Helemano to the Army's Kahuku training range, was constructed by the U. S. Army in the 1930s to handle increases in military vehicle traffic and to provide an alternative route to the north of the island in the event of potential damage to Kamehameha Highway.

In 1947, the Oahu Railway and Land Company went out of business, and by 1950, much of the railroad infrastructure had been dismantled. The plantation railways were also dismantled, with hauling of sugar cane conducted by truck. Cultivation continued through the modern era, with the plantation growing to include over 12,000 acres of planted lands. However, over time, sugar production in the Hawaiian Islands became largely unprofitable, resulting in the closure of sugar plantations throughout the islands toward the end of the century. The last sugarcane fields in this area date to 1996 (Dorrance and Morgan 2000). This final episode of sugar planting was marked by heavy machinery creating a virtually continuous wall of push piles along the edges of the fields, and in so doing obliterated much of the older irrigation ditches on the tablelands.

<u>3.7.3 Archaeological Investigation</u>

Rechtman Consulting, LLC conducted a detailed archaeological investigation : *Archaeological Inventory Survey of the First Wind Kawailoa Wind Project Area*) to identify archaeological and historical resources within the project area (Rechtman et al. 2011). The first round of fieldwork for the current project was conducted between April 12 and May 14, 2010, and between February 15 and February 25, 2011, with follow-up field days on March 30, April 14, and April 27, 2011. Portions of the project area addressed during the first round of fieldwork include the eastern tableland array, Kawailoa Road, the southern end of Cane Haul Road, and Ashley Road. The second round of fieldwork focused on the western tableland array, Mid-Line Road, and the remainder of Cane Haul Road. Follow-up fieldwork addressed the makai interconnection facility and the overhead collector lines.

In addition to the archaeological fieldwork, archival cartographic material concerning plantation infrastructure was obtained and correlated with the field findings. Also, whenever possible, individuals knowledgeable about the area and past land use practices were consulted.

As a result of the current study, 17 archaeological sites have been identified within the project area. All of these sites date from the historic period and were likely associated with either former military operations or former plantation activities. Given the extensive disturbance of the project area by the sugarcane industry, it is likely that any earlier archaeological features within the project area were significantly impacted if not completely destroyed. In addition to the sites identified within the study area, 6 previously identified archaeological sites and 19 newly identified sites were inspected during the current study. These sites are near to, but outside of, the study area footprint, and represent both Precontact and Historic use of the area.

Of the 17 Historic Period sites found within the project area, 5 are associated with the irrigation of sugarcane. A sixth site is a possible concrete field marker identifying the location of one of the mauka-most agricultural plots within the project area.

A 1929 Haleiwa Quadrangle map shows an extensive network of irrigation features along Kawailoa Road. Historical documents (such as Dorrance and Morgan 2000) suggest that plantation agricultural may have begun impacting the Kawailoa landscape as early as 1898, and that by the late 1920s, irrigated fields covered vast portions of the project area, which included ditches, pipes, tunnels, a few pump houses, several reservoirs/ponds, roads, and railway lines; this infrastructure was identified as the Kamananui Ditch System.

Dates incised into the cement capping of ditch and sluice gate walls of the four defined ditch complexes suggest that the Kamananui Ditch System was in place by at least 1913, and dates incised in other concrete features recorded at the site suggest that by 1926 and 1927, the main channels were well established. A spurt of activity occurred in 1937, with ongoing maintenance to the ditch occurring during the war years, as attested by a few early 1940s dates. Judging from the incised dates, a second spurt of activity occurred between 1950 and 1954, and further maintenance and update activities occurred between 1981 and 1990. Even though sugarcane cultivation was terminated at the end of 1996, the ditch complex continued to be used and maintained along certain sections, as attested by the 2008 and 2009 dates incised on portions of the lower Mid-Line Road and the main Kawailoa Road ditches.

Features associated with the transport of sugarcane within the project area include the concrete bridge along Cane Haul Road, the four stone-walled road culverts, and stone abutments and kebstone alignment within the Kawailoa Road corridor. An additional plantation-related site recorded within the Kawailoa Road Corridor appears to be the location of a former stable.

Sites seemingly associated with World War II (or slightly earlier) military activities include three separate concrete pillar foundations along the northern mauka-most ridge within the project area. These three related sites are most probably remnants of a military cable-communication and signaling network. These, along with one other site, are the only sites that were found in the vicinity of any of the proposed wind turbines tower locations.

3.7.4 Traditional Cultural Practices and Uses

Cultural Surveys Hawaii conducted a Cultural Impact Assessment (Appendix A) (2011). The OEQC Guidelines identify several possible types of cultural practices and beliefs that are subject to assessment. These include subsistence, commercial, residential, agricultural, access-related, recreational, and religious and spiritual customs. The guidelines also identify the types of potential cultural resources, associated with cultural practices and beliefs that are subject to assessment. These are essentially natural features of the landscape and historic sites, including traditional cultural properties. "Traditional" as it is used, implies a time depth of at least 50 years, and a generalized mode of transmission of information from one generation to the next, either orally or by act. "Cultural" refers to the beliefs, practices, lifeways, and social institutions of a given community. The use of the term "Property" defines this category of resource as an identifiable place. Traditional cultural properties are not intangible; they must have some kind of boundary. With one important exception, they are subject to the same kind of evaluation as any other historic resource; the exception stems from the fact that, by definition, the significance of traditional cultural properties is determined by the community that values them.

The process used to conduct a CIA typically includes first generating the cultural and historical background, based on a synthesis of relevant archaeological, ethnographic and historic information. Sources of data include archaeological reports, ethnographies, historic documents, collected *moolelo* (oral traditions), Land Commission Awards of the Mahele, previously recorded life histories/interviews, and historic maps, aerial images, and photographs.

The second component of the CIA involves a series community consultation and interviews. A list of approximately 30 Hawaiian organizations and individuals was compiled. This list of organizations and individuals reflects the extensive community outreach and consultation conducted by Kamehameha Schools for their North Shore master planning effort. A total of 37 individuals were contacted to request an interview; these individuals include kamaaina (Native-born) and kupuna (elders) with knowledge of the study area. Of these, 17 responded and 9 participated in formal interviews from January 2011 to April 2011. The interviews included questions from the following five broad categories: wahi pana (storied places) and moolelo, agriculture and gathering practices, freshwater and marine resources, cultural and historic properties, and burials.

Participants in the community consultation and interviews shared a range of manao (thoughts and opinions) on cultural sites, beliefs, and practices, as related to the proposed wind farm. For example, participants described numerous pre-Contact cultural sites in the vicinity of the proposed project. Several sites were identified within the makai section of Kawailoa, particularly those that are near the existing access roads that would be used for the proposed project; these include Kahokuwelowelo Heiau, Kahokuwelowelo Hale, burials, an enclosure, a wall, a rock carving, an altar, and other rock structures. Several heiau, former habitation sites, and other cultural sites in the mauka lands of Kawailoa were also referenced, although the locations of these sites were not specified. With respect to post-Contact sites, one participant recalled the presence of sugarcane across the entire landscape of Waialua during the first half of the twentieth century. The immigrant plantation camps were described, particularly the Kawailoa Camp, which included Japanese, Chinese, Korean, and Filipino laborers and their families, and were located near the existing access roads to be used for the proposed project. Two Japanese graveyards, located near the intersection of Cane Haul Road and Kawailoa Road, were also discussed.

The participants described abundant ocean and forest resources that were once caught or gathered in the makai and mauka lands of Kawailoa. A variety of cultivars were also grown in the makai portion of Kawailoa, but the historic research and community consultation suggest that the mauka lands of Kawailoa (including the proposed locations for the wind turbines and appurtenant facilities) were mostly covered in sugarcane. As the fields were left fallow in the 1990s, there does not appear to have been any recent use of the land for cultivation or gathering of resources. A response letter provided by the History and Culture Branch Chief of SHPD states that certain families, practitioners, and/or groups continue to practice Hawaiian spirituality, traditional burials, and other activities, such as hunting and hiking.

3.7.5 Mt. Kaala Communication Sites

From a traditional Hawaiian perspective, Mt. Kaala is revered and honor as a sacred place. A review of the records on file at the Hawaii Department of Land and Natural Resources State Historic Preservation Division (DLNR-SHPD) suggests that no archaeological studies have been conducted at the upper elevations on Mt. Kaala, and that no sites are known to exist in the vicinity of the proposed communication sites. However, there was one Section 106 consultation/determination made for the existing Hawaiian Telcom facility located along Mt. Kaala access road, which is one of the two sites that is the subject of the current study. In May 2005, the Hawaii State Historic Preservation Office (SHPO) (DLNR-SHPD Doc. No. 1005RS47) concurred with an Applicant determination that the proposed co-location of cellular communication antennae and a 100-square-foot ground sublease would not affect historic properties. A field inspection of both of the existing facility locations was conducted by Rechtman Consulting, LLC on July 16, 2010. There were no archaeological resources observed at either site. The Mt. Kaala communication sites are also being addressed as part of the CIA.

3.8 Visual Resources

The project is located in a relatively rural area known for its scenic shoreline, expansive agricultural lands, and natural character. In general, the region has a high aesthetic quality, which is generally attributed to the sweeping landscape views of the ocean and open lands, with the backdrop of the Koolau and Waianae mountain ranges. There are frequent opportunities for views of both the coastline and the mountains from Kamehameha Highway, the main roadway which runs the length of the coastline. Two small towns, Haleiwa and Waialua, and several residential communities, including Pupukea, are also located in the project vicinity. This section of the coastline also includes many well-known beaches, including Waimea Bay, Chun's Reef, Laniakea, Puaena Point, and Haleiwa Beach Park.

The North Shore Sustainable Communities Plan (City and County of Honolulu 2011) addresses the scenic quality of this region and identifies protection of scenic views as a general policy. Within the context of this policy, one of the planning principles identified in the plan is the preservation of views of the mountains, coastline, and Pacific Ocean from public places, including major roadways. The plan establishes specific guidelines including the need to evaluate the impact of land use proposals on the visual quality of the landscape, but recognizes that the protection of roadway views should be balanced with the operating requirements of diversified agriculture. Furthermore, the guidelines specify that alternative energy systems should be sited to minimize their impact on visual resources, including clustering and techniques to blend the equipment into the natural landscape. Where possible, utility lines should be placed underground and artificial lighting should be minimized.

The visual character of the wind farm site is defined by the broad agricultural fields with the Koolau Mountains as a backdrop. The site is comprised of a series of broad upland plateaus interspersed with steep gulches. The uplands support either actively maintained agricultural crops or overgrown, weedy vegetation. The gulches are densely vegetated with a well-developed canopy, which blocks portions of the *mauka* views from Kamehameha Highway. In addition, a steep bluff occurs along the lower edge of the Kawailoa property, just *mauka* of Kamehameha Highway, further limiting the views of the wind farm site from the highway. The site is visible at a distance from areas to the north (including Pupukea) and to the south (including Haleiwa, Waialua, and Mokuleia), as well as from the ocean. The proposed project site would be located at an elevation ranging between approximately 100 and 1,300 feet above mean sea level (msl). The turbines would be located a minimum of approximately 0.7 mile from Kamehameha Highway, 0.85 mile from Pupukea, and 3.8 miles from Haleiwa Town. The proposed communication tower sites are located on rocky mountain ridges, surrounded by steep mountainous slopes. These sites each include existing Hawaiian Telcom structures that have been in place for several decades. The ridges are part of the Mokuleia Forest Reserve, and are heavily vegetated with a well-developed canopy and dense undergrowth. The lower communication tower site is generally visible from the Mt. Kaala access road. The repeater communication site is along the DuPont Trail, but is not visible from the access road.

3.9 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, time of day, and apply to sound levels at the property boundary (Table 3-5).

The proposed wind energy facility uses would be subject to the Community Noise Control Rule. The project area is surrounded by Class A (preservation lands) and C (agricultural) Zoning Districts. Noises produced by the project in Class A Zoning Districts cannot exceed 55 dBA[8] during the daytime or 45 dBA during the nighttime *at the project area property line*. In Class C Zoning Districts, noise levels from the project cannot exceed 70 dBA during the daytime or nighttime (CH2M Hill 2011a, b). Additional details are available in Appendix B: Environmental Noise Assessment Report for Kawailoa Wind Farm.

Table 3-5. 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 level measurements and wind speed data were collected between January and March 2011 to assess the existing acoustical environment within various representative areas within project site and the community. Data were collected from various locations within the project site, as well as

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

in community areas, including areas readily accessible to the public or residential areas. The community sampling locations include:

- Puu O Mahuka Heiau
- Pupukea Residence
- Waimea Valley
- Punalau Residence (adjacent to Ashley Road and Kamehameha Highway)
- Kawailoa Road (*mauka* of Transfer Station)
- Haleiwa(*mauka* of Joseph P. Leong Highway)
- Dole Plantation (along Kamehameha Highway

At each location, continuous 1-hour statistical sound levels were recorded for up to two weeks with a tripod-mounted microphone located generally about 5 feet above grade, and covered by a windscreen. Simultaneous weather data (such as wind speed, direction, and temperature) were also collected with a tripod-mounted anemometer near the sound level meter, generally at a height of about 7 feet above grade. A handheld Garmin global positioning system (GPS) unit was used to adjust the wind vane to accurately measure wind direction. Wind speed measurements were validated using a handheld Kestrel 3000 Pocket Weather Meter.

The data used to calculate the range of equivalent sound levels, Leq, during the day (7 a.m. to 10 p.m.) and night (10 p.m. to 7 a.m.), as well as the day-night average, Ldn. The average calculated Ldn ranged from 43 to 69 dBA on the project site and 42 to 63 dBA in the surrounding community. Contributing noise sources included environmental noise sources such as wind and birds, vehicular traffic, community noises, landscaping or grading equipment, and aircraft flyovers. Additional detail, including the measurement results for each sampling location, is provided in the Environmental Noise Assessment Report for the Kawailoa Wind Farm contained in Appendix B

3.10 Land Use

The proposed facility is situated in the Waialua District on the north central portion of Oahu. The project area encompasses portions of five parcels (TMKs 6-1-005:001, 6-1-006:001, 6-1-007:001, 6-2-009:001, 6-2-011:001). All parcels are owned by Bishop Estate/ Kamehameha Schools. The entire Kamehameha Schools Kawailoa property is roughly 7,000 acres in size (CH2MHill 2011a, 2011b). Portions of the parcels are leased for various agricultural uses with roughly 2,200 acres in cultivation (Kamehameha Schools 2005).

In the late 1800s, the Kawailoa area was used for extensive sugar cane production by the Waialua Sugar Co. The fields were plowed, burned, harvested, and planted in continuous cycles for about 100 years. Some of the broader gulches within the project area were used to pasture plantation horses and mules (Hobdy 2010a).

There are no planned land uses identified in any state or local plans for the project area.

The following land uses currently occur within the vicinity:

- Kawailoa Training Area: The largest U. S. Military training area on Oahu, covering 23,348 acres (U. S. Army Environmental Command 2008).
- Kawailoa Refuse Transfer Station: Site for the temporary collection and storage of waste.

- Waimea Valley: Roughly 1,875 acre valley owned by the Office of Hawaiian Affairs and managed by Hiipaka, a non-profit organization which operates Hawaiian based recreational and educational activities (http://waimeavalley.net/default.aspx).

- Drum Road: A military access road running along the west slope of the Koolau Mountain Range and across the Schofield Plateau (SWCA 2008).

Nearby urban areas include the residential communities of Kawailoa, Haleiwa, and Pupukea. Pupukea is beyond Waimea Bay and roughly 5.2 miles to the north of the project area. Haleiwa is the nearest commercial center, located approximately 1.9 miles to the south of the project area.

Most of the Kawailoa Wind Power project area is designated as an Agricultural District according to HRS Chapter 205; however, portions of some of the parcels are designated as General and Limited subzones of a State Conservation District. Lands mauka of the project area are also designated as Conservation. Both of the proposed offsite communication towers are located on Conservation District land. 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). The communication towers are planned to be located on a single parcel (TMK 6-7-003:024) owned by the State of Hawaii.

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

3.11 Transportation and Traffic

This section addresses publicly-accessible transportation infrastructure, including harbors, airports and roadways as well as privately-owned project site roadways. Kalaeloa Harbor on Oahu is a heavy lift berthing facility located on the western coast of Oahu, suitable for unloading and temporary storage of the large turbine components needed for the proposed project. Turbine blades, nacelles, and tower components would be removed from barges at Kalaeloa Harbor and loaded onto vehicles for transport to the wind farm site.

3.11.1 Roadways

Access to the wind farm site is provided via a network of state, county, and privately owned roadways. These roads range from multi-lane highways with paved shoulders to privately owned paved or dirt roads. The existing roads within the proposed wind farm project area are owned and maintained by Kamehameha Schools.[9] Based on the size and weight of the turbine components and the dimensions and capacities of existing roadway infrastructure (including bridges and overpasses), transportation routes between Kalaeloa Harbor and the wind farm site were identified by ATS International. The following routes are proposed for transporting the various turbine components to the project site. The proposed route from Kalaeloa Harbor to the wind farm site for the transport of the wind turbine blade components is as follows:

- Take Kalaeloa Harbor to Malokili Drive
- Left on Malokili Drive toward Kalaeloa Boulevard
- Left on Kalaeloa Boulevard
- Merge on to H-1 East
- Exit H-1 East to Wahiawa heading northeast
- Exit on to H-2 north
- Continue on H-2 north to Wilikina Drive
- Right on Kamananui Road
- Turn west on Kamehameha Highway

[9] The existing onsite access roads traverse several small properties owned by other entities. Kamehameha Schools currently has grants of easement with these other landowners for long-term access through their properties for both Kamehameha Schools and its lessees and tenants, which includes Kawailoa Wind. In addition, Kawailoa Wind has a separate access agreement with three of these landowners that allows for access and road improvements as needed for delivery of equipment.

- Continue on Kamehameha Highway west to Joseph P. Leong Highway (Highway 99)
- Continue on Highway 99 to Kamehameha Highway west (Highway 83)
- Continue on Highway 83 to proposed entrance on Kawailoa Drive
- Right from Kamehameha Highway into the wind farm site

No modifications to infrastructure or tree trimming are expected to be required along this route. Given the roadway slope of several of the overpasses, this route is not suitable for transporting the tower sections or nacelle components. The proposed route from Kalaeloa Harbor to the wind farm site for the transport of the tower sections is as follows:

- Take Kalaeloa Harbor to Malokili Drive
- Left on Malokili Drive toward Kalaeloa Boulevard
- Left on Kalaeloa Boulevard
- Merge on to H-1 East
- Exit H-1 East to Kamehameha Highway west
- Take Exit 8 from Kamehameha Highway
- Right on Ka Uka Road
- Left on to H-2 North
- Continue on H-2 North to Wilikina Drive
- Right on Kamananui Road
- Turn west on Kamehameha Highway
- Continue on Kamehameha Highway west to Joseph P. Leong Highway (Highway 99)
- Continue on Highway 99 to Kamehameha Highway west (Highway 83)
- Continue on Highway 83 to proposed entrance on Kawailoa Drive
- Right from Kamehameha Highway into the wind farm site

All trees along the section of Kamehameha Highway in Waipahu would require trimming to a clearance height of 17 feet. In addition, police escorts would be needed to stop traffic at the intersection of Kamehameha Highway and Ka Uka Road in order for the trailers carrying oversized loads to navigate the right hand turn.

The transport of the oversized nacelle components would require 19-axle trailers; the proposed route from Kalaeloa Harbor to the wind farm site for this equipment is as follows:

- Take Kalaeloa Harbor to Malokili Drive
- Left on Malokili Drive toward Kalaeloa Boulevard
- Left on Kalaeloa Boulevard
- Merge on to H-1 East
- Exit H-1 East to Kunia Road exit
- Left on to Kunia Road
- Continue on Kunia Road to Wilikina Drive
- Left on to Wilikina Drive
- Right on Kamananui Road
- Turn west on Kamehameha Highway
- Continue on Kamehameha Highway west to Joseph P. Leong Highway (Highway 99)
- Continue on Highway 99 to Kamehameha Highway west (Highway 83)
- Continue on Highway 83 to proposed entrance on Kawailoa Drive
- Right from Kamehameha Highway on to Kawailoa Drive

Trees along the golf driving range on Kunia Road and trees approximately 0.3 mile before Foote Avenue would require trimming to a clearance height of 17 feet. In addition, police escorts would be required to stop east-west bound traffic at the intersection of Kunia Road and Wilikina Drive in order for the trailers carrying oversized loads to navigate the left hand turn.

Access to the Mt. Kaala communication site is via an existing single-lane access road, which is owned and maintained by the Kaala Joint Use Coordinating Committee (JUCC).

3.11.2 Airports and Airfields

The nearest airfield to the Kawailoa wind farm site is Dillingham Airfield, approximately 9 miles to the west. Wheeler Army Airfield is located approximately 12 miles to the south, in central Oahu. The Honolulu International Airport is approximately 25 miles to the south on the coast of the island.

In addition, the U. S. Army leases property from Kamehameha Schools for the Kawailoa Training Area that, along with other nearby training areas (such as the Kahuku Training Area), comprises a TFTA (Tactical Flight Training Area) for high-density air traffic from the ground surface to 500 feet above ground level (known as the A-311 alert area). This area is used for aviation and ground training by multiple branches of the Department of Defense, and includes flight routes and helicopter landing zones. Nine of the proposed turbine locations in the eastern portion of the project area overlap with the TFTA.

3.11.3 Harbors

Kalaeloa Harbor on Oahu is a heavy lift berthing facility located on the western coast of Oahu, suitable for unloading and temporary storage of the large turbine components needed for the proposed project. Turbine blades, nacelles, and tower components would be removed from barges at Kalaeloa Harbor and loaded onto vehicles for transport to the wind farm site.

Honolulu Harbor is a heavy lift berthing facility located on the southern coast of Oahu suitable for unloading and temporary storage of heavy equipment and construction materials needed for the proposed project. Rotor hubs, drive trains, and all other miscellaneous turbine components and construction equipment would be unloaded from barges at Honolulu Harbor and transported to the site.

3.12 Military Operations

The U. S. Army utilizes the Kahuku Training Area and Kawailoa Training Area for aviation and ground training by the Army as well as the Marine Corps, Air Force and Navy. The Army-owned lands comprising the TFTA are contiguous and stretch from their northern extent at the uplands *mauka* of Kawela Bay to Kahuku Town, eastward following the spine of the Koolau Mountains, westward to the agricultural lands of the Schofield Plain and as far south as Whitmore Village. The majority of these lands are zoned for preservation; those lower in elevation and closest to roads are zoned for agriculture and commercial.

The TFTA is an FAA-designated alert area of high-density air traffic from the ground surface to 500 feet above ground level, known as the A-311 alert area. According to the FAA Air Traffic Organization Policy ORDER JO 7400.8T Part II – Nonregulatory Special Use Airspace Areas, Subpart C – Alert Areas, an alert area is defined as airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft. Activities include pilot training or an unusual type of aeronautical activity.

The TFTA is the military's low level, day, night, and night vision device (NVD) tactical training area, and is used by several branches, or services, of the Department of Defense including the U. S. Army, Marine Corps, Navy, and Air Force. The services fly thousands of hours in day, night, and multi-ship helicopter operations at low altitudes in the area for aviation and ground training. Key to using A-311 is a series of low-level flight routes and helicopter landing zones (LZs) that have been developed over the years; these accommodate tactical LZ operations, air-assault operations, sling load operations, and other activities. Drum Road, which is used by the military for training and was recently improved with a paved surface, is also in the TFTA and portions of the road pass through the wind farm site.

As indicated in an EISPN consultation letter from Marine Corps Base Hawaii, roughly 70 percent of all Marine Corps Hawaii unit aviation training takes place within the TFTA. Continued access by aircraft in support of ground combat training operations is vital because the existing road network is limited and often impassable because of wet weather conditions. The U. S. Army 25th Combat Aviation Brigade (CAB) also conducts aviation and ground training in the area. The Army also serves as the host for multi-service, land-based training requirements; these requirements are continuing to grow as the military prepares its service members for combat and modernizes the force.

Wheeler Army Airfield maintains a non-directional beacon (NDB 152) as a navigational aid for instrument-only aircraft approaches to its airfield in central Oahu. This instrument approach is used primarily for instrument recovery to the airfield from the TFTA and the Kahuku Training Area, and while this approach technology is not often employed, the designated approach area and elevations cross over portions of the wind project. The services also operate radar facilities in the general area that could potentially be affected by the wind farm turbines.

3.13 Hazardous Substances and Materials

The Kawailoa project area is located within agricultural plantation lands with no known activities that produced hazardous waste or involved the disposal of hazardous waste in the area, though contaminants related to former agricultural use (e.g., herbicides) may be present in the soils. A Phase I Environmental Site Assessment (Phase I) has not been prepared for the Kawailoa project area.

The communication towers are located on State land leased by Hawaiian Telecom. The facility includes a subsurface underground storage tank (UST). Available information indicates that a release from the UST may have been documented, but that response actions for the documented UST releases have been completed (CH2M Hill 2011a, 2011b). No other activities are known to have generated potentially hazardous waste (or the disposal of hazardous waste) at the communication facilities.

3.14 Socioeconomic Characteristics

The proposed Kawailoa Wind Power facility is located in Kawailoa, within the District of Waialua, on the Island of Oahu. The total resident population of the Island of Oahu is approximately 905,034 individuals (Table 3-6, DBEDT 2009). The majority of the resident population on Oahu lives in the District of Honolulu. In 2000, the District of Waialua had a resident population of 14,027 individuals representing roughly 1.6% of the entire island’s population. The district experienced a 21.5% change in population between 1990 and 2000 (DBEDT 2009)

Table 3-6. Resident Population for Selected Areas.

Area	1980	% change	1990	% change	2000
State of Hawaii	964,691	14.9	1,108,229	9.3	1,211,537
Oahu Island	762,534	9.7	836,231	4.8	876,156
Waialua District	9,849	17.3	11,549	21.5	14,027
Haleiwa CDP			2,442	-8.9	2,225
Pupukea CDP			4,111	3.4	4,250
Source: DBEDT (2009), U.S. Census Bureau (2000).					

The nearest communities to the proposed project area are Haleiwa and Pupukea. Haleiwa Town is approximately 3.8 miles to the south and Pupukea is less than one mile to the north. The population of the Haleiwa Census Designated Place (CDP) in 2000, as defined at the U. S. Census Bureau, was approximately 2,225 individuals. The population in the Pupukea CDP is roughly double, with an estimated 4,250 individuals (U.S. Census Bureau 2000).

In 1999, the median household income in the Haleiwa CDP was $39,643 and the median per capita income was $16,504. During that year, approximately 15.0% of families and 17.6% of individuals in the Haleiwa CDP had an income below poverty level. The Pupukea CDP had a median household income of $56,146 and a median per capita income of $25,682. Roughly 11.4% of families and 15.2% of individuals in the Pupukea CDP had an income below poverty level in 1999. Combined, 13% of families and 16% of individuals 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 2000).

Demographic information for 2000 indicates that the population of the Haleiwa CDP was primarily composed of Asians (29%), Whites (25%), and Native Hawaiian and other Pacific Islander (10%). Almost 35% of the CDP's population reported two or more races (U. S. Census Bureau 2000). In the Pupukea CDP, 56% of the population identified themselves as White, 15% as Asians, 7% as Native Hawaiian and other Pacific Islanders, and 21% as two or more races combined, the population was 45% White, 19% Asian, 8% Native Hawaiian and other Pacific Islander, and 26% two or more races. In comparison, the State of Hawaii was 42% Asian, 24% White, and 9% Native Hawaiian and other Pacific Islander, and 21% two or more races (U. S. Census Bureau 2000).

The visitor and recreational industries are a major part of the economy in the area providing small-scale, country-style visitor accommodations. Agriculture is also an important component of the economy of the region. Diverse crops and forest products production provide a multitude of jobs for area residents (DBEDT 2009).

3.15 Natural Hazards

A natural hazard is a threat of a naturally occurring event that could negatively affect people or the environment. Many natural hazards can be triggered by another event, though they may occur in different geographical locations (for example, an earthquake can trigger a tsunami). Natural hazards that can affect Hawaii include hurricanes and tropical storms, tsunamis, volcanic eruptions, earthquakes, flooding, and wildfire.

3.15.1 Hurricanes and Tropical Storms

Hurricanes develop over warm tropical oceans, and have sustained winds that exceed 74 mph. Tropical storms are similar to hurricanes, except that the sustained winds are below 74 mph. These events can also produce torrential rains. Given the steep and complex topography of the islands, wind can amplify across ridges and through channels, and rain can be focused down valleys, resulting in destructive flash floods and landslides. As a result, even a relatively weak tropical storm can potentially result in considerable damage (Businger 1998). The Central Pacific Hurricane season runs from June 1 to November 30.

True hurricanes are very rare in Hawaii, indicated by the fact that only five have affected the islands over the last 50 years (Businger 1998). Tropical storms occur more frequently than hurricanes, and typically pass sufficiently close to Hawaii every 1 to 2 years to affect the weather in some part of the Islands (WRCC 2008). Historically, the hurricanes have made landfall at (or passed more closely to) the northern Hawaiian Islands, such as Kauai (Businger 1998). No hurricane or tropical storm has historically made landfall on Oahu.

3.15.2 Tsunamis

Tsunamis are large, rapidly moving ocean waves triggered both by disturbances around the Pacific Rim (that is, teletsunamis) and earthquakes and landslides near Hawaii (that is, local tsunamis). The Pacific Disaster Center reports that tsunamis have resulted in more lost lives in Hawaii than the total of all other natural disasters (Pacific Disaster Center 2010a). In the 20th century, an estimated 221 people have been killed in Hawaii by tsunamis. One of the largest and most devastating tsunamis to hit Hawaii occurred in 1946, resulting from an earthquake along the Aleutian subduction zone. Wave runup heights reached a maximum of 33 to 55 feet and 159 people were killed. A total of 32 tsunamis with run-up greater than 1 meter have occurred in Hawaii since 1811 (U. S. Geological Survey [USGS], 2010). The western-most edge of the wind power facility, consisting of onsite access roads, is within the Civil Defense Tsunami Evacuation Zone (Hawaii State Civil Defense 2010).

3.15.3 Volcanic Eruptions

There are currently no active volcanoes on Oahu.

3.15.4 Earthquakes and Seismicity

Earthquakes in Hawaii are linked with volcanic activity. Small earthquakes are generally triggered by eruptions and magma movement within the active volcanoes (for example, Kilauea, Mauna Loa). Larger earthquakes (that is, tectonic earthquakes) tend to occur in areas of structural weakness at the base of these volcanoes or deep within the Earth's crust beneath the island. Several strong tectonic earthquakes (magnitude 6 to 8) have occurred in Hawaii and caused extensive damage to roads, buildings, and homes, triggered local tsunami, and resulted in loss of life. The most destructive earthquake in Hawaii had a magnitude 7.9 and occurred on April 2, 1868, when 81 people lost their lives (USGS 2001).

3.15.5 Flooding

Potential flood hazards are identified by the Federal Emergency Management Agency (FEMA) National Flood Insurance Program and are mapped on the Flood Insurance Rate Maps (FIRM). The maps classify land into four zones depending on the potential for flood inundation. According to the FIRM, the project area is almost entirely within Flood Zone D, where analysis of flood hazards has not been conducted and flood hazards are undetermined. The western-most edge of the wind farm site, throughout which the onsite access roads traverse, is near the mouths of several streams (Kawailoa, Laniakea, Loko Ea, and Anahulu) and is designated as Flood Zone XS and Flood Zone X. Flood Zone XS includes areas between the limits of the 100-year (1-percent annual probability) and 500-year (0.2-percent annual probability) floodplains, including areas inundated by 100-year flooding with average depths of less than 1 foot. Zone X is assigned to those areas that are determined to be outside the 500-year floodplain with less than 0.2-percent annual probability of flooding (FEMA 2010). All of the wind turbines and appurtenant structures would be located within areas classified as Zone D; no development would occur within a special flood hazard zone.

The proposed Mt. Kaala communications sites are within an area designated by FEMA as Flood Zone D, where analysis of flood hazards has not been conducted and flood hazards are undetermined.

3.15.6 Wildfire

Wildfire occurs on all of the major Hawaiian Islands, with human activity as the primary cause. Because Hawaii’s native ecosystems are not adaptive to wildlife, they can result in extinction of native species and increased coverage of nonnative, invasive species. Other effects include soil erosion, increased runoff and decreased water quality (Pacific Disaster Center 2010b).

3.16 Public Safety

Public safety concerns associated with the operation of a wind power project are the focus of this section. In many ways, wind energy facilities are safer than other forms of energy production because combustible fuel and fuel storage are not required. In addition, use and/or generation of toxic or hazardous materials are minor when compared to other types of generating facilities. However, wind turbines are generally more accessible to the public, and risks to public health and safety can be associated with these facilities. Examples of such safety concerns include tower collapse, blade throw, stray voltage, fire in the nacelle, and lighting strikes.

3.16.1 Tower Collapse/Blade Throw

It is very rare for a wind turbine tower to collapse or a rotor blade to be dropped or thrown from the nacelle, but such incidents have been documented and are potentially dangerous for project personnel, as well as the general public. Past occurrences of these incidents have generally been the result of manufacturing defects, poor maintenance, wind gusts that exceed the maximum design load of the engineered turbine structure, extreme seismic events, or lightning strikes (AWEA n.d.). Most instances of blade throw and turbine collapse were reported during the early years of the wind industry. Technological improvements and mandatory safety standards during turbine design, manufacturing, and installation have largely eliminated such occurrences.

3.16.2 Stray Voltage

Stray voltage is an effect that is primarily a concern of farmers/ranchers, whose livestock can receive electrical shocks. Stray voltage is a low level of neutral-to-earth electrical current that occurs between two points on a grounded electrical system. In a farm setting, stray voltage typically originates from low levels of AC voltage on the grounded conductors of a farm wiring system. These voltages are termed stray when they are large enough to form a circuit when a person or an animal simultaneously touches two objects that are part of an electrical system. Stray voltage results from damaged or poorly connected wiring systems, corrosion, or weak/damaged insulation. Livestock may encounter stray voltage when they contact two surfaces with voltage differences, resulting in a small electrical current flowing through the animal and creating a shock.

Stray voltage can occur at electric facilities (such as wind power projects) because of factors such as operating voltage, geometry, shielding, rock/soil electrical resistively, and proximity. Stray voltage from such facilities usually only occurs if the system is poorly grounded and located in proximity to ungrounded or poorly grounded metal objects (such as fences or buildings).

3.16.3 Fire

Although the turbines contain relatively few flammable components, the presence of electrical generating equipment and electrical cables, along with various oils (lubricating, cooling, and hydraulic), does create the potential for fire within the tower or the nacelle. Other project activities create the potential for a fire or medical emergency because of the storage and use of diesel fuels, lubricating oils, and hydraulic fluids. Storage and use of these substances may occur at the collector substation, staging and laydown area, and the O&M building.

3.16.4 Lightning Strikes

Because of their height and metal/carbon components, wind turbines and communications facilities are susceptible to lightning strikes. Statistics on lightning strikes to wind turbines are not readily available, but it is reported that lightning causes four to eight faults per 100 turbine-years in northern Europe, and up to 14 faults per 100 turbine-years in southern Germany (Korsgaard and Mortensen 2006). Most lightning strikes hit the rotor, and their effect is highly variable, ranging from minor surface damage to complete blade failure. All modern wind turbines include lightning protection systems, which generally prevent catastrophic blade failure.

3.16.5 Shadow Flicker

Shadow flicker is the term used to refer to the alternating changes in light intensity that can occur at times when the rotating blades of wind turbines cast moving shadows on the ground or on structures. Shadow flicker occurs only when the wind turbines are operating during sunny conditions, and is most likely to occur early and late in the day when the sun is at a low angle in the sky. The intensity of shadow flicker is "… defined as the difference or variation in brightness at a given location in the presence or absence of a shadow" (National Research Council 2007). The intensity of the shadows cast by the moving blades of wind turbines and thus the perceived intensity of the flickering effect is determined by the distance of the affected area from the turbine, with the most intense, distinct, and focused shadows occurring closest to the turbine. The frequency of shadow flicker is a function of the number of blades making up the wind turbine rotor and rotor speed.

There are two kinds of potential concerns that have been raised about severe shadow flicker conditions. One is that shadow flicker could have the potential to trigger epileptic seizures, and the other is that shadow flicker could become a source of annoyance to residents living in close proximity to wind turbines. The Epilepsy Foundation notes that for a small minority (about 3 percent) of the three million people in the U. S. who are affected by epilepsy, there is a potential for epileptic seizures to be triggered by flashing light. These seizures have the potential to be triggered when the light flashes are in the 5 to 30 Hz range. Because the frequency of the shadow flicker created by modern wind turbines is in the range of 0.6 to 1.0 Hz, the shadow flicker effects created by wind turbines do not have the potential to trigger epileptic seizures.

The second issue is of annoyance and is considered more subjective. There could be cases in which shadow flicker cast on dwellings in very close proximity to wind turbines could be significant enough to be considered a nuisance to residents. The National Research Council has observed that shadow flicker is more likely to be a concern in the higher latitude regions of Northern Europe, where the sun is likely to be at a low angle (particularly in winter) than in lower latitudes, where it states that "…shadow flicker has not been identified as causing even a mild annoyance" (National Research Council 2007).

3.17 Public Infrastructure and Services

3.17.1 Water Supply

Water resources and distribution on Oahu is managed by the Board of Water Supply (BWS). A connection to the BWS' facilities is not anticipated to be needed for the proposed wind energy project. A connection to City and County water facilities is not anticipated to be needed for the proposed project. Kawailoa Wind Power plans to truck in and store water in onsite holding tanks for its water requirements at the wind farm facility. Given the nature of the proposed project and small number of people working onsite, water usage would be limited to that provided by water tanks installed onsite; the tanks would be refilled monthly, as needed. There is no expected need for water supply at the Mt. Kaala communications facilities.

3.17.2 Wastewater and Solid Waste

It is anticipated that an onsite septic tank system would be constructed to deal with project-associated wastewater generated from the few people working onsite. The wastewater discharge from the project area would be within the City and County requirement of less than 1,000 gallons per day. The waste that accumulates in the septic tank system would be collected by a private contractor and transported to an appropriate wastewater treatment facility or other approved location for disposal. The small amount of wastewater that this represents can easily be accommodated in the existing treatment and disposal facilities.

Solid waste generated by the residents in the area is disposed of at Waimanalo Gulch landfill or the H-POWER facility, the City's waste-to-energy facility. Materials collected at the nearby Kawailoa Transfer Station are transported to the H-POWER facility.

3.17.3 Telecommunications

Telecommunication services that are used in the vicinity of the wind farm may include a variety of radio, cell phone, internet, and radar technologies. These types of services can be affected by electromagnetic interference generated by electrical infrastructure, particularly transmission lines. Electromagnetic interference is the result of corona, or the electrical ionization of the air that occurs near the surface of the energized conductor and suspension hardware because of very high electric field strength at the surface of the metal during certain conditions. Corona most commonly results in radio and television reception interference.

3.17.4 Energy

The State of Hawaii uses a higher percentage of petroleum to generate electricity than any other state in the U. S. In 2007, petroleum was used to produce 76.9% of the electricity generated in the State. The remaining electricity generation during that year was supplied by coal (14.0%), municipal solid waste (2.7%), wind (2.1%), geothermal (2.0%), biomass (1.4%), hydroelectricity (0.8%), and solar photovoltaics (0.1%) (DBEDT 2009). On Oahu, electrical energy is primarily supplied from oil (77.7%) and coal (18.3%). Municipal solid waste (3.7%), biomass (0.4%), and solar photovoltaics (0.02%) produced the remainder of the energy consumed on Oahu during that year (DBEDT 2009). Imported oil costs Hawaii between $2 and $4 billion annually (DBEDT 2008b). 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.

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). In October 2008, the State of Hawaii signed an Energy Agreement with the HECO 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.

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.

HECO provides electrical service to the entire Island of Oahu. Power is generated by Hawaiian Electric power plants and independent power producers and transported via transmission lines to substations in the North Shore area (Helber Hastert & Fee Planners 2009).

3.17.5 Hospitals, Police, and Fire Protection Services

The nearest hospital to the proposed project area is the Wahiawa General Hospital, which is roughly 9 miles from the Kawailoa Road access road and roughly 12 miles from the Mount Kaala access road. The Kahuku Medical Center is just over 13 miles from the Kawailoa access road and roughly 19 miles from the Mount Kaala access road. In case of emergencies, paramedic/ambulance services are also available.

The Wahiawa Police Station is the closest station to the proposed project area. It is located at 330 North Cane Street, almost 11 miles southeast of the access road to the project area. The Kahuku Police Headquarters is located at 56-470 Kamehameha Highway roughly almost 22 miles from the project area.

The closest fire stations are the Waialua Fire Station and the Sunset Beach Station located approximately 2 miles and 4 miles from the Kawailoa access road, respectively. The Waialua Fire Station is the closest station to the offsite communication tower sites.

CHAPTER 4: POTENTIAL IMPACTS

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 Kawailoa project), Alternative 2 (Alternative Communications Site Layout), and Alternative 3 (No Action and non-issuance of an ITP) are discussed in this section. The potential impacts of constructing and operating the facility are evaluated and discussed in relation to the existing conditions in the proposed project area and on the Island of Oahu. 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. Kawailoa Wind Power 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 Draft Kawailoa Wind Power HCP (SWCA 2011).

4.1 Climate

4.1.1 Alternative 1 (Proposed Action)

The proposed Kawailoa Wind Power project is expected to have a beneficial impact on the climate by decreasing fossil fuel consumption and decreasing GHG 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).

Kawailoa Wind Power estimates that the Proposed Action could provide HECO with approximately 70 MW of renewable electricity annually, thereby eliminating the use of roughly 304,200 barrels of oil per year (CH2M Hill 2011). Eliminating the consumption of this amount of oil would reduce emissions of CO_2 by more than 134,400 tons. Although construction and operation of the facility would 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 Action 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, Kawailoa 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.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures proposed for the project under the HCP are not expected to affect the local climate surrounding the area.

Impacts of Mitigation Measures

To the proposed mitigation for seabirds, waterbirds, bats and owls are not expected to affect the local climate surrounding the area.

4.1.2 Alternative 2 (Alternative Communications Site Layout)

Overall, impacts to climate would be expected to be the same as 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.

No climate impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.2 Air Quality

4. Alternative 1 (Proposed Action)

The construction, operation, and monitoring phases of the Proposed Action would result in emission of low levels of air pollutants. These emissions would be temporary or infrequent, and would 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 fugitive dust or particulate matter (PM), hydrocarbons (HC), CO, NO_2, CO_2, and SO_2. Estimated emissions in tons per year are: 123.1 for $PM_{2.5}$, 26.2 for PM_{10}, 1.2 for HC, 21.5 for CO, 8.0 for NO_2, 1493 for CO_2, and 0.05 for SO_2 (CH2MHill 2011). These pollutants would be released by construction equipment, fugitive construction dust, haul truck exhaust, and worker commute exhaust. Emissions are anticipated to primarily occur locally, intermittently, and at low levels.

Because emissions during the construction phase would be temporary and of relatively low level, and would 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 Action. Therefore, construction of the project is not expected to result in appreciable degradation of air quality.

Construction-related emissions would 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, Kawailoa Wind Power would require construction contractors to adhere to specific minimization measures (see below).

During operation, including environmental monitoring, minor air emissions would result from staff and vendor vehicle traffic, maintenance equipment, and facility electricity usage. It is estimated that there would be a maximum of 16 one-way vehicle trips per day during operation. There would also be minor emissions associated with infrequent use of cranes used for maintenance of the project components. In addition to the maintenance equipment and vehicle emissions, operation of the electrical substation and BESS equipment would result in minor indirect emissions as a result of fossil fuel energy use for electricity. Estimated emissions in tons per year are: 0.003 for $PM_{2.5}$, 0.002 for PM_{10}, 0.09 for HC, 0.83 for CO, 0.06 for NO_2, 146.5 for CO_2, and 0.0004 for SO_2 (CH2M Hill 2011).

These very low emission levels, similar to construction, would not be expected to significantly affect air quality. At a broader scale, the project would provide a substantial net beneficial impact to global climate conditions by replacing energy generated by burning fossil fuels with renewable energy, thereby reducing emissions of greenhouse gases.

At the Mt. Kaala communications site, very low emissions are expected from construction and approximately 20 vehicle trips. Installation of the antennas and appurtenant equipment on the existing structures would not require any ground disturbance. Similar to construction, operation of the project would result in an extremely minor amount of emissions in association with maintenance vehicles; a total of approximately 4 vehicle trips per year are expected. Collectively, the emissions associated with construction and operation of the communications sites is extremely low, and in combination with the wind farm site, would not be expected to significantly affect air quality.

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 During Construction:

Construction BMPs detailed in Kawailoa Wind Power's NPDES General Permit Notice of Intent would 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). Kawailoa Wind Power would use only water with no chemical additives for dust control.

In order to minimize any adverse effect on air quality, Kawailoa Wind Power would 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 or less.
- Cover all trucks hauling dirt, sand, soil, or other loose materials.

<u>Impacts of Avoidance and Minimization Measures</u>

The avoidance and minimization measures proposed for the project under the HCP are not expected to affect the air quality surrounding the area.

<u>Impacts of Mitigation Measures</u>

Seabird Mitigation: Only minor impacts are expected due to actions implemented for seabird mitigation. The self-resetting cat trap will need to be checked at regular intervals (monthly or weekly) and if translocation or predator trapping occurs, regular visits (monthly or weekly) to the seabird colony will be required to implement management measures and document reproductive success. The minor air quality impacts will be primarily due to vehicles using fossil-fuel fired internal combustion engines transporting staff and equipment to the study site.

Waterbird Mitigation: Only minor impacts are expected due to actions implemented for waterbird mitigation. During the first year when fencing and vegetation removal at the wetland will occur, vehicles using fossil-fuel fired internal combustion engines will be used to transport staff and equipment to the wetland site. Light machinery may be used for fence building or vegetation removal. The visits during fence building and vegetation removal may occur several times a week. Once the fencing and vegetation removal is completed and regular visits (weekly during the seabird breeding season) to the wetland will be required to implement management measures such as trapping, ungulate control and to document reproductive success. The minor air quality impacts will be primarily due to vehicular transport of staff and equipment to the mitigation site.

Bat Mitigation: Minor impacts to air quality are similarly expected to be primarily due to vehicular transport of staff and equipment to the study site for research, forest or wetland restoration activities, monitoring or research activities. During the wetland or forest 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.

Owl Mitigation: Insignificant air quality impacts for owl rehabilitation are expected as vehicles will only be used to transport the owls to and from the rehabilitation center. During the implementation of management activities, vehicles may be used on a regular basis to staff and equipment to the mitigation site and may result in minor impacts to air quality.

4.2.2 Alternative 2 (Alternative Communications Site Layout)

Compared to the Proposed Action (Alternative 1), construction and operation of the Mt. Kaala communication facilities under this alternative would result in a very small amount of emissions associated with construction and maintenance vehicles. In addition, a small amount of ground disturbance would be required for excavation of the tower foundations (approximately 144 square feet per tower). Collectively, the emissions associated with construction and operation of the alternative communications site layout is extremely low, and similar to the Proposed Action, would not be expected to significantly affect air quality. Mitigation and minimization measures implemented during construction would be the same as Alternative 1.

Air quality impacts due to avoidance and minimization measures or mitigation measures as prescribed in the HCP are expected to be the same at Alternative 1.

4.2.3 Alternative 3 (No Action Alternative)

Under the No Action Alternative, no new emissions or changes in air quality over the baseline conditions would occur. Furthermore, the alternative would decrease the potential to replace energy derived from burning fossil fuels with renewable energy. As such, the air quality benefits from reduced greenhouse gas emissions of greenhouse gases and other air pollutants would not be realized.

No air quality impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.3 Geology, Topography, and Soils

4.3.1 Alternative 1 (Proposed Action)

Construction of the project would require grading for both temporary and permanent project features. Temporary features that would require grading include the equipment laydown areas and temporary work areas adjacent to each turbine location. Permanent structures that would require grading include the wind turbine generators, substation and BESS facility, the electrical collector system, the O&M building, HECO interconnection facilities, meteorological towers, the communication tower, and onsite access roads. The site civil design is still being developed; however, the estimate of the total area of disturbance is approximately 335.1 acres, of which 21.7 acres would be permanent, within the 4,200 acre project area. During the operations and maintenance phase of the project, grading is expected to be limited to replacement of the underground collector lines and/or maintenance of the onsite access roads. These events are expected to occur infrequently.

Ground-disturbing activities would be conducted using graders, multiple cranes, dump trucks, concrete mix trucks, front end loaders, bulldozers, excavators, and heavy haul trucks. In general, grading would be limited to areas that have been extensively disturbed through repeated discing and grading as part of former agricultural activities. In some cases, shallow bedrock may be disturbed. To the extent possible, the earthwork would be designed to minimize cut and fill, and to avoid impacts to the major topographic features (including the gullies and streams); some components of the project may result in localized topographic changes and increased potential for erosion.

Minimization and/or Mitigation Measures During Construction:

The BMPs outlined below would be implemented to avoid and minimize erosion associated with ground disturbing activities:

- Sequence construction activities to minimize the exposure time of cleared areas.
- Minimize the extent of disturbed areas, where possible.
- To avoid fugitive dust emissions, cover soil stockpile areas containing more than 100 cubic yards of material, or keep continuously wet.
- Stabilize all disturbed soil that is not subject to re-vegetation, 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.
- Cover all trucks hauling dirt, sand, soil, or other loose materials.
- Install erosion and sediment control measures (for example, silt fences) before initiating earth moving activities, and properly maintain throughout the construction period.
- Minimize the extent of clearing and grubbing to only what is necessary for grading, site access, and equipment operation.
- Properly implement all stormwater runoff and erosion control BMPs, as specified in the Construction Stormwater Permit to be obtained from HDOH.
- During dry periods, inspect BMP features once weekly and repair as necessary. Inspect and repair features as needed within 24 hours after a rainfall event of 0.5 inches or greater in a 24-hour period. During periods of prolonged rainfall, inspect daily would occur.
- Maintain records for all inspections and repairs, on site.
- Apply permanent soil stabilization (that is, graveling or re-planting of vegetation) as soon as practical after final grading.

Given that the majority of the site has been extensively disturbed as part of previous site activities and that no major existing topographic features are expected to be affected (including the gullies and intermittent streams), construction and subsequent operation of the project is not expected to result in significant impacts to geology and topography. With implementation of BMPs, impacts to soils would be minimal.

<u>Impacts of Avoidance and Minimization Measures</u>

The avoidance and minimization measures proposed for the project under the HCP are not expected to affect the geology, topography and soils in surrounding the area.

Impacts of Mitigation Measures

Seabird mitigation: Minor impact to topography and soil resources due to trampling by monitors may occur during the monitoring of cat traps or implementation of translocation protocols and predator control. Regular visits to the mitigation site will occur and existing trails will be used whenever possible to reduce impacts to the topography and soil.

Waterbird mitigation: Minor impact to topography and soil resources due to trampling by monitors may occur during the monitoring or implementation of waterbird management measures such as fencing, vegetation maintenance 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 topography and soil.

The removal of invasive vegetation at the wetland will result in temporary impacts to the topography and soils but the reestablishment of native vegetation will result in reduced erosion (Vitousek 1993). Fencing will result in some permanent disturbance of the soil and topography due to fence posts. The fence is estimated to be 4,900 feet, with posts driven into the ground every 10 feet approximating roughly 490 posts. The fenceline will be buried (approximately 6 inches deep) to prevent ungulates from digging through the fence. These narrow swaths of disturbance would be widely distributed over geography, and local impacts of constructing the fence would be minimal. Soil and topographical disturbance is expected to be short term with no significant impacts expected.

Bat Mitigation: Minor impact to topography and soil resources due to trampling by monitors may occur during the monitoring or implementation of bat management measures such as fencing, vegetation maintenance and predator control at either wetland or forest site. Regular visits to the mitigation site will occur (weekly or monthly) and existing trails will be used whenever possible to reduce impacts to the topography and soil.

The removal of invasive vegetation at the wetland or forest will result in temporary impacts to the topography and soils but the reestablishment of native vegetation will result in reduced erosion (Vitousek 1993). Ungulate control will reduce the number of ungulates within the mitigation area and impacts to the topography and soil will be reduced overall due to the reduction of trampling, rooting and grazing by introduced ungulates.

If wetland restoration is chosen for Tier 1 and higher take level mitigation, fencing at the wetland will result in an addition of 6,200 feet in addition to the fence constructed for waterbird mitigation. Permanent disturbance to the soils and topography will occur when posts driven into the ground every 10 feet approximating roughly an additional 620 posts. The fenceline will be buried (approximately 6 inches deep) to prevent ungulates from digging through the fence. These narrow swaths of disturbance would be widely distributed over geography, and local impacts of constructing the fence would be minimal. Soil and topographical disturbance is expected to be short term with no significant impacts.

If forest restoration is conducted for bat mitigation at Tier 2 take levels, fencing may also be needed for 400acres or more of forest restoration. The fenceline may be up to 32,424 feet in length. Permanent disturbance to the soils and topography will occur when posts driven into the ground, up to 7,065 posts may be driven into the ground. The fenceline will be buried (approximately 6 inches deep) to prevent ungulates from digging through the fence. These narrow swaths of disturbance would be widely distributed over geography, and local impacts of constructing the fence would be minimal. Soil and topographical disturbance is expected to be short term with no significant impacts expected.

An equivalent amount of fencing may be required for another 400 acres of forest if Tier 3mitigation is implemented. Similarly, soil and topographical disturbance due to fencing an additional 400 acres is expected to be short term with no significant impacts expected.

Owl mitigation: No soil and topographical impacts are expected due to owl rehabilitation or research. Depending on the owl management measure chosen, minimal soil disturbance may occur due to regular visits to the management site to monitor owls or carry out management measures.

4.3.2 Alternative 2 (Alternative Communications Site Layout)

Under this alternative, a new communication tower would be installed at either one or both of the Mt. Kaala communication sites in previously disturbed areas adjacent to the existing Hawaiian Telcom structures; access would be via existing roads and trails. Installation of each tower would require minor excavation for the tower foundations (approximately 144 square feet per tower). Construction would not result in significant changes to the soils or geology or soils of the site. Mitigation and minimization measures would be the same as Alternative 1.

Soil and topography impacts due to avoidance and minimization measures or mitigation measures as prescribed in the HCP are expected to be the same at Alternative 1.

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.

No soil and topography impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.4 Hydrology and Water Resources

4.4.1 Alternative 1 (Proposed Action)

Construction of the project components would require minimal subsurface work, with the maximum depth of excavation expected to be approximately 10 feet. These depths are well above the water table, and therefore, no direct interaction with groundwater is anticipated. Other types of impacts to groundwater that could result from construction and/or operation of the project include reductions in recharge, availability, or quality. Specific to groundwater recharge, the project would increase the total impervious surface across the property by approximately 21.7 acres; however, these surfaces would only comprise a very small percentage of the overall area, and there is still sufficient open space such that groundwater recharge is not expected to measurably decrease. Total water consumption would be minimal (for example, watering roads and stockpiles), and would be addressed using water tanks that would be periodically filled with water trucked onto the site (or obtained from the onsite irrigation ditches). As such, the project is not expected to adversely affect groundwater availability.

Finally, construction and operation activities would require the use of some hazardous materials, which if handled inappropriately, could affect groundwater quality. However, appropriate management practices, including preparation and implementation of a Spill Prevention, Countermeasure, and Control (SPCC) Plan, would be in place throughout construction and operation to avoid and minimize impacts associated with these materials. With implementation of these measures, no impacts to groundwater quality are expected.

The project footprint has been designed to avoid potentially jurisdictional features to the maximum extent possible; these features include Loko Ea, Laniakea, Kawailoa, Kaalaea, and the unnamed tributary to Waimea River. The only locations where potentially jurisdictional features occur within the footprint are those areas where they intersect with the existing onsite roads. In general, the waterways are culverted under the roads, and road improvements would be conducted so as to avoid impacts to these features. The only unculverted road crossing within the project footprint is along Laniakea Stream, an intermittent waterway, where it washes over Cane Haul Road. Work that would be conducted in this area would be limited to repair and maintenance of the road surface; no work would be conducted outside the existing footprint of the road.

Although construction is not expected to directly impact any potentially jurisdictional features, ground disturbing activities during construction have the potential to increase the amount of sediment and other pollutants in stormwater runoff, which could adversely affect the water quality in the onsite waterways, as well as downstream receiving waters. Of all of the components of the project, the access roads are expected to have the greatest potential to contribute sediment (and associated pollutants) to stormwater runoff, primarily because dirt roadways function as both a source area and transport mechanism. The project has been designed to use the existing access roads to the extent possible, thereby minimizing construction of new roadways. To reduce the potential for sediment and pollutant delivery from both the existing and new roadways to be used for the project, gravel would be applied to the road surfaces and rock-lined swales would be installed along the edge of the roadways. Large rock (typically Surge-B) would be used to line each swale, helping to slow the flow and allowing sediment to settle out. Swales would generally be located in areas where conveyance of stormwater is focused, with dimensions based on anticipated flow volume. Each swale would also include "level spreaders," which would allow a portion of the runoff to flow from the swale and disperse onto an adjacent vegetated field (or other relatively flat area). The swales would be installed and maintained during construction and throughout the life of the project, such that impacts to water quality are expected to be minimal; given the large network of existing, unimproved dirt roads on the site, it is likely these features would decrease sediment delivery on a per-unit area basis below existing levels.

Minimization and/or Mitigation Measures During Construction:

In addition to the roadway swales, other general BMPs would be implemented as part of construction to avoid and minimize impacts. These BMPs include sequencing of activities to minimize the exposure time of cleared and excavated areas; in addition, to the extent possible, excavation for the turbines would be timed to avoid the wet winter months.

Because the area to be disturbed is over an acre, Kawailoa Wind Power would 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 would identify potential receiving waters for runoff, quantify the anticipated volume of runoff, and identify BMPs that would 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 would retain or contain soil/sediment within the project area, thereby reducing the amount of sediment discharged into nearby water bodies. Regular inspection and maintenance of vehicles and equipment, as well as proper containment and storage of potential pollutants, would also minimize or prevent the pollution of storm water runoff.

Table 4-1. Potential Pollutants from Construction Activities and BMPs.

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 onsite fuel storage, drip pan for onsite 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, offsite vehicle washing
Sanitary Waste	Portable toilets or septic tank	Sanitary/septic waste management
Source: Department of Environmental Services, City and County of Honolulu (1999).		

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

- Clearing and grubbing would be held to the minimum necessary for grading, access and equipment operation.
- Erosion and sediment control measures would be in place prior to initiating earth moving activities. Functionality would be maintained throughout the construction period.
- Construction would be sequenced to minimize the exposure time of the cleared surface area.
- Areas that are disturbed during the course of construction would 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) would 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) would 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 Kawailoa Revegetation Plan. Kawailoa Wind Power will coordinate with DLNR and other specialists regarding selection of appropriate species for revegetation.

<u>Impacts of Avoidance and Minimization Measures</u>

The hydrology in a few small areas on site may be altered to a minor extent to prevent standing water from accumulating on site to prevent attraction to waterbirds. However, currently no standing water occurs at the project site and the alteration of hydrology to prevent standing water may not be necessary. No other avoidance and minimization measures are expected to have any effect on the hydrology or water resources in the area.

<u>Impacts of Mitigation Measures</u>

Monitoring, fencing, ungulate control, predator control and weed control may affect hydrology and water resources. These mitigation activities could be part of seabird, waterbird, bats and owl mitigation.

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. 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 due to by decreasing the number of ungulates and reducing soil erosion. Predator trapping 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 which will be used for waterbird mitigation 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 for waterbird mitigation.

Weed control may consist of the application of herbicides. Only appropriate herbicides for the area (wetland or forest) 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 weed control.

4.4.2 Alternative 2 (Alternative Communications Site Layout)

Under this alternative, installation of the communication towers would require a minimal amount of excavation and ground disturbance. No surface water features are present within either communications site, so no direct impacts would occur. The tower footings would only slightly increase the impervious surfaces at each site and indirect impacts to surface water quality would be insignificant. Construction at the communications site is also not expected to affect the recharge, availability, quality of the groundwater. Mitigation and minimization measures would be the same as Alternative 1. Hydrology or water quality impacts due to avoidance and minimization measures or mitigation measures as prescribed in the HCP are expected to be the same at Alternative 1.

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 in the area. No hydrology or water quality impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.5 Biological Resources - Flora

4.5.1 Alternative 1 (Proposed Action)

Construction of the facility would 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 Action would result in disturbance of approximately 335.1 acres of the project area. To improve searcher efficiency during monitoring of the WTGs and met towers, vegetation may be removed from search plots if such vegetation creates unsearchable conditions within the required search areas.

No state or federally listed threatened, endangered, or candidate plant species have been documented within the Kawailoa project area (Hobdy 2010a, 2010b). No critical habitats have been designated for plant species at the project site. Vegetation occurring in areas that would be disturbed consists mostly of non-native grasses and trees. These species are common throughout Oahu and the main Hawaiian Islands. Due to the general condition of the area and the specific lack of any environmentally sensitive native plant species within the project area, the Proposed Action is not expected to result in any significant adverse impact on botanical resources in this part of Oahu.

Although native vegetation occurs in the vicinity of the proposed offsite communication tower sites, areas that would be directly disturbed by construction of the offsite towers were previously cleared and consist of non-native species common throughout Oahu and the main Hawaiian Islands. However, no impacts to flora are anticipated as the communication equipment would be installed on the two existing towers and ground disturbance is expected to be minimal.

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. Several invasive plants occur in the Kawailoa project area and the vicinity. Due to the existing conditions of the project area, the potential for the project to result in an increase in the number or distribution of invasive plant species would be minor. However, to minimize the potential for introducing new invasive plants to the project area, Kawailoa Wind Power will implement the minimization measures described below.

None of the nine plant species with critical habitat designations that encompass the tower sites are present on-site at the two tower locations and no impacts to these plant species are expected. Any vegetation that would be disturbed at the off-site microwave facility sites consists of non-native species common throughout Oahu and the main Hawaiian Islands. However, no impacts to flora are anticipated as the communication equipment will be installed on the two existing towers and ground disturbance is expected to be minimal.

Minimization and/or Mitigation Measures During Construction:

- Revegetation: Following construction, Kawailoa Wind Power intends to stabilize the project area using suitable ground cover. Where practical, native species will be used to stabilize bank slopes along constructed access roads or cut and fill slopes within the project area, as recommended by Hobdy (2010a). Although native species may be re-introduced, the primary goal of the revegetation would be to immediately stabilize soil and prevent erosion following construction. Kawailoa Wind Power would also replant an equivalent or greater number of native trees in the vicinity of the project to replace any native trees that may be removed during construction.

- Invasive Species Control:

  Kawailoa Wind Power intends to minimize and avoid the introduction of new invasive species to the project area during the proposed wind farm development using the following best management practices. To avoid the unintentional introduction or transport of these species through soil and debris, all construction equipment and vehicles arriving from outside of the Island of Oahu will be washed prior to entering the project area. In addition, Kawailoa Wind Power will ensure that construction materials arriving from outside of Oahu are washed and/or visually inspected (as appropriate) for excessive debris, plant materials, and invasive or harmful non-native species prior to transportation to the project area. Most inspection and cleaning activities will be conducted at a vacant 6.8 acre parcel immediately adjacent to the Barbers Point Harbor, will be leased by Kawailoa Wind Power. Equipment and material arriving through Honolulu Harbor will be inspected and/or cleaned (as appropriate) at a designated location prior to entering the project area. Kawailoa Wind Power will document all inspection and cleaning activities using inspection forms. Kawailoa Wind Power will ensure that off-site sources of revegetation materials (seed mixes, gravel, mulches, etc.) are certified weed-free or inspected prior to transport to the project area. Furthermore, weed establishment will be limited by minimizing ground disturbance and vegetation removal to the maximum extent practicable. Erosion of the job site and the potential transport of weedy species will be prevented through implementation of storm water runoff Best Management Practices.

  At the end of the construction period, areas altered by construction of the project will be surveyed to ensure that no problematic and/or invasive species have been introduced. All areas that are hydroseeded will be monitored for at least six months to ensure removal of any invasive plants that have established from seeds inadvertently introduced as part of the seed mixes. Appropriate remedial actions will be undertaken as needed, at the direction of DLNR and USFWS to facilitate containment or eradication of the target species. Any remedial actions will require the approval and direction of USFWS and DOFAW.

- To avoid the unintentional introduction or transport of invasive species through soil and debris, all construction equipment and vehicles arriving from outside of the Island of Oahu would be washed prior to entering the project area.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures proposed for the project under the HCP are not expected to affect the flora surrounding the area.

Impacts of Mitigation Measures

Botanical surveys will be conducted prior to the implementation of mitigation measures for all species, and listed plant species, ecologically sensitive or culturally valuable plant species will be avoided during the implementation of any mitigation measure.

Seabird mitigation: Minor impact to flora may occur due to trampling by monitors may occur during the monitoring of cat traps 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.

Waterbird mitigation: Minor impact to flora due to trampling by monitors may occur during the monitoring or implementation of waterbird management measures such as fencing, vegetation maintenance and ungulate 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 topography and soil.

The removal of invasive vegetation at the wetland will reduce the number of alien species on site and the reestablishment of native vegetation will result in an increase in the percentage of native vegetation at the mitigation site and will have a positive effect on the native species assemblage present at the site. Ungulate control will reduce the number of ungulates within the mitigation area and impacts to the flora will be reduced overall due to the reduction of trampling, rooting and grazing by introduced ungulates.

Fencing will result in the temporary disturbance of the flora along the fenceline. The fence is estimated to be 4,900 feet long, with up to a 10-foot corridor resulting up to a maximum of 1.1 acres of vegetation disturbance. These narrow swaths of disturbance would be widely distributed, and local impacts to the flora due to constructing the fence would be minimal. Flora disturbance is expected to be short term with no significant impacts expected. Most of the flora around the fenceline is also expected to consist mostly of alien species.

Bat Mitigation: Minor impact to the flora due to trampling by monitors may occur during the monitoring or implementation of bat management measures such as fencing, vegetation maintenance, and restoration at either wetland or forest site. 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.

The removal of invasive vegetation at the wetland or forest will reduce the number of alien species on site and the reestablishment of native vegetation will result in an increase in the percentage of native vegetation at the mitigation site and will have a positive effect on the native species assemblage present at the site. Ungulate control will reduce the number of ungulates within the mitigation area and impacts to the flora will be reduced overall due to the reduction of trampling, rooting and grazing by introduced ungulates.

If wetland restoration is chosen for Tier 1 and higher tier mitigation, fencing at the wetland will result in an addition of 6,200 feet in addition to the fence constructed for waterbird mitigation. This fenceline will also have a 10 feet corridor resulting up to a maximum of 1.4 acres of vegetation disturbance. 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. Flora disturbance is expected to be short term with no significant impacts expected. Most of the flora around the fenceline is also expected to consist mostly of alien species.

If forest restoration is conducted for bat mitigation at Tier 2, fencing may also be needed for 400 acres of forest restoration. The fenceline may be up to 32,424 feet in length with a 10-foot corridor resulting up to a maximum of 7.4 acres of vegetation disturbance. 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. Flora disturbance is expected to be short term with no significant impacts expected. As stated above, botanical surveys will be conducted prior to the erection of the fences and all ecologically sensitive or culturally valuable plant species will be avoided to minimize impacts to the native plant species.

An equivalent amount of fencing and ground disturbance may be required for another 400 acres of forest if the highest level mitigation is reached. Similarly, impacts to flora due to fencing an additional 400 acres is expected to be short term with no significant impacts expected.

Owl mitigation: No flora impacts are expected due to owl rehabilitation or research. Depending on the owl management measure chosen, minimal impacts to flora may occur due to regular visits to the management site to monitor owls or carry out management measures.

4.5.2 Alternative 2 (Alternative Communications Site Layout)

Under Alternative 2, impacts would be similar to the Proposed Action. Disturbance at the wind farm site would be the same with minor additional disturbance at the communications site. Construction and operation of the equipment at the Mt. Kaala communication sites would involve installation of a new tower within those areas where vegetation has been previously cleared and maintained adjacent to each of the existing Hawaiian Telcom facilities. These areas do not support any protected plant species or habitats, and therefore, no impacts are expected. Nonetheless, the same mitigation measures described for the Proposed Action would be implemented to reduce the likelihood of invasive species being introduced to the area.

Impacts to flora due to avoidance and minimization measures or mitigation measures as prescribed in the HCP are expected to be the same as Alternative 1.

Nine plant species have critical habitat designations that encompass the tower sites. The plant species are *Alsinidendron trinerve*, *Cyanea acuminate*, *Cyanea longiflora*, *Diplazium molokaiense*, *Hedyotis parvula*, *Labordia cyrtandrae*, *Phyllostegia hirsute*, *Tetramolopium lepidotum* ssp. *lepidotum*, and *Viola chamissoniana* ssp. *chamissoniana*.

As outlined by the 2003 critical habitat rule: existing man-made features and structures within the boundaries of the mapped units, such as buildings; roads; aqueducts and other water system features, including but not limited to pumping stations, irrigation ditches, pipelines, siphons, tunnels, water tanks, gauging stations, intakes, reservoirs, diversions, flumes, and wells; existing trails; campgrounds and their immediate surrounding landscaped area; scenic lookouts; remote helicopter landing sites; existing fences; telecommunications equipment towers and associated structures and electrical power transmission lines and distribution and communication facilities and regularly maintained associated rights-of-way and access ways; radars; telemetry antennas; missile launch sites; arboreta and gardens, heiau (indigenous places of worship or shrines) and other archaeological sites; airports; other paved areas; and lawns and other rural residential landscaped areas do not contain, and are not likely to develop, primary constituent elements and are specifically excluded from designation under this rule.

The Mt. Kaala off-site communications location is an existing infrastructure and excluded from critical habitat designation and no impacts to critical habitat are expected.

No trimming of vegetation along the trails is anticipated. No vegetation will be cleared if the endangered *Achatinella* species are detected and the detections will be reported to USFWS and DOFAW. If *Achatinella* species are detected at the location of the proposed towers, the towers will not be erected and there will be no impacts to the vegetation. Leaf litter will be collected before the area is graded and distributed to the surrounding area to allow any native snails in the leaf litter to move on to undisturbed ground. If a helicopter is used to deliver construction materials, it will remain 100 ft (30.5 m) agl to avoid the impact of rotor wash on any *Achatinella* species that may be present in the vicinity and forest habitat that have been designated as critical habitat for the Oahu elepaio.

4.5.3 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.

No flora impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.6 Biological Resources - Wildlife

Construction and operation of the Proposed Action has potential to impact wildlife through disturbance of onsite habitats and by creating a potential for collisions with WTGs, unguyed 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 Kaheawa Wind Project (KWP) facility on Maui 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 Hawaii, as well as a means to assess the accuracy of pre-construction mortality estimates. No Covered Species were found downed or dead during the first year of construction and operation of the KWP project (2008a,b). During the subsequent years of monitoring, KWP documented observed direct take of three federally listed species – three adult Hawaiian petrel, nine full-grown nene, and two Hawaiian hoary bats (KWP LLC 2008c; Spencer pers. comm. 2009). Although 1-2 fatalities annually were predicted for Newell’s shearwater, no fatalities have been documented to date. Other documented fatalities of native birds include white-tailed tropicbirds, great frigate birds and Hawaiian short-eared owls.

4.6.1 Alternative 1 (Proposed Action)

4.6.1.1 Non-Listed Species

The Proposed Action would result in the alteration of approximately 335.1 acres, most of which has been previously disturbed and is overwhelmingly comprised of non-native species; of this area, a total of approximately 21.7 acres would be permanently displaced. The vegetated areas within the maximum project footprint for Kawailoa Wind Power consist mostly of agricultural land, alien grassland, shrubland and forest. The vegetated areas that are not permanently displaced will likely be converted to short-stature shrubs and grasses. Non-listed species that use this habitat could be either directly impacted by construction activities (for example, through collision with construction vehicles), or indirectly impacted by loss of habitat.

No habitat loss or related impacts to wildlife resources are anticipated at the Mt. Kaala communications sites because the proposed antennas are static features attached to existing Hawaiian Telcom structures. The existing structures are relatively low, with a small profile, and the proposed equipment is similar in size and type to equipment currently onsite; therefore, installation of the equipment is not expected to create a significant collision hazard to any non-listed or Covered Species, if they should happen to transit the tower location.

Non-listed bird species occurring in the project area are largely common and widespread on Oahu and most are tolerant of some degree of development and human presence. The Proposed Action could 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 alteration 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 2011).

During operation, non-listed birds also have potential to collide with WTGs and the unguyed met towers. In particular, passerines are known to have comparatively high fatality rates (Erickson et al. 2001; Kingsley and Whittam 2007). Any of the bird species occurring in the general project area have potential to collide with the proposed WTGs and unguyed met towers. Potential for collision with the met towers would be minimized through the use of streamers and bird diverters.

The black-crowned night heron, the great frigate bird and pacific golden plover are native or migratory birds protected by the Migratory Bird Treaty Act (Table 3-4).

Based on observations, the black-crowned night heron is likely present on-site and in the vicinity year round. As no birds were recorded within the rotor swept zone of the turbines, night-herons are expected to be at very low risk of colliding with project components. No irrigation ponds will be impacted by the construction of the project thus no foraging habitat will be lost and no waterbodies will be created by the project (see section5.3) and will not attract the night-heron to the site. No impacts to the local population of night-herons is anticipated.

No birds were recorded at flight altitudes within the rotor swept zone of the proposed turbines and are not expected to be at very low risk of colliding with project components. The creation of roads and open spaces during project construction and the maintenance of the search plots is likely to marginally benefit the pacific golden plover by creating more usable habitat. No impacts to the population of Pacific golden plovers that utilize the site are anticipated.

No great frigate birds were observed over the site either during systematic surveys or within incidental sightings. The one observation was of a bird flying in Waimea valley (Table 3-4). Given that these birds can be expected to fly over the site very rarely, they are anticipated to be a low risk of collision with project components. No impact to the local population of frigate birds is anticipated.

Non-listed mammals expected to occur in the project area are limited to alien 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. 2003; 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.

Alteration of onsite habitat from one vegetation type to another (e.g., from alien forest to short-stature grass and shrubs) may reduce the amount of habitat available for mammals in the project area. As with birds, alteration of the surrounding 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 Action is generally expected to have a neutral effect on mammals.

Construction-related impacts to mollusk species could also occur, and similar to mammals, could include both direct impacts because of collisions with project vehicles and indirect impacts associated with habitat loss and alteration. However, the only mollusk species observed within the wind farm site are non-native and are generally widespread; consequently, any impacts to non-listed mollusk species are not expected to be significant at the population level.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures to reduce collision risk of the Covered Species with project components or vehicles will likewise reduce the collision risk for non-listed native and non-native species. Barn owl which may also perch on overhead lines will also be minimal risk of electrocution.

The avoidance and minimization measures will have no effect on ground dwelling species.

For the off-site communications towers, measures will also be implemented to avoid impacts to native mollusks at the off-site antennae locations. The antennae will be mounted on existing towers. A limited amount of tree trimming may be required during installation and ongoing maintenance, to provide adequate line-of-sight between the antennas. A helicopter will be used to transport the antennae to the repeater station to minimize the need for vegetation trimming along the access trail. In addition, all vegetation trimming activities will be directly coordinated with USFWS and DOFAW staff to minimize the potential for impacts to native vegetation. Because native vegetation at the site could potentially support native mollusk species (including at least one Federally and State listed species, *Achatinella* spp.), additional mollusk surveys will be conducted before any vegetation trimming at either site, also in coordination with USFWS and DOFAW staff. If the endangered *Achatinella* spp. is detected during the surveys, no vegetation will be trimmed and the detections will be reported to USFWS and DOFAW. If no *Achatinella* are detected, then vegetation will be trimmed by hand.

In addition to minimize the potential for introduction of non-native invasive ant species at either of the Hawaiian Telcom sites, baseline surveys of ant fauna would be conducted before and following installation of the antennas, in coordination with DOFAW staff. In addition, all materials and vehicles would be inspected for the presence of ants before transport to the site. With implementation of these measures, impacts to native invertebrate species would be insignificant. If new species of ants are detected in the post-construction survey, and are attributed to the construction work, control measures will be implemented to remove the new species from the area.

Impacts of Mitigation Measures

Fencing, ungulate control, predator control can affect non-listed non-native fauna present at the mitigation sites. These mitigation activities could be part of seabird, waterbird, bats and owl mitigation.

The construction of fences is expected to exclude feral ungulates from mitigation sites. Ungulate control will potentially eradicate ungulates within the mitigation sites. Predator control is expected to decrease the number of introduced predators present within the mitigation sites. Overall, these measures are expected to decrease the number of introduced ungulate and mammal species present at the mitigation sites, and increase the number of native species present at each of the mitigation sites.

4.6.1.2 Federally Listed Non-Covered Species

One listed bird the Oahu elepaio (*Chasiempis sandwichensis ibidis*), and one listed invertebrate the Hawaiian picture-wing fly (*Drosophila substenoptera*) have critical habitat designations that encompass the tower sites.

As outlined by the 2003 critical habitat rule: existing man-made features and structures within the boundaries of the mapped units, such as buildings; roads; aqueducts and other water system features, including but not limited to pumping stations, irrigation ditches, pipelines, siphons, tunnels, water tanks, gauging stations, intakes, reservoirs, diversions, flumes, and wells; existing trails; campgrounds and their immediate surrounding landscaped area; scenic lookouts; remote helicopter landing sites; existing fences; telecommunications equipment towers and associated structures and electrical power transmission lines and distribution and communication facilities and regularly maintained associated rights-of-way and access ways; radars; telemetry antennas; missile launch sites; arboreta and gardens, heiau (indigenous places of worship or shrines) and other archaeological sites; airports; other paved areas; and lawns and other rural residential landscaped areas do not contain, and are not likely to develop, primary constituent elements and are specifically excluded from designation under this rule.

The Mt. Kaala off-site communications location is an existing infrastructure and excluded from critical habitat designation, and impacts are not anticipated to indirectly affect nearby habitat containing the primary constituent elements.

No impacts to *Drosophila substenoptera* are anticipated at the off-site communications towers. None of the larval host plants are present at the site. If a helicopter is used to deliver construction materials, it will remain 100 feet above ground level to avoid the impact of rotor wash on any *Drosophila substenoptera* that may be present in the vicinity.

The endangered Oahu elepaio (*Chasiempis sandwichensis ibidis*) critical habitat is currently unoccupied by the species at the off-site communications towers (Federal Register 2001). No impacts to the habitat for the Oahu elepaio are anticipated for foraging, sheltering, roosting, nesting, rearing of young or dispersal. If a helicopter is used to deliver construction materials, it will remain 100 feet above ground level to avoid the impact of rotor wash on any forest habitat.

Impacts of Avoidance and Minimization Measures

No impacts are expected from the proposed avoidance and minimization measures.

Impacts of Mitigation Measures

No impacts are expected from the proposed mitigation measures.

4.6.1.3 Federally Listed Covered Species

Construction and operation of the Kawailoa Wind Power 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; however, cranes are intended for daytime use during a portion of the construction phase (three to four months) and would be lowered to a position that would reduce the risk of flight collision when not in use. The crane that would permanently be available for Kawailoa would 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 onsite 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 onsite surveys and information about the Proposed Action design. The fatality estimate models developed for Kawailoa 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. Due to the very low observed levels of bird and bat activity at Kawailoa for most of the Covered Species, the mortality modeling provides very low estimated rates of direct take. 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 Action.

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 Kawailoa 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).

Computed “take” for each Covered Species will be classified as Tier 1 and Tier 2. For bats, an additional higher tier, Tier 3, was added to account for the uncertainty surrounding the susceptibility of non-migrating Hawaiian hoary bats colliding with turbines. The continental subspecies of hoary bats is most susceptible to turbine collisions during their fall migration period but the same migration behavior does not occur in Hawaii, thus the take levels encompass a wider range to accommodate the possible differences in susceptibility.

Requested take at Tier 1 is the baseline amount requested to be authorized by the ITP/ITL for the life of the project. A Tier 2 or 3 (higher or greater) rate of take would be that which exceeds the authorized Tier 1 limit. In this HCP, a Tier 2 take limit may be up to twice the Tier 1 requested take limit. For bats, the Tier 3 requested take limit is three times greater than Tier 1. Exceeding the five- or 20-year take limit for Tier 1 for any Covered Species would indicate that the rate of take has moved to Tier 2 or Tier 3 (in the case of bats). At this point, the Applicant will also consult with DLNR and USFWS to implement adaptive management strategies. Exceeding only the one-year limit will not move take to a higher tier, but will be used as an “early warning” to spur investigation into why a higher annual rate of take is occurring and whether steps may be able to be taken to reduce future take.

Expected impacts to the Covered Species from the Proposed Action are described below. The sections below identify the number of individuals of each Covered Species for which Kawailoa Wind Power is seeking take authorization under a Federal ITP. A summary of the estimated and requested take of the Covered Species is provided in Table 2-3.

4.6.1.3 (a) Newell’s Shearwater

Pre-construction surveys suggest that Newell’s shearwaters are likely to be at risk of collision with the turbines and met towers throughout the project site at Kawailoa Wind Power. The estimated fatality rate for Newell’s shearwaters are 0.017 shearwaters/turbine/year (assuming 99% avoidance), 0.084 shearwaters/turbine/year (95% avoidance) and and 0.169 shearwaters/turbine/year (90% collision avoidance rates). For the 30 turbines anticipated on site, the total fatality therefore ranges between 0.50 shearwaters/year (assuming 99% avoidance), 2.52 shearwaters/year (95% avoidance) and 5.04 shearwaters/year (90% collision avoidance rates).

Fatality rates due to Newell’s shearwaters striking the met towers are 0.0054 birds/tower/year (assuming a 99% avoidance rate), 0.024 birds/tower/year (95% avoidance rate) and 0.047 birds/tower/year (90% avoidance rate).

No Newell’s shearwater mortality has been documented at the KWP facility on Maui since operations began. However, modeling suggests that for the measured passage rates, at 95% avoidance, approximately three Newell’s shearwater fatalities should have occurred already. Since that scenario seems unlikely, given that no carcasses have been found, a 99% avoidance rate was assumed for Kawailoa Wind Power. Thus, the estimated average fatality rate at a 99% avoidance level for all turbines is estimated at 0.50 shearwaters/year. Fatality at the (up to) two permanent met towers is estimated at 0.01 shearwaters/year at the 99% avoidance rate. The total expected fatality for the turbines and met towers combined is calculated to be 0.51 shearwaters/year. However, this estimated fatality may still be inflated as during the radar survey, it was evident that some of the targets observed on radar were likely not Newell’s shearwater but other seabirds or shorebirds that have similar flight speeds and sizes, such as the Pacific golden-plover, black-crowned night heron or white-tailed tropic bird (Day et al. 2003b). Coupled with the uncertainty over whether the species still breeds on the Island of Oahu, Kawailoa Wind Power proposes to assume that approximately only one quarter of the targets are Newell’s shearwater and projects a mortality rate of 0.13 shearwaters/year for all turbines and met towers on site.

In addition to collisions with turbines and met towers, some limited potential exists for shearwaters to collide with cranes during the construction phase of the project. Cranes used during construction are typically comparable in height to the met towers that will be onsite, but will have a smaller profile. The construction phase is expected to last less than a year, with cranes on-site for only four to six months.

Assuming that the cranes have an equal or lesser probability of a bird strike as a met tower the take is calculated to be 0.0025 birds per crane (0.005 (take/year for met tower) x 0.5 years = 0.0025 birds). This also conservatively assumes that the cranes will be onsite during the breeding season for the Newell's shearwater. Given the modeled low rate, potential for Newell's shearwaters to collide with construction cranes is considered unlikely and no additional take is requested.

Potential for shearwaters to collide with the on-site communication towers, off-site antennae and utility poles also exists. These structures, except for one of the communications tower, are 60 ft tall or less. Studies have shown that only 1% of Newell's shearwaters (n = 688 birds; B. Cooper/ABR, pers. comm.) fly below 60 ft and for the one communications tower that is 150 ft tall, it is expected that 25% of all Newell's shearwater will fly below 150 ft (n = 688 birds; B. Cooper/ABR, pers. comm.). Of these individuals, the estimated collision avoidance rate is 97% (Day et al., in prep). Given that the seabird traffic rate on Oahu is extremely low, the likelihood of a seabird flying at low altitudes and colliding with any of the communication towers, antennae, and utility poles related to the project is considered to be remote.

The possibility of Newell's shearwater colliding with overhead lines is also considered remote. On Kauai, take associated with 1145 miles of transmission, distribution, and secondary lines in 2008 was estimated to be 15.5 breeding adults, and 63 non-breeding or immature Newell's shearwaters (Planning Solutions, Inc. 2010).Kauai is estimated to host 75% of the total population of Newell's shearwater population, which is estimated at 21,250 breeding and non-breeding birds in 2008 (Planning Solutions, Inc. 2010). This amounts to 0.067 mortalities per year per mile of power line. Most of the remaining birds are believed to nest on Hawaii and Maui, but some birds could potentially be nesting on Oahu. If 1% of the Newell's shearwater population still uses Oahu (approximately two hundred individuals which is likely an overestimate), the total mortality for the 4 miles of proposed overhead lines at Kawailoa would be 0.07 Newell's shearwaters over 20 years.
With a total of 2995 miles of transmission and distribution lines on Oahu, the fallout rates associated with power line strikes alone, assuming 1% of the population utilizing this area would be expected to be 2.67 birds per year for the entire island.

Some potential exists for construction or maintenance vehicles to strike downed shearwaters (birds already injured by collision with turbines or towers) while traveling along the onsite access roads. This source of mortality does not result in an increase in the amount of direct take expected from the proposed project because these birds are accounted for in the take modeling.

(If seabird mortality is found and mortality can be attributed to the onsite construction cranes, communication facilities, overhead cables or utility poles, their loss will be mitigated at a level commensurate with any take recorded onsite. The take will be assessed as part of the project)

The requested take for Tier 1 and Tier 2 are listed in Table 2-3 and the total requested authorized take for Newell's shearwater is 9 individuals (6 adults and 3 chicks).

The most recent population estimate of Newell's shearwater was approximately 84,000 breeding and non-breeding birds, with a possible range of 57,000 to 115,000 birds (Ainley et al*.* 1997). However, based on population modeling, Ainley et al. (2001) calculated an annual population decrease of 6.1%. More recently, Holmes (Planning Solutions, Inc. 2010) suggest a 75% population decrease between 1993 and 2008, based on radar surveys and SOS data. This puts the 2008 total population estimate on the order of 21,000. The Tier 1 requested take is for five shearwaters over 20 years, resulting in an annual rate of take of shearwaters at 0.4 shearwater/yr which is less than 0.002% of the current estimated Newell's shearwater population. If all five mortalities occur at once, it only constitutes 0.02% of the estimated population. Given these very low percentages, take caused by the proposed project would not result in significant adverse effects to Newell's shearwater at the population level. Tier 2 requested take totals 9 shearwater over 20 years, resulting in an average annual rate of take at 0.5 shearwaters/yr. This impact is less than 0.004% of the overall population. If all nine mortalities occur at once, it only constitutes 0.04% of the estimated population. Given these very low percentages, take caused by the proposed project would not result in significant adverse effects to Newell's shearwater at the population level.

To mitigate for these impacts, Kawailoa Wind Power is proposing to support the development of improved traps for predators and subsequently testing the effectiveness of the prototype at a Newell's shearwater colony on Kauai or Maui, or provide support for colony-based protection and productivity enhancement for a seabird colony on Kauai, Maui, or elsewhere.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures proposed are likely to minimize collision risk of seabirds with project components take by increasing visibility and reducing collision risk. Marking guy wires from temporary met towers and overhead collection lines will increase visibility of these structures and the placement of overhead lines parallel to the treelines where practicable will reduce collision risk. The reduction in on-site lighting and minimization of night-time construction activity will reduce light attraction of Newell's shearwater to the site. Low wind speed curtailment, while implemented mainly for bats will also have the potential to reduce seabird collision as the turbines will not be spinning during nights with wind speeds less than 5m/s. Seabirds are most likely to transit the site at night.

Impacts of Mitigation

If mitigation consists of developing a self-resetting cat trap, the pilot study is expected to demonstrate that the traps successfully function in the field at a Newell's shearwater colony by dispatching cats with no impact to the seabirds. The cat trap will be deployed for one breeding season and based on modeling of a reduction from medium to mild predation, the cat trap deployment is expected to result in a 10% increased breeding probability, 7.5% increased breeding success and 1.5-2.5% increase in survival of Newell's shearwater adults and sub-adults that are protected within the trapping area. Modeling shows that within one year, for 20 active burrows protected, the reduction of cat predation could potentially result in the additional survival of 0.5 adults, 4.1 juveniles and 2 fledglings. For 30 burrows, the accrual after one season is expected to be 0.8 adults, 6.1 juveniles and 2.9 fledglings (HT Harvey and Associates 2011). The preferred location for the seabird colony is Kauai, but Maui may be selected with USFWS and DOFAW concurrence. Seabird colonies currently under consideration include, but are not limited to, Wainiha Valley, Limahuli Valley and Hono O Na Pali on Kauai, or Makamakaole and a potential seabird colony at Upper Kahakuloa Valley on Maui. Mitigation will be deemed successful if the self-resetting cat trap is successfully developed and is demonstrated to successfully function in the field at a Newell's shearwater colony for one breeding season, is efficient and effective in dispatching cats, with no adverse impact to the seabirds.

With the low requested take at Tier 1, the proposed mitigation measures of the development of a self-resetting cat trap and its implementation at a seabird colony as part of a pilot study, are expected to produce a net benefit in the form of an increase in the species' population by increasing productivity and survival rates. As stated above, the pilot study will result in an immediate increase in adult and subadult survival at the colony as well as increased reproductive success, above the unmanaged state. While the area managed is anticipated to be small, trap development as outlined is expected to more than compensate for the requested take at Tier 1. A more effective cat trap for Newell's shearwater predator management will help to meet a milestone identified as necessary for the recovery of the species, and the eventual implementation at additional colonies will increase survival and reproduction. The new trap is anticipated to have far reaching benefits beyond the mitigation measures implemented by the Applicant. The development of the trap will enable managers to conduct predator control at sites that are currently not suitable for trapping because of their remoteness and the intensive labor required to maintain a trapping grid. It is anticipated that the cat trap will be less labor intensive to operate and more effective than the cat traps currently available (current cat traps, once sprung, are inactive and need to be manually reset by a person) and will be utilized extensively by most parties involved in the management of Newell's shearwater colonies once developed. This is expected to yield improvements in protection, reproductive success and survival over current management methods, for many currently unmanaged colonies, with benefits extending years into the future.

Tier 2 mitigation will consist of contributing to a restoration fund that includes predator trapping and translocation of Newell's shearwater to create a new colony. This will help to meet a milestone identified as necessary for the recovery of the species. The new colony will be established at a site that is managed for predators and where birds are at low risk from fallout due to powerline collisions and light attraction. The establishment of a new colony is expected to help increase the population of Newell's shearwaters and may also contribute to a range expansion of the species.

4.6.1.3 (b) Hawaiian Duck

Ducks are only expected to be at risk of collision with the turbines at Zone 1; thirteen turbines and two meteorological towers are anticipated in Zone 1. The estimated average rate of mortality at 99 percent avoidance is 0.017Hawaiian ducks/year.

Ducks also have the potential to collide with communication towers, overhead collection lines, relocation distribution lines and utility poles. However, as Hawaiian hybrid ducks are primarily diurnal, they are expected to easily avoid the communication towers which would be highly visible during daylight hours. Observations of ducks conducted at wetlands at Kahuku in 2008 and 2009 demonstrated that Hawaiian duck hybrids easily negotiated the overhead powerlines strung across the wetland habitat (SWCA 2010a). No ducks were observed to have any collisions or near-collisions with the overhead powerlines or utility poles (147 flocks observed, average of two birds per flock). Consequently, potential for hybrid Hawaiian ducks to collide with communication towers, overhead collection lines, relocated distribution lines and utility poles onsite is considered negligible.

Some very limited and temporary potential risk would also exist for ducks to collide with cranes during the construction phase of the project. However, the cranes would be highly visible, and so should be readily avoided. In addition, as discussed for Newell's shearwater, the cranes are only expected to be present onsite for a brief period. Consequently, potential for hybrid Hawaiian ducks to collide with construction cranes is considered negligible. Some potential also exists for construction or maintenance vehicles to strike downed ducks (ducks already injured by collision with turbines or towers) while traveling project roads.

Even though few pure Hawaiian ducks are expected to be present on Oahu, given the dispersal capabilities of the species, it is possible for pure Hawaiian ducks to occasionally fly over from Kauai. In addition, genetic research in 2007 showed presence of several Hawaiian ducks at James Campbell National Wildlife Refuge, and a bird struck by a plane at Honolulu International Airport in 2007 was found to be Hawaiian duck (A. Nadig, USFWS, pers comm.). Browne (1993) found absence of pure Hawaiian ducks on Oahu due to extensive hybridization with feral mallards. Uyehara et. al (2007) found a predominance of hybrids on Oahu. An estimated 300 Hawaiian duck-like birds are found on Oahu, but the majority of these, given the genetic evidence, are thought to be hybrids (USFWS 2005a). Mallard control and possible reintroduction of Hawaiian ducks to Oahu may increase the population of Hawaiian ducks on the island within the 20-year life of the project. Given a very small starting population and a very high proportion of hybrids, it is conservatively assumed that only 10% of the ducks seen may have the potential to be pure Hawaiian ducks, though the proportion of pure Hawaiian ducks to Hawaiian duck-mallard hybrids is expected to be much less as described above. Thus the expected fatality rate of pure Hawaiian ducks is projected to occur at one-tenth the rate of Hawaiian duck-mallard fatalities at 0.017 ducks/year.

The requested take for Tier 1 and Tier 2 are listed in Table 2-3 and the total requested authorized take for the Hawaiian duck is 12 individuals (adults or fledglings).

An estimated 2,000 pure Hawaiian ducks are present on Kauai. The Tier 1 requested take is for 8 total birds over 20 years, resulting in an annual average rate of take of 0.4 birds/yr, which would constitute a loss of 0.02% of the population on Kauai per year. Mortality at this very low rate is not expected to cause significant negative impacts to the population of pure Hawaiian ducks. This small annual rate of take is also not expected to adversely affect the Oahu population if reintroduction has already occurred. If eight ducks get taken at once, it would constitute 0.4% of the population on Kauai and would not be expected to cause significant negative impacts to the population of pure Hawaiian ducks. All eight mortalities occurring at once could begin to impact the Oahu population if reintroduction had already occurred as the initial population is expected to be small. However, the expected small initial population also makes the likelihood of taking eight pure Hawaiian ducks at once that are resident on Oahu extremely unlikely.

Tier 2 requested take totals 12 ducks over 20 years, resulting in an average annual rate of take at 0.6 birds/year which would constitute 0.03% of the Kauai population annually and is also not expected to have significant population level impacts. If 12 ducks get taken at once, it would constitute 0.6% of the population on Kauai and is still not expected to cause significant negative impacts to the population of pure Hawaiian ducks. All 12 mortalities occurring at once could begin to impact the Oahu population if reintroduction has already occurred. However, the expected small initial population also makes the likelihood of taking 12 pure Hawaiian ducks at once that are resident on Oahu extremely unlikely.

<u>Impacts of Avoidance and Minimization Measures</u>

The avoidance and minimization measures proposed are likely to minimize collision risk of waterbirds with project components take by increasing visibility and reducing collision risk. Marking guy wires from temporary met towers and overhead collection lines will increase visibility of these structures and the placement of overhead lines parallel to the treelines where practicable will reduce collision risk. Improving the drainage of the site will reduce waterbird attraction to the site and decrease their risk of collision with the turbines and other structures. Low wind speed curtailment, while implemented mainly for bats will also have the potential to reduce waterbird collision as the turbines will not be spinning during nights with wind speeds less than 5m/s. Waterbirds may occasionally transit the site at night. The on-site speed limit of 15 mph will also reduce the likelihood of injuring downed waterbirds.

<u>Impacts of Mitigation</u>

Currently, as few pure Hawaiian ducks are believed to exist on Oahu due to hybridization, mitigation for Hawaiian ducks at Tier 1 and Tier 2 levels may consist of removal of feral ducks, mallards and Hawaiian duck hybrids at Ukoa Pond. Removals will be coordinated with DOFAW and USFWS. This will prevent the continued dilution of the Hawaiian duck gene pool. Furthermore, if pure Hawaiian ducks are reintroduced to Oahu, the elimination of all sources of feral mallard ducks will need to occur (Engilis et al. 2002). The control of ducks at Ukoa Pond will contribute to this effort. The wetland restoration, fencing, and predator control at Ukoa Pond is also expected to protect any pure Hawaiian ducks that may utilize the pond in the future. In the event duck hybrids are exterminated and pure Hawaiian ducks are reintroduced, mitigation at both Tier 1 and Tier 2 levels will be deemed successful if the number of fledglings and adults accrued exceed the requested take for the required level for the Hawaiian duck and result in a net benefit for the Hawaiian duck over the entire permit term as measured in annual increments and based upon banding and resight studies. Mitigation will continue till the the requested take is off-set, even if it requires an extension of management past the 20-year term of the ITP/ITL. As a result of the mitigation, no adverse impacts to the species' overall population are anticipated.

4.6.1.3 (c) Hawaiian Stilt

No Hawaiian stilts were observed flying over the project site during the avian surveys. Consequently, modeling would result in an estimated take rate of zero because known stilt passage rate is zero. Because Hawaiian stilts have historically occurred in the wetlands in the Kawailoa area, it is assumed that the project would create some risk of causing take of this species, however small. The estimated rate of take of the Hawaiian stilt would be assumed to be the same as for Hawaiian duck hybrids, or an average of 0.17 stilts/year lost through interaction with turbines, met towers, onsite and offsite communication towers and overhead cables, utility poles and other associated structures, as well as mortality because of construction-related fatalities and vehicular strikes.

The requested take for Tier 1 and Tier 2 are listed in Table 2-3 and the total requested authorized take for the Hawaiian stilt is 18 individuals (adults or fledglings).

Oahu supports 35-50% of the State's stilt population with approximately 450 to 700 birds present on the island. However, Hawaiian stilts readily disperse between islands and constitute a homogenous metapopulation (Reed et al. 1998). Currently, the population of Hawaiian stilts is considered to be stable to increasing (Service 2005) and is estimated to be between 1,200 to 1,600 birds (Griffin et al. 1989; Engilis and Pratt 1993; Hawaii Biodiversity and Mapping Program 2007). The Tier 1 requested take is for 12 total birds over 20 years, resulting in an annual rate of take of stilts at 0.6 birds/yr which constitutes no more than 0.01% of the estimated population annually on Oahu and is not expected to significantly impact the population of the stilt on the island. In the unlikely event that all 12 stilt mortalities occur at once, it will constitute 1.7 to 2.7% of the resident population or 0.8 to 1.0% of the overall population of Hawaiian stilt.

Tier 2 requested take totals 18 stilt over 20 years, resulting in an average annual rate of take at 0.9 stilt/yr which still only constitutes no more than 0.2% of the population on the island annually and is unlikely to significantly impact the population. As stated above, mortality of waterbirds at wind farms has historically been low, despite the proximity of large populations of waterbirds near turbines. Waterbirds also learn to avoid turbines over time (Kingsley and Whittam 2007; Carothers 2008). Mortality of 18 stilts at once would constitute 2.5-4% of the resident population or 1.1-1.5% of the overall population of Hawaiian stilt.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures proposed are likely to minimize collision risk of waterbirds with project components take by increasing visibility and reducing collision risk. Marking guy wires from temporary met towers and overhead collection lines will increase visibility of these structures and the placement of overhead lines parallel to the treelines where practicable will reduce collision risk. Improving the drainage of the site will reduce waterbird attraction to the site and decrease their risk of collision with the turbines and other structures. Low wind speed curtailment, while implemented mainly for bats will also have the potential to reduce waterbird collision as the turbines will not be spinning during nights with wind speeds less than 5m/s. Waterbirds may occasionally transit the site at night. The on-site speed limit of 15mph will also reduce the likelihood of injuring downed waterbirds.

Impacts of Mitigation Measures

Measures intended to increase waterbird population sizes have been generally aimed at reducing or eliminating predation through exclusion (i.e., fencing) and eradication of predators from an enclosed breeding area. Garrettson and Rohwer (2001) found that lethal predator control using professional trappers was an effective way to increase waterfowl production; average nest success was nearly twice as high at trapped sites than at untrapped sites. Nest success of several dabbling ducks was also determined to be higher under predator management (by trapping, shooting, or lethal baiting) than at sites without predator management, although this relationship varied with climatic conditions (Drever et al. 2004). Long term removal of feral mink (*Mustela vison*) via trained animals also resulted in an increase in the breeding densities of four waterfowl species compared to densities in control areas (Nordström et al. 2002). On Oahu, the restoration and management of Hamakua Marsh has also been demonstrated to increase the reproductive success of the endangered waterbird species (SWCA 2010d).

Mitigation efforts at Ukoa Pond, which will include fencing, predator control, weed control, and monitoring, are expected to increase the productivity of the endangered waterbirds, as well as increase juvenile and adult survival rates.

Mitigation will be deemed successful if the number of fledglings and adults accrued exceed the requested take for the required level for the Hawaiian coot, Hawaiian stilt and Hawaiian moorhen and result in a net benefit for the three Covered Species over the entire permit term as measured in annual increments and based upon banding and resight studies. The mitigation is expected to be successful as the Hawaiian stilt (and Hawaiian coot and Hawaiian moorhen) is classified as a species with a high potential for recovery (USFWS 2005a) where the biological and limiting factors are well understood, the threats are understood and easily alleviated and intensive management is not needed or the known techniques have been documented with a high probability of success (USFWS 1983). Mitigation will continue till the the requested take if off-set, even if it requires an extension of management past the 20-year term of the ITP/ITL. As a result of the mitigation, no adverse impacts to the species’ overall population are anticipated. Net benefit will also be considered to have been achieved as these mitigation efforts will have contributed to wetland restoration, a reduction in introduced predator populations, and will have contributed to the recovery of the species.

4.6.1.3 (d) Hawaiian Coot

A small number of fatalities of American coot have been reported at wind facilities in North America, although these involved projects where surface waters occurred within the project area. No coots were observed flying through the project area during the avian surveys but one Hawaiian coot was observed foraging in a pond adjacent to Kawailoa Road. The Hawaiian coot was absent in subsequent observations. Because the coot was not observed in flight, mortality modeling for this species would result in a projected rate of take of zero. As the Hawaiian coot presumably took flight to arrive and depart from the pond, Hawaiian coots may occasionally occur in or near the airspace envelope of the turbines. Therefore, it seems the potential for take of this species occurring from the Proposed Action, while very low, is not zero. Therefore, it is assumed that the rate of take of Hawaiian coot would be the same as for hybrid Hawaiian ducks, or an average of 0.17 coots/year resulting from interactions with turbines, met towers, and onsite and offsite communication towers associated overhead cables, utility poles, and other associated structures, as well as mortality because of construction-related fatalities and vehicular strikes.

The requested take for Tier 1 and Tier 2 are listed in Table 2-3 and the total requested authorized take for the Hawaiian coot is 18 individuals (adults or fledglings).

Island-wide population, based on bi-annual waterbird counts conducted by DOFAW, suggests that the population is stable and is estimated at between 2,000 and 3,000 individuals. Oahu supports between 500 and 1,000 coots, or up to 33% of the State population. Hawaiian coots readily disperse between islands and constitute a homogenous metapopulation. The Tier 1 requested take is for 12 total birds over 20 years, resulting in an annual rate of take of coots at 0.6 birds/yr which constitutes no more than 0.06 – 0.12% of the estimated population on Oahu annually and is not expected to significantly impact the population of the coots on the island. If 12 coot mortalities occur at once, it will constitute 1.2% of the resident population or 0.4% of the overall population of Hawaiian coot.

Tier 2 requested take totals 18 coot over 20 years, resulting in an average annual rate of take at 0.9 stilt/yr which still only constitutes no more than 0.1-0.2% of the population annually on the island. As stated above, mortality of waterbirds at wind farms has historically been low, despite the proximity of large populations of waterbirds near turbines. Waterbirds also learn to avoid turbines over time (Kingsley and Whittam 2007; Carothers 2008). The likelihood of 18 coot mortalities occurring all at once is even more remote and would constitute 1.8-3.6% of the resident population or 0.6-0.9% of the overall population of Hawaiian coot.

Impacts of Avoidance and Minimization Measures

Impacts of the avoidance and minimization measures for the Hawaiian coot are as described for the Hawaiian stilt.

Impacts of Mitigation Measures

Impacts of the proposed mitigation measures for the Hawaiian coot are as described for the Hawaiian Stilt.

4.6.1.3 (e) Hawaiian Moorhen

Hawaiian moorhens were not detected at the Kawailoa wind farm site during the year-long avian point count survey, but are known to occur in the nearby waterbodies. However, Hawaiian moorhen are also thought to be at very low risk of collision with turbines because of their sedentary habits. However, for similar reasons discussed for Hawaiian stilt and Hawaiian coot, risk of collision by this species is not zero, and would be assumed to occur at the same rate assumed for those species, or on an average of 0.17 moorhens/year as a result of collision with turbines, met towers, onsite and offsite communication towers, associated overhead cables, utility poles and other associated structures, as well as mortality because of construction-related fatalities and vehicular strikes.

The requested take for Tier 1 and Tier 2 are listed in Table 2-3 and the total requested authorized take for the Hawaiian moorhen is 18 individuals (adults or fledglings), and 50 individuals in form of capture from trapping activities.

Biannual waterbird surveys record an average of 341 moorhen throughout the State (USFWS 2005a). This average is likely an inaccurate estimate of true population size as common moorhens are secretive and difficult to census (USFWS 2005a) and the actual population is expected to be larger. The Tier 1 requested take is for 12 total birds over 20 years, resulting in an annual rate of take of moorhen at 0.6 birds/yr which constitutes no more than 0.2% of the known estimated population annually on Oahu and is not expected to significantly impact the population of the moorhen on the island. If12 moorhen mortalities occur at once, it will constitute 3.5% of the known resident population.

Tier 2 requested take totals 18 moorhen over 20 years, resulting in an average annual rate of take at 0.9 stilt/yr which still only constitutes no more than 0.3% of the known estimated population on the island annually. Mortality of 18 moorhen at would constitute 2.4% of the known resident population.

<u>Impacts of Avoidance and Minimization Measures</u>

Impacts of the avoidance and minimization measures for the Hawaiian moorhen are as described for the Hawaiian Stilt.

<u>Impacts of Mitigation Measures</u>

Primary impacts of the proposed mitigation measures for the Hawaiian moorhen are as described for the Hawaiian Stilt.

In addition to the anticipated take by the project, predator trapping poses some risk of harassment due to capture, and could result in injury or mortality to the Covered waterbird species and is accounted for in Section 6.3.5.4 of the HCP. Moorhen are attracted to traps (DesRochers et al. 2006) and moorhen on Oahu have been documented entering live traps (DesRochers et al. 2006; Nadig/USFWS, pers. comm.). USFWS recommends additional take of not more than ten Hawaiian moorhen annually in the form of capture. The trapping at Ukoa Pond is anticipated to last five years and a total of take of 50 individuals in the form of capture is also requested. Minimal risk of injury or mortality is anticipated from this capture and the conservation strategy to implement wetland management including a predator control program will result in an overall increase in the baseline number of individuals of the endangered Hawaiian moorhen. Therefore, the implementation of live trapping will have beneficial effects through the control of nonnative predators and increased productivity of Hawaiian moorhen. As a beneficial effect no further mitigation would be required for the potential capture of Hawaiian moorhen.

However, if the implementation of mitigation measures causes a waterbird capture that does result in mortality or injury, the take will be assessed as part of the 18 birds (Tier 2 total) estimated for injury or mortality as part of the Kawailoa Wind Power project.

4.6.1.3 (f) Hawaiian Hoary Bat

Habitat Impacts

Hawaiian hoary bats have been known to use both native and non-native habitats for feeding and roosting (Mitchell et al. 2005). The vegetated areas within the maximum project footprint for Kawailoa Wind Power consist mostly of agricultural land, alien grassland, shrubland and forest. The alien forest habitat at Kawailoa Wind Power is fairly homogenous, with stands of albizia, ironwood and eucalyptus trees, all of which are considered invasive species in Hawaii. At Kawailoa Wind Power, bats may roost in the trees present in the area and bat activity has been detected in essentially all habitats, including clearings, along roads, along the edges of treelines, in gulches and at irrigation ponds. Monitoring to date indicates that bats use all of these features for travelling and foraging. The construction of Kawailoa Wind Power will result in the loss of about 5.6 ac of land to permanent structures such as buildings, met towers, turbines and riser poles. An additional 16.4 ac of land is expected to be altered by road widening or creation of access roads to turbine pads. Up to 9.9 ac and 1.9 ac of land will be cleared around each turbine and permanent met tower respectively (to a possible maximum of about 305 ac for all 30 turbines and 4 met towers) to establish searchable plots for the monitoring of downed wildlife. Of the 305 ac total approximately 259 ac is likely to be cleared and maintained; the remainder of the search areas will likely remain undisturbed due to steep topography. These search plots will be maintained as short stature shrubs and grasses to maximize the probability of finding downed wildlife and will result in the conversion of approximately 44 ac of agricultural land, 64 ac of shrubland, 130 ac of alien forest and 21 ac of grassland to mowed or otherwise maintained clearings. These habitats contain mostly invasive tree, shrub and grass species. Only the clearing of alien forest has the potential to affect the roosting of Hawaiian hoary bats in the area. However, the total population of bats on Oahu is believed to be small (USFWS 1998), and alien roost trees are plentiful; thus roost trees in alien forests are probably not a limiting factor for the species on Oahu. The alien forest habitat in the vicinity of Kawailoa Wind Power is fairly homogenous, and does not vary significantly in composition or structure between adjacent patches (L. Ong/SWCA personal observations). For these reasons, it is expected that any bats displaced by the clearing of alien forest would readily find alternate roost sites in surrounding undisturbed forest. Although bats may use the alien forest trees on the site for roosting, the loss of 130 ac of alien forest constitutes only 1.0% of the total lowland forest (alien and native) available in the project area and vicinity[10]. The clearing of an additional 5.6 ac of land for permanent structures and 16.4 ac of land for road widening may also result in the additional loss of alien forest. Althought the exact location of the roads and buildings have not been finalized, alien forest habitat loss (versus the amount of agricultural, grassland and shrubland lost) is expected to be less than 50% of the 22 ac. total for roads and structures. This additional small loss is also not expected to reduce the availability of roost trees to the Hawaiian hoary bat. Moreover, the conversion of some of the alien forest habitat to open spaces, and the addition of edges and corridors due to road creation and improvements will result in the creation of foraging habitat. Bat activity has been detected in similar types of clearings around the current temporary met towers, and along edges and roads at the project site (see above). Therefore, these changes in the habitat mosaic (forest to open areas) are not expected to adversely affect the Hawaiian hoary bat but may result in changes in the patterns of use within the area (roosting versus foraging). Furthermore, the clearing of trees will not occur during the pupping season from June 1 to September 15 to avoid take of non-volant juveniles.

In summary, the total population of bats on Oahu is believed to be small (USFWS 1998), and roost trees in alien forests are probably not a limiting factor for the species on Oahu. For these reasons, no net habitat loss is expected for the Hawaiian hoary bat, as the roosting habitat is not expected to be limiting in the area, and is further offset by the creation of foraging habitat due to increased availability of open spaces, edges and corridors. The construction and operation of Kawailoa Wind Power is not expected to result in significant bat habitat loss or significantly displace any bats or negatively impact bat foraging and roosting behavior on site. The only impacts from the project are anticipated to be due to the take of individuals by collisions with the project components and are addressed in the following section.

Scattered native trees, notably koa, are present in small numbers intermixed within the alien forest, and an equivalent or greater number of these trees will be replanted in the vicinity to replace the trees lost due to clearing. This will result in the creation of some native tree habitat which may also be used by bats in the future.

The potential for bats to collide with met towers onsite and offsite communication towers and overhead cables, utility poles, other associated structures, or cranes is considered to be negligible because they would be immobile and should be readily detectable by the bats through echo-location. While the guy wires on the temporary meteorological towers may pose a somewhat greater threat to bats, bats present at KWP on Maui have not been found to have collided with the guyed met towers after three years of operation nor with any cranes during the construction phase of that project. Similarly, no downed bats have been found during the weekly searches of the four guyed temporary

[10] The area analyzed includes vegetation bounded by Waimea Valley to the north, Kawailoa Gulch to the south, the coastline to the west and lowland forest which extends to an elevation of 1,600 ft to the east. The total area is 19,150 ac, of which 11,290 ac is designated conservation land, 7,553 ac agricultural land and 307 ac, urban land.

meteorological tower within the Kawailoa wind farm site. Weekly searches began in October 2009 and are ongoing. These search plots have been regularly mowed since the plots were established. In addition, of 64 wind turbines studied at Mountaineer Wind Energy Center in the Appalachian plateau in West Virginia, bat fatalities were recorded at operating turbines, but not at a turbine that remained non-operational during the study period (Kerns et al. 2005). This supports the expectation that presence of the stationary structures such as met towers and cranes should not result in bat fatalities.

The estimated average rate of take for the Proposed Action is 0.075 bats/turbine/year. This equates to a total average take of 2.25 bats/year for 30 turbines on the site. However, as previously described, in an effort to minimize this risk, low wind speed curtailment would be implemented from the start of project operations for peak months of March through November. The expected fatality at the Kawailoa wind farm site with low wind speed curtailment assumes a conservative 70 percent reduction in fatalities. This leads to an overall take of 0.67 bats/year for the entire project and approximately 13.5 bats for the life of the project.

The requested take for Tier 1, Tier 2 and Tier 3 are listed in Table 2-3 and the total requested authorized take for the Hawaiian hoary bat is 72 individuals (adults or juveniles).

No recent population estimates exist for Hawaiian hoary bat, though previous estimates have ranged from several hundreds to several thousands (Tomich 1969; Menard 2001). The Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998) states "since no accurate population estimates exist for this subspecies and because historical information regarding its past distribution is scant, the decline of the bat has been largely inferred." Although overall numbers of Hawaiian hoary bats are believed to be low, they are thought to occur in the greatest numbers on the Islands of Hawaii and Kauai (Menard 2001). No breeding bats have been recorded on Oahu and based on published literature, the bats found on Oahu are thought to be migrant or vagrant (USFWS 1998) though bat activity data at Kawailoa Wind Power suggests that some bats may reside on Oahu (see Section 3.8.4.4). Species recovery is also currently focused on the Islands of Hawaii and Kauai as recommended by the Recovery Plan for the Hawaiian Hoary Bat (USFWS 1998).

The Tier 1 requested take is for 24 total bats over 20 years, resulting in an annual rate of take at 1.2 bats/yr. This low rate of take is unlikely to adversely affect the population on Oahu (if present) and evern 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 bats are expected to be migrant or vagrant, or if a small resident population is present on the island, it is very unlikely that all 24 bat mortalities will occur at once. If this occurs, it could impact the local resident population, but if the bats are migrant or vagrant, it is unlikely to affect the population as a whole.

Take at Tier 2 (48 bats total or 2.4 bats/yr) or 3 (72 bats total or 3.6 bats/yr) could only occur and impact the Oahu population, if a resident population is present and is much larger than anticipated (likely to at least be in the hundreds). This would in turn imply that the populations on the Islands of Hawaii and Kauai, where bats are known to breed and are detected more frequently, are even larger (in the thousands), and thus the somewhat higher average yearly take is not expected to impact the status of the species as a whole. The Tier 2 and Tier 3 rates of take could impact the resident population on Oahu, in the very unlikely event that all the mortality occurs at once (48 bats for Tier 2 and 72 bats for Tier 3).

Impacts of Avoidance and Minimization Measures

Low wind speed curtailment will be implemented at night by raising the cut-in speed of the project's wind turbines to 5 m/s. Based on data collected to date, the curtailment will initially occur during months of March to November, which is when bat activity has been relatively higher

This is expected to reduce the risk of bat take by approximately 70%. Recent studies on the mainland indicate that most bat fatalities occur at relatively low wind speeds, and consequently the risk of fatalities may be significantly reduced by curtailing operations on nights when winds are light and variable. Research suggests this may best be accomplished by increasing the cut-in speed of wind turbines from their normal levels (usually 3.5 or 4 m/s, depending on the model) to 5 m/s. Two years of research conducted by Arnett et al. (2009, 2010) found that bat fatalities were reduced by an average of 82 percent (95% CI: 52 to 93 percent) in 2008 and by 72 percent (95% CI: 44 to 86 percent) in 2009 when cut-in speed was increased to 5 m/s. Therefore, based on best available science, low wind speed curtailment would be implemented at night by raising the cut-in speed of the project's wind turbines to 5 m/s.

Clearing of trees above 15 feet in height for construction would not be conducted between June 1st to September 15th, to avoid take of non-volant Hawaiian hoary bat juveniles that may occur in the project area.

The use of barbless wire on the top strand of any ungulate fence erected as part of the mitigation measures will prevent take of the Hawaiian hoary bat due to entanglement with the barbed wire.

Impacts of Mitigation

Proposed mitigation for Kawailoa Wind Power at Tier 1 consists of restoring wetland habitat or native forest to improve foraging resources available to bats and to provide additional roost trees, along with a complimentary research project that supports the efficacy of the mitigation method selected. Research will also be conducted to identify bat habitat utilization patterns and bat interactions at Kawailoa Wind Power.

The wetland or forest habitat restoration is expected to increase and improve bat foraging and roosting habitat which will lead to increased adult and juvenile survival and increased productivity to mitigate for the impacts to the population at Tier 1. Research will quantify the success of the mitigation and components of the research could consist of documenting increasing bat activity from pre- to post-restoration, to support that wetland restoration improves foraging habitat for bats and results in greater survival and increased productivity. Documenting increased numbers of bats caught in mist-nets or seen during visual surveys will demonstrate that the restoration at the restored wetland or forest has increased the number of individuals utilizing the area. If the pregnant bats or juveniles caught increase over time, this will also demonstrate that increased reproductive success is occurring at the restored wetland or forest, as compared to baseline (pre-restoration) levels. All these data will be used to determine if the increase in survivorship and productivity at the restored wetland or forest have been sufficient to compensate for the requested take in Tier 1. Due to the small amount of information currently available about the basic biology of the Hawaiian hoary bat, the exact metric or combination thereof, to be used to determine the effectiveness of the mitigation, will an integral part of the research that will have to be fulfilled as part of the mitigation.

If after five years it is determined that the wetland restoration is insufficient to meet Tier 1 obligations, then additional wetland restoration or forest restoration or other newer management measures will be conducted to offset the deficit. Mitigation measures may be extended beyond the term of the ITL/ITP if necessary to compensate for the requested take. For these reasons, no adverse impacts to the species' overall population are anticipated.

The on-site research at Kawailoa Wind Power 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. These on-site surveys are also expected to advance avoidance and minimization strategies that wind facilities in Hawaii and elsewhere can employ in the future to reduce bat fatalities.

Tier 2 and Tier 3 mitigation consist of additional wetland or forest restoration. The restoration may be modified depending on the outcome of the research that was conducted in Tier 1. The wetland or forest habitat restoration is expected to increase and improve bat foraging and roosting habitat which will lead to increased adult and juvenile survival and increased productivity to mitigate for the impacts to the population at Tier 2 or 3. Mitigation will be deemed successful based on the same criteria established for the respective mitigation measure in Tier 1, with improvements incorporated as determined by the research conducted in Tier 1. Mitigation measures may also be extended beyond the term of the ITL/ITP if necessary to compensate for the requested take. For these reasons, no adverse impacts to the species' overall population are anticipated.

Further research will be conducted to investigate the reasons for the increased rate of take, and additional measures to reduce the take will be implemented if possible. The research will further advance avoidance and minimization strategies that wind facilities in Hawaii and elsewhere can employ in the future to reduce bat fatalities.

4.6.1.4 State Listed Covered Species

4.6.1.4 (a) Hawaiian Short-Eared Owl

Given that no Hawaiian short-eared owls have been observed on site, it is possible that no Hawaiian short-eared owl fatalities would be realized during the life of the Kawailoa Wind Power project. However, as suitable habitat for hunting does seem to be present, the risk of collision cannot therefore be considered zero. Given the onsite survey results and monitoring results from First Wind's Kaheawa wind farm project on Maui, it seems reasonable to assume that the chance of the Proposed Action causing a short-eared owl fatality in any given year is well less than 1.0. For the purposes of this HCP, it is assumed that the Proposed Action would on average result in the loss of 0.2 Hawaiian short-eared owl/year. This equates to one owl every five years. This mortality rate includes loss because of interaction with turbines, met towers, onsite and offsite communication towers and overhead cables, utility poles and other associated structures, as well as mortality because of construction-related fatalities and vehicular strikes.

The expected rates of take for the Hawaiian short-eared owl, based on the information provided in the HCP (SWCA 2011) are as follows:

Annual average	=	0.2 adults/immatures and 0.2 owlets (0.4 birds per year)
20-year project life	=	4 adults/immatures and 4 owlets

The requested take for Tier 1 and Tier 2 are listed in Table 2-3 and the total requested authorized take for the Hawaiian short-eared owl is 12 individuals (adults or fledglings).

No population numbers for Hawaiian short-eared owl are available for the Island of Oahu or any of the other Hawaiian Islands. The Tier 1 requested take is for 8 total birds over 20 years, resulting in an annual rate of take of owls at 0.4 birds/yr, this is unlikely to cause a significant impact on the Hawaiian short-eared owl population on Oahu. Given that short-eared owls do not congregate in large numbers, the likelihood of all 8 owl mortalities occuring at once is extremely unlikely. Given that the population numbers are unknown, this may impact the resident population on the island but such take would not be expected to affect the status of the species on other islands.

Tier 2 requested take totals 12 owls over 20 years, resulting in an average annual rate of take at 0.6 owls/yr. However, realization of take at higher levels is considered extremely unlikely to occur because Hawaiian short-eared owls have not been seen at the Kawailoa Wind Power site over the course of 12 months of surveys. These rates of take are also unlikely to cause a significant impact on the Hawaiian short-eared owl population on Oahu. Given that short-eared owls also do not congregate in large numbers, the likelihood of all 12 owl mortalities occurring at once is extremely remote. However, if it were to occur, the take could impact the resident population on the island but such take would not be expected to affect the status of the species on other islands.

Impacts of Avoidance and Minimization Measures

Vegetation clearing will be avoided around nesting Hawaiian short-eared owls and will only recommence when the young have fledged or nesting is no longer occurring. These measures will ensure that any owls breeding on the project site will not be affected by the construction activities. The spacing of the overhead lines is also tailored to prevent the electrocution of owls if they perch on the lines. The implementation of a 15mph speed limit will also reduce the risk of vehicular collisions with the owl if it should be hunting along or flying low across the road. Thus the avoidance and minimization measures are expected to minimize the impact any Hawaiian short-eared owls utilizing or breeding on site.

Impacts of Mitigation Measures

Mitigation for possible take of the Hawaiian short-eared owl at the Tier 1 level would consist of two parts: funding research or rehabilitation of injured owls and subsequently implementing management actions on Oahu as they are identified and as needed to bring mitigation ahead of take (that is, providing a net benefit).

The rehabilitation efforts of injured owls are anticipated to offset any impact that the wind facility may have on the local population in the area. If research is funded, it is anticipated that the research conducted would result in an increased understanding of the habitat requirements and life history characteristics of Hawaiian short-eared owl populations, leading to the development practicable management strategies and possibly help with the recovery of the Hawaiian short-eared owl on Oahu.

Management measures when implemented at the respective tier are expected to improve adult or juvenile survival which should mitigate for impacts at Tier 1 or Tier 2.

4.6.2 Alternative 2 (Alternative Communications Site Layout)

Under this alternative, a new tower would be installed in the areas adjacent to the existing Hawaiian Telcom structures, and communications equipment would be mounted on each tower. Approximately 144 square feet of vegetation would be cleared at each site, resulting in a small loss of habitat for avian, mammalian, and mollusk species. However, the disturbed area would constitute a only a sliver of the range of the species identified within this site and, as such, would not be expected to significantly affect any of the faunal resources at the population level. To minimize direct impacts of clearing on native mollusk species, additional mollusk surveys will be conducted, in coordination with USFWS and DOFAW staff, before any vegetation clearing or trimming at either site. No vegetation will be cleared if *Achatinella* species are detected and the detections will be reported to USFWS and DOFAW. Leaf litter will be collected before the area is graded and distributed to the surrounding area to allow any native snails in the leaf litter to move on to undisturbed ground. In addition, measures to minimize the potential for introduction of non-native invasive ant species would be implemented, as described above. No direct impacts to avian or mammalian species would be expected to occur.

The construction of the towers is not expected to increase the requested take for any of the Covered Species. Studies have shown that only 1% of Newell's shearwaters (n = 688 birds; B. Cooper/ABR, pers. comm.) fly below 60 ft and of these individuals, the estimated collision avoidance rate is 97% (Day et al., in prep). Given that the seabird traffic rate on Oahu is extremely low, and that the towers are substantially less than 60 ft tall, the likelihood of a seabird flying at such low altitudes and colliding with the microwave towers is considered to be remote.

There are no open water features near the proposed location of the microwave towers, and waterbirds have not been historically documented at Mt. Kaala (DOFAW 1990). In addition, none of the listed waterbird species have been observed at the site (Hobdy 2010c; Steve Mosher pers. comm.). Therefore, the erection of additional microwave towers is not expected to increase the risk of waterbird fatality for the project.

Potential for short-eared owls to collide with the microwave towers is also considered negligible because these structures will be immobile and stationed in cleared sites. The towers should be readily visible to, and avoidable by, owls. Likewise, the potential for bats to collide with the microwave towers is considered to be negligible because they will be immobile and should be readily detectable by the bats through echolocation.

4.6.3 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.

4.7 Historical, Archaeological, and Cultural Resources

4.7.1 Alternative 1 (Proposed Action)

The sites recorded to date were assessed for their significance based on criteria established and promoted by the DLNR-SHPD and contained in HAR §13-284-6. This significance evaluation should be considered as preliminary until DLNR-SHPD provides concurrence. For a resource to be considered significant it 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 because of associations with traditional cultural practices once carried out, or still carried out, at the property or because of associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity.

The preliminary evaluation of significance and recommended treatment for the 17 recorded archaeological sites within the project area (in the context of the National Historic Preservation Act) of the recorded sites indicated that three sites meet two significance criteria. These sites are likely interrelated elements of a WWII military cable-communication and signaling network that was established as a warning system in the event of a foreign invasion. Although the integrity of the overall system no longer exists, the locational and contextual integrity of these elements are intact, and as such these sites are considered significant under Criteria A and D. The remaining sites retain sufficient integrity to be considered significant under Criterion D for the historical information they have yielded relative to the development of the plantation industry on the north shore of Oahu. Impacts to these sites would be avoided and therefore no significant impacts are expected.

Many of the participants in the interviews for the Cultural Impact Assessment supported the proposed project, while others articulated concerns that the project may impact the area's cultural sites, and beliefs and practices. Several of the participants voiced the importance of the project being done in the correct way. As previously described, the project was deliberately sited to avoid known cultural sites, as well as gulches and steep slopes where burials could be found. The archaeological inventory survey did not identify any burial features, or other cultural sites within the areas that would be disturbed by the project (Rechtman et al. 2011). Sensitive cultural sites in adjacent areas that have been avoided would be fenced before construction. In addition, as described above, archaeological monitoring would be conducted within the project area during construction.

A few of the participants also expressed that the turbines would impact the visual landscape and the integrity of the cultural landscape of Kawailoa. Although the participants did not describe visual impacts from any specific cultural sites, it is expected that some of the turbines would be visible from cultural sites (such as Puu o Mahuka) and culturally significant locations (including Waimea Valley, which has been nominated as a Traditional Cultural Property, and Haleiwa town, which is a State Historic, Cultural, and Scenic District).

At the Mt. Kaala communication sites, no additional archaeological or cultural resources are expected to be affected because of the negative findings of the field investigation coupled with the fact that the proposed communication equipment would be installed on existing structures. Given the negative findings of the field investigation coupled with the fact that the proposed communication equipment would be installed on existing structures, no archaeological resources are expected to be affected at the Mt. Kaala communication sites.

Minimization Measures:

To the extent possible, impacts to these features would be avoided as part of construction and operation of the project. However, in the event that impacts are unavoidable, it is expected that a reasonable and adequate amount of information has been collected about all of these potentially significant historic properties as part of the archaeological assessment to warrant a no further work recommendation, and thus a no historic properties affected determination for these sites. However, archaeological monitoring would be conducted during construction to help ensure that any inadvertently discovered resources would receive immediate attention and protection, while their ultimate disposition is determined by SHPD. In compliance with HAR 13§13-279, a monitoring plan would be prepared and submitted to SHPD for review and approval.

Although the project cannot be implemented in a way that entirely avoids all potential cultural impacts, particularly those related to cultural beliefs, the goal is to develop and operate the project in a way that is respectful to Hawaii's unique cultural and natural resources while also contributing to the local community where the project is located, so as to balance any perceived adverse impacts. Following is a list of cultural and environmental mitigation and community outreach that has been conducted on other First Wind projects; similar mitigation and outreach is ongoing or is planned for the Kawailoa wind farm project:

- Community Consultation. Throughout project development, First Wind meets with community members and organizations to share information and seek input about the project. For the Kahuku project, the community asked for the project to be sited in a way to minimize project-related sound in Kahuku town; the project was adjusted accordingly. Similarly, residents in Mokuleia were concerned about a planned communications tower in their neighborhood, so an alternate location for the antennas was found on an existing facility at Mt. Kaala. In both cases, community feedback helped to improve the final project. First Wind also seeks input from residents about community priorities and local efforts which the project can help support. For the Kahuku project, residents identified education, flood mitigation and agriculture as the most important priorities for their local community. In response, First Wind is working with schools, community associations and local ranchers to contribute to these priorities over the life of the Kahuku project. For the Kawailoa project, a wide range of community members has been engaged to share information and seek input on the project; the community will continue to be consulted as the project design and construction progresses.
- Support for Native Hawaiian Organizations. Since beginning operations in Hawaii, First Wind has been a strong supporter of Native Hawaiian organizations and cultural events, including Aha Punana Leo, Maui Cultural Lands, Hawaiian Homestead Associations on Molokai, Na Pua Noeau, Waimea Valley Music Festival, Waimea Valley Makahiki Festival, and the Council for Native Hawaiian Advancement's annual convention. For the Kawailoa project, First Wind intends to form a long-term partnership with Waimea Valley to support their efforts to promote Hawaiian culture and environmental awareness.
- Continued Access for Traditional Activities. In parallel with the wind farm project, Kamehameha Schools is planning to expand its access opportunities to allow for safe, legal and controlled access to and around the *mauka* portions of the Kawailoa property for hiking, hunting, gathering and cultural practices. As part of this effort, First Wind is coordinating with Kamehameha Schools to facilitate safe access in and around the wind farm site.
- Continued Agricultural Use of Land. Implementation of the proposed wind farm project would allow Kamehameha Schools to maintain the existing agricultural uses of the Kawailoa property, which is consistent with their North Shore Master Plan and Strategic Agricultural Plan. The turbines would be located on unirrigated land on the *mauka* sections of the Kawailoa property, which is currently being fenced for pasture by Kamehameha Schools. Lease revenues generated by the project can be used by Kamehameha Schools to improve the irrigation system and other infrastructure that directly benefits local farmers on the *makai* sections of the property. Not unlike the traditional concept of an *ahupuaa*, this arrangement would provide for productive, sustainable use of the land while not depleting resources.
- Conservation of Native Species. For each wind farm project, First Wind develops a habitat conservation plan to address endangered native wildlife species that may be impacted as a

result of the project. Similar efforts are also made to conserve native plant species. First Wind is working with Kamehameha Schools to identify native trees that should be avoided (for example, koa and sandalwood); any native trees that are removed would be replanted on a one-to-one basis.

The intent of these measures is to balance the beliefs and traditions of the past with the need for clean, renewable energy to sustain future generations.

Impacts of Avoidance and Minimization Measures

No historical, archaeological or cultural resources are expected to be impacted due to the implementation of avoidance and minimization measures as prescribed in the HCP.

Impacts of Mitigation Measures

Historical, archaeological and cultural surveys will be conducted prior to the implementation of mitigation measures for all species, and any identified sensitive site will be avoided during the implementation of any mitigation measure.

All historical, archaeological or cultural resources will be avoided during the implementation of management measures therefore no impacts are expected.

4.7.2 Alternative 2 (Alternative Communications Site Layout)

Impacts as a result of Alternative 2 are expected to be to the same as those described for the Proposed Action (Alternative 1), except that this alternative includes ground disturbing activity at the Mt. Kaala communications site. The new communication towers would be installed adjacent to the existing Hawaiian Telcom facilities, resulting in a small amount of disturbance. However, no archaeological resources were identified within these sites, and as such, no significant archaeological impacts are expected. Impacts to historical, archaeological or cultural impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.7.3 Alternative 3 (No Action Alternative)

No impacts to cultural resources or traditional cultural practices 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. No impacts to historical, archaeological or cultural resources due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.8 Visual Resources

4.8.1 Alternative 1 (Proposed Action)

Two analyses were conducted to determine the impacts of the wind farm project. First, a zone of visual influence (ZVI) analysis was conducted in June of 2011 to identify locations on the island from which the turbines would be visible, and to assess the extent to which they might be potentially visible. Second, visual simulation were produced which illustrate the appearance of the wind farm site from key observation points (KOPs), both with and without the project. Following is a summar of these two analyses and the results from the EIS (CH2M Hill 2011).

The ZVI analysis was conducted based on digital elevation model (DEM) information from the State of Hawaii, specifications of the Siemens SWT-2.3-101 wind turbine model and the 30-turbine layout. Project features were plotted on topographic maps and overlaid with the locations of communities, roads, preservation areas, historic landmarks, and recreation areas (that is, parks, hiking trails, and beaches). A viewshed analysis was subsequently conducted to determine the areas from which project features could be visible.

Visual simulations were prepared for each key observation point (KOP) using computer modeling techniques to depict the view as it would appear with the project constructed. In general, KOPs that may be of concern to local residents, businesses and visitors were selected for the visual simulations. The KOPs are: 1) the entrance to Waimea Valley Park, 2) within Waimea Valley Park, 3) Kamehameha Highway above Waimea Bay, 4) Puu O Mahuka Heiau, 5) Kamehameha Highway near Turtle Beach, 6) Mokuleia Beach Park, 7) Waialua District Park, 8) Matsumoto's Shave Ice Shop, 9) Dole Plantation Visitor's Center in Wahiawa, 10) Pupukea Residence on Holike Road, and 11) Pupukea Private Property on Maulukua Road. Each of the KOP simulations is briefly described below according to distance zone.

Near foreground: No KOP locations within the near foreground were selected because these areas are not readily accessible to the public.

Foreground: The existing topography and vegetation heavily influence the views at the Waimea Valley KOPs. In some locations, the turbines are potentially obstructed by the existing vegetation, but this is not necessarily the case for all potential viewing locations throughout Waimea Valley.

Given the difficulty of identifying a KOP that captures the full extent of the turbines unobstructed by existing vegetation cover, a line-of-sight analysis was conducted from three viewing locations within Waimea Valley to determine the potential line-of-sight for turbines without potential obstructions from vegetation cover. The line-of-sight analysis indicated that portions of four towers and blades (Turbines 10, 11, 13, 14) would be potentially visible.

Near middle ground: Existing vegetation and topographical features potentially obstruct views of the turbines, particularly the mauka views from the coastline, from the entrance to Waimea Valley, Kamehameha Highway above Waimea Bay, Puu O Mahuka Heiau, and Pupukea residence on Holike Street, Pupukea private property on Maulukua Road, and Kamehameha Highway at Turtle Beach, and Kamehameha Highway approaching Haleiwa town. Analysis indicates that visual obstruction by vegetation and topographic features would potentially extend north along the coastline, including Pupukea Beach Park and Waialee Beach Park, with limited views consisting of the blades of only a few turbines.

Far middle ground: The views from Kamehameha Highway at Matsumoto's Shave Ice Shop, Waialua District Park, and Haleiwa Alii Beach Park are potentially obstructed by existing vegetation and structures such as buildings, utility poles, and lines. Where not obstructed, views of the project from this distance can be relatively expansive. For views in which the turbines are seen against a land backdrop, the turbines have the potential, at least under some lighting conditions, to be visually absorbed into the landscape's background.

Near background: While turbines are potentially visible from the Mokuleia Beach Park and Waialua District Park, turbines are potentially obstructed by vegetation, existing structures, and topographical features from the Dole Plantation Visitor's Center. Similar to views from the Far Middleground zone, unobstructed views from these distances can be relatively expansive, but under at least some lighting conditions, the turbines may be visually absorbed into the background.

At the Mt. Kaala communications site, the equipment installation would not be readily visible from any public vantage points, given the distance of the site and the small size of the structures. They would be visible from the Mt. Kaala summit access road and the nearby hiking trails; however, the equipment is visually consistent with the existing communication facilities. As such, visual impacts associated with the additional antennae are expected to be insignificant.

Impacts of Avoidance and Minimization Measures

The marking of guy wires for the temporary met towers and overhead lines to reduce bird collisions may make these structures more visible, but these structures are not adjacent to populated areas and the visual impact of these structures is likely to be insignificant. No other avoidance and minimization activities are expected to have a visual impact.

Impacts of Mitigation Measures

Only the construction of fences and fence corridors for waterbird and possibly bat mitigation have the potential to have visual impacts. Most of the fences and fenceline corridors will be constructed away from populated areas and will likely not be visible to the public. If visible at all, the visual impact would be temporary until regrowth of the understory.

However, a portion of Ukoa Pond, the mitigation site for waterbirds and possibly bats, is along Kamehameha highway, and the fenceline could be visible from the highway. However, an existing fence is already present and the construction of the new fence (while removing the old one) will not add to the existing visual landscape. No other mitigation measures are expected to have a visual impact.

4.8.2 Alternative 2 (Alternative Communications Site Layout)

As in the Proposed Action, installation of two communications towers at the Mt. Kaala site would not be readily visible from any public vantage points, given the distance of the site and the small size of the structures. They would be visible from the Mt. Kaala summit access road and the nearby hiking trails; however, these features are visually consistent with the existing communication facilities. As such, visual impacts associated with this alternative are expected to be insignificant. Visual impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.8.3 Alternative 3 (No Action Alternative)

No impacts to existing visual resources would occur under the No Action Alternative because the wind facility would not be constructed or operated in the project area. Visual impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.9 Noise

4.9.1 Alternative 1 (Proposed Action)

Construction of the Proposed Action would produce short-term construction-related noise. Site grading, vegetative clearing, and construction of the various facility related structures would involve the short-term use of graders, excavators, bulldozers, cranes, cement trucks, haul trucks, and other heavy equipment. Construction noise would be expected to exceed DOH's "maximum permissible" property line noise levels and, as such, Kawailoa Wind Power would 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. The HDOH may also require the incorporation of noise mitigation into the construction plan and/or community meetings to discuss construction noise with the neighboring residents and business owners. As discussed in the minimization and mitigation measures section, BMPs would be implemented to mitigate construction noise, as needed.

During operation, the only project components expected to create sound on a regular basis would 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 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 would result in lower or higher sound levels (van den Berg 2004).

The wind turbines are considered stationary sources and would be subject to the State of Hawaii Community Noise Control standards. The maximum permissible noise levels would be enforced by the HDOH for any location at or beyond the property line and should not be exceeded for more than 10 percent of the time during any 20-minute period. The specified noise limits that apply are a function of the zoning and time of day; with respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible noise level. For enforcement purposes, noise levels are typically measured at the property line or on the property of the complainant; the maximum permissible noise level corresponds with the zoning of the complainant’s property. HDOH also takes the ambient noise environment into account when enforcing the noise limits and typically allows for a 3 dB increase in noise level over the ambient noise when the ambient noise is combined with the noise source of interest.

Based on the zoning surrounding the proposed project site, the following Community Noise Control standards:

A) Class C sound level limits apply to the areas surrounding the project site that are zoned as agriculture. Therefore, sound levels from the wind turbines cannot exceed 70 dBA at the site property lines. Ambient noise levels in these areas are expected to be below 70 dBA and are not expected to change this requirement.

B) The project site is also situated adjacent to areas zoned as preservation. Therefore, Class A sound level limits may apply, where sound levels from the wind turbines cannot exceed 55 dBA during the day or 45 dBA during the night at the property lines. However, ambient sound at these sampling locations along the preservation boundary north of the project site are close to or exceed these limits and may be taken into account by the HDOH in determining the maximum permissible sound level.

To evaluate the potential sound-related impacts associated with the project, a sound propagation model was developed to predict wind turbine sound in the areas throughout the project site and surrounding areas. The model is a 3-D representation of the propagation of wind turbine sound and includes the effect of ground cover and terrain and also considers environmental parameters, such as temperature, humidity, and wind direction. These model results were then compared to the ambient sound levels that were measured in the community surrounding the project site to assess the potential community reaction to project-related sound. The results were also compared to the HDOH maximum permissible noise limits to assess potential noise impacts and regulatory compliance.

Based on the results of the sound propagation model and comparisons to the measured ambient sound levels, the predicted wind turbine sounds are expected to increase the ambient sound level by less than 3 dB at the nearest sensitive receptor, Waimea Valley. The predicted sound levels would be 30 to 35 dBA over approximately 20 percent of the valley, 35 to 40 dBA over approximately 11 percent of the valley, 40 to 45 dBA over approximately 3 percent of the valley, and greater than 45 dBA over less than 1 percent of the valley. During daytime hours, model results indicate that wind turbine sounds would be completely masked by ambient noise sources such as birds and wind. At night, wind turbine sounds would be just barely perceptible at Waimea Valley. Other residential areas surrounding the project site are a sufficient distance away from the site that wind turbine sounds are predicted to be below ambient noise levels, and therefore not perceptible. These results indicate that the wind farm project is unlikely to create a noise impact at nearby sensitive receptors or generate complaints from the surrounding residential communities.

The predicted wind turbine sounds are not expected to exceed the HDOH maximum permissible noise limit in the areas to the west of the project site that are zoned for agriculture. However, sounds from the wind turbines are expected to exceed the HDOH nighttime maximum permissible noise limit where the project borders preservation land (that is, to the north, east, and south). Because these areas are not easily accessible and are not inhabited, it is unlikely that there would be noise complaints from these areas. In addition, ambient noise measured along the preservation land boundaries to the north and south of the site indicate that average ambient noise levels are close to or exceed 45 dBA.

However, to comply with the Community Noise Rule, the need for a variance will be coordinated with HDOH. Given expected noise levels and distance to receptors, no significant impacts are expected.

The proposed communication equipment near Mt. Kaala would be installed on existing Hawaiian Telcom structures; no excavation or ground disturbing activities would be required. Installation would involve trucks and a helicopter to transport the components and necessary tools to the site. Noise generated by these activities would be intermittent and very short in duration (occurring over the course of approximately 15 days). Operation of the communications equipment would not be expected to result in any significant noise impacts.

Minimization and/or Mitigation Measures During Construction:

The State DOH may require Kawailoa Wind Power to incorporate noise mitigation into the construction plan and/or it may require Kawailoa Wind Power 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, Kawailoa Wind Power would 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 would 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.

<u>Impacts of Avoidance and Minimization Measures</u>

The implementation of avoidance and minimization measures as prescribed by the HCP will not have significant noise impacts.

<u>Impacts of Mitigation Measures</u>

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 site 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 is expected during fence construction and vegetation removal (may apply to seabird, waterbird 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 and will likely have insignificant impact on the affected area.

The transportation of antennae to the off-site microwave tower by helicopter will temporarily increase noise levels along the flight path. The flights will be few in number and will occur during normal work hours and is not expected to substantially change the sound levels in the affected areas.

No other mitigation measures are anticipated to have significant noise impacts.

<u>4.9.2 Alternative 2 (Alternative Communications Site Layout)</u>

Under this alternative, a new tower would be constructed in the areas adjacent to the existing Hawaiian Telcom structures, and communications equipment would be mounted on each tower. Construction of the towers would involve the use of heavy equipment and a helicopter to transport the materials to the site and to excavate footings for the tower. Although this equipment would generate moderate levels of noise, the activities are expected to be very short in duration (occurring over the course of approximately 15 days). Operation of the communications equipment would not be expected to generate any significant noise. Noise impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.9.3 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. No noise impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.10 Land Use

4.10.1 Alternative 1 (Proposed Action)

4.10.1.1 Existing Land Use

The project would be located almost entirely on unirrigated, fallow fields that were previously used for cultivation of sugar cane; these areas are not currently used for agricultural purposes. However, the eastern portion of the wind farm site overlaps with an area that is actively used by the military as an aviation training area. To minimize the potential impact of the proposed project on agricultural uses, the project components were sited to avoid areas that are currently being cultivated, which generally include the irrigated fields at the lower elevations of the Kawailoa Plantation. The existing onsite roads that would be used to access the wind farm site traverse these active agricultural fields, but use of the roads (including the proposed road improvements) are not expected to adversely affect these operations.

The permanent footprint of the project would occupy approximately 21.7 acres. These areas would be located almost entirely on prime agricultural lands as classified under the ALISH system, but would only constitute less than 1 percent of the more than 3,600 acres of prime agricultural lands available for cultivation within the general project location. Relative to agricultural productivity classification, the project components would span areas with soil ratings of A, B, C, D, and E.

As previously noted, the turbines and potential meteorological tower locations would be distributed as follows: 15 of the turbines and 2 potential meteorological tower locations would be located in B soils, 8 turbines and 1 potential meteorological tower location would be located in C soils, and 7 turbines and 1 potential meteorological tower location would be located in D soils. Other appurtenant facilities essential to the operation of the wind farm would generally be located in soils classified as Categories B.

Although the areas within the project footprint would no longer be available for agricultural purposes, implementation of the proposed wind farm project would allow Kamehameha Schools to maintain the existing agricultural uses of the Kawailoa property, which is consistent with their North Shore Master Plan and Strategic Agricultural Plan. Lease revenues generated by the project can be used by Kamehameha Schools to improve the irrigation system and other infrastructure that directly benefits local farmers on the *makai* sections of the property.

The unused areas surrounding the wind farm components are currently being fenced for pasture by Kamehameha Schools, and would be actively grazed. As indicated by other wind farm projects in the U. S. and worldwide, wind turbines are highly compatible with grazing activities; the animals routinely graze right up to the base of the towers, which they often use as rubbing posts or for shade (New Zealand Wind Energy Association [NZWEA], 2011; DOE, 2005).

Given that the permanent project footprint would comprise only approximately 21.7 acres and the remainder of the Kawailoa plantation lands would be maintained for agricultural uses, the proposed project is not expected to have more than a minimal adverse impact on agricultural production and, in fact, would allow for productive, sustainable use of the land.

4.10.1.2 Existing Policies and Land Use Plans

The proposed Kawailoa Wind Power 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 Action is compatible with this Act. See Sections 1.2 and 1.3.1.1.

Federal Endangered Species Act

The Proposed Action is compatible with this Act. See Sections 1.2, 1.3.1.2, and 4.11.

Federal Migratory Bird Treaty Act

The Proposed Action is compatible with this Act. See Sections 1.3.1.3 and 4.11.

Federal National Historic Preservation Act

The Proposed Action is compatible with this Act. See Sections 1.3.1.4 and 4.13.

Executive Order 12898 - Environmental Justice

The Proposed Action 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 Action 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;*
>
> *(2) Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;*
>
> *(3) Greater energy security in the face of threats to Hawaii's energy supplies and systems.*
>
> *(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.*

§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.*

The Proposed Action would produce clean, renewable energy, thus contributing to energy self-sufficiency by increasing the ratio of domestic to imported energy use. The Proposed Action would generate up to 70MW energy, contributing to the array of renewable energy projects in Hawaii, and thus increasing energy security for the State. The Proposed Action would also help to reduce greenhouse gas emissions associated with State’s energy supply because of the very low or no emissions associated with wind energy.

Hawaii Revised Statutes, Chapter 195D

Kawailoa Wind Power is currently seeking a State ITL. A HCP will be submitted to the State DLNR in 2011. Acquisition of a State 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 permitting process pursuant to the State's HRS Chapter 201N Energy Facility Siting Process requires compliance with HRS Chapter 343.

An EIS Preparation Notice (EISPN) was released for public comment on September 23, 2010. Following the end of the 30-day public review period for the EISPN, Kawailoa Wind Power will address comments on the EISPN into a DEIS which will discuss the likely direct, indirect, and cumulative impacts of the Proposed Action, as well as mitigation measures. The public comment period for the DEIS will last for 45-days as provided by law. A Final EIS (FEIS) which incorporates and responds to all comments on the DEIS will then be submitted to DBEDT for review and acceptance.

The DEIS was released on February 23, 2010 and the FEIS was released on June 27, 2011 (CH2M Hill 2011b). Feedback and comments on the document were accepted by the Office of Coastal and Conservation Lands (OCCL) after completing the State 343 environmental review process. In addition to the FEIS, Kawailoa Wind Power will also comply with Chapter 343 for any actions conducted under the Habitat Conservation Plan, including this EA, as required by law.

Hawaii Revised Statutes, Chapter 205

The project area is located within an Agricultural District. Per HRS Chapter 205-4.5, wind energy facilities are a permissible use in State Agricultural Districts. The statute states that these facilities are permitted "provided that the wind energy facilities and appurtenances are compatible with agriculture uses and cause minimal adverse impact on agricultural land. "The proposed facility meets these requirements as it would result in disturbance of only a small percentage of the project area and it is compatible with agricultural land uses. Kawailoa Wind Power is in the process of evaluating the possibility of complementary agricultural uses in the project area.

HAR Chapter 13-5-22 lists the types of uses permissible in a Conservation District. This includes: "transportation systems, transmission facilities for public utilities, water systems, energy generation facilities utilizing the renewable resource of the area (e.g., hydroelectric or wind farms) and communications systems and other such land uses which are undertaken by non-governmental entities which benefit the public and are consistent with the purpose of the conservation district." Thus, the offsite communication towers are compatible with the land use designation. However, construction of these facilities may require Kawailoa Wind Power to obtain a CDUP.

Hawaii's Coastal Zone Management Program

Hawaii's Coastal Zone Management (CZM) Program (HRS 205A) is a broad management framework 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 entire State of Hawaii is within the coastal zone boundary. The CZM Program focuses on ten objectives and associated policies. Federal actions occurring in, or affecting, the state's coastal zone must be in agreement with the CZM Program's objectives and policies.

City and County of Honolulu General Plan

The following section lists the objectives and policies outlined in the City and County of Honolulu Plan that are most relevant to the Proposed Action followed by a discussion of the Proposed Action's consistency with these topics.

Natural Environment

> *Objective A – To protect and preserve the natural environment*
>
> > *Policy 1 – Protect Oahu's natural environment, especially the shoreline, valleys, and ridges from incompatible development.*
>
> *Objective B – To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.*
>
> > *Policy 1 – Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, and bays; and reefs and offshore islands.*
> > *Policy 2 – Protect Oahu's scenic views, especially those seen from highly developed and heavily traveled areas.*
> > *Policy 3 – Locate roads, highways, and other public facilities and utilities in areas where they will least obstruct important views of the mountains and the sea*

Environmental due diligence conducted for the Proposed Action included extensive biological surveys of the site to identify existing habitats, native ecosystems, and threatened and endangered species. The project would be designed to minimize and mitigate impacts to ecologically sensitive habitats and species. The associated Habitat Conservation Plan addresses mitigation associated with the incidental take of six federally listed threatened or endangered species. The project is being designed to minimize disturbance to ecologically sensitive habitats and species, and also to minimize encroachment into the City and County of Honolulu's Preservation Districts.

In addition, natural gulches, streams, and drainages were identified and their avoidance would be taken into consideration in the final design of the Kawailoa wind farm project. A views analysis was also conducted to assess the potential impacts of the Proposed Action's effect on the North Shore's scenic resources. Consideration was taken with regard to maximizing the distance of associated wind farm components (i.e., substation, O&M building, and BESS) from Kamehameha Highway and placement of collector lines underground where feasible.

Energy

> *Objective A – To maintain an adequate, dependable, and economical supply of energy for Oahu residents*
>
> > *Policy 1 – Develop and maintain a comprehensive plan to guide and coordinate energy conservation and alternative energy development and utilization programs on Oahu.*
>
> *Objective D – To develop and apply new, locally available energy resources.*
>
> > *Policy 1 – Support and participate in research, development, demonstration, and commercialization programs aimed at producing new, economical, and environmentally sound energy supplies from:*
> >
> > *a. Solar insolation;*
> > *b. Biomass energy conversion;*
> > *c. Wind energy conversion;*
> > *d. Geothermal energy; and*
> > *e. Ocean thermal energy conversion.*

The Proposed Action meets the City and County General Plan's energy objectives and policies by providing new, dependable, and economical supplies of wind energy to Oahu.

<u>Community Plans</u>

Several of the opportunities, objectives, and policies identified in the North Shore Sustainable Communities Plan area are relevant to the Proposed Action. The following objectives and policies in the plan are compatible with the Proposed Action:

3.1.1 Open Space and Natural Environment General Policies

- *Protect significant natural features*

- *Protect ecologically sensitive lands*
- *Protect scenic views*

Environmental due diligence conducted for the Proposed Action included extensive biological surveys of the site to identify existing habitats, native ecosystems, and threatened and endangered species. The project would be designed to minimize and mitigate impacts to ecologically sensitive habitats and species. The associated Habitat Conservation Plan addresses mitigation associated with the incidental take of six federally listed threatened or endangered species. The project would also minimize encroachment into the State Conservation District and North Shore SCP preservation districts and avoid, to the extent possible, natural gulches, streams, and drainages.

A views analysis was also conducted to assess the potential impacts of the Proposed Action's effect on the North Shore's scenic resources. Consideration was taken with regard to maximizing the distance of associated wind farm components (i.e., substation, O&M building, and BESS) from Kamehameha Highway and placement of collector lines underground where feasible.

3.2.1 Agriculture General Policies

- *Protect all important agricultural lands, regardless of current crop production capabilities, from uses that would undermine or otherwise irreversibly compromise their agricultural potential and crop production capabilities.*

Road access improvements on Kamehameha School property formerly used for agriculture would be required for the construction and operation of the Proposed Action. These improvements would once again provide access to agricultural lands formerly used to produce sugarcane but has since become inaccessible. Furthermore, the operation and maintenance of the wind turbines allow the lands on which they are located to be concurrently used for agriculture.

3.4.1 Historic and Cultural Resources General Policies

- *Preserve significant historic features from earlier periods*
- *Respect significant historic resources by applying appropriate management policies and practices. Such practices may range from total preservation to integration with contemporary uses.*
- *Restore or keep intact sites with cultural and/or religious significance out of respect for their inherent cultural and religious values.*

Archaeological and cultural surveys were conducted as part of the Proposed Action's environmental due diligence and design process to identify plantation-era and historic resources. Such features are to be avoided or managed accordingly as part of the final design and construction of the wind farm facility.

The implementation of the North Shore SCP also includes the integration of general policies and principles for public facilities and infrastructure. As such, the following public facilities and infrastructure policy is applicable to the Kawailoa project:

4.4.1 Electrical Power Development General Policies

- *Additions to utility systems and other public facilities should be located in areas where they will least obstruct important views. Locate and design system elements such as renewable electrical power facilities, substations, communication sites, and transmission lines to avoid or mitigate any potential adverse impacts on scenic and natural resources. Locating powerlines underground or away from Kamehameha Highway is desired.*

The location of wind farm components such as turbines, substations, BESS, O&M building, collector lines, onsite access roads, were determined based on the location of suitable wind resources and existing facilities (i.e., former agriculture roads and existing transmission lines). Consideration was also taken with regard to maximizing the distance of these components from Kamehameha Highway and placement of collector lines underground where feasible.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any effect on land use.

Impacts of Mitigation Measures

For mitigation occurring at Ukoa Pond, former ranching that occurred in the area will no longer be allowed if restoration and fencing of the wetland occurs (for waterbird and as an alternative for bat mitigation) may be restored. Ranching will no longer be allowed at the entire 150 acres of wetland and possibly up to 80 acres of forest in the periphery of the pond may also be fenced off and restored.

No mitigation measures are anticipated to have any effect on land use as the areas identified for mitigation are on state conservation land or not part of any plans for any development or agricultural projects during the project permit term.

4.10.2 Alternative 2 (Alternative Communications Site Layout)

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. Land use impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.10.3 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 Kawailoa Wind Power 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. No land use impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.11 Transportation and Traffic

4.11.1 Alternative 1 (Proposed Action)

Roadways

Delivery of the turbine components and other project equipment would require the use of existing State and County roadways by oversized vehicles. The number of oversized equipment delivery trips is estimated to average five trips per day, with a total of 270 trips during the 12-month construction period. The proposed routes (described above) have been evaluated and the existing infrastructure and adjacent utility lines are expected to be of sufficient capacity and dimension to accommodate the oversized loads. Potential impacts associated with oversized equipment transport include traffic delays and delays in emergency services caused by periods where traffic flow must be stopped to allow oversized trailers to navigate turns. To mitigate these impacts, the following measures would be implemented:

- All tower and blade components would have a minimum of four police escorts per load. Police escorts would direct traffic at intersections along each proposed route where necessary to allow oversized trailers to navigate turns.
- Police escorts and/or flagmen would provide traffic direction at the entrance to the wind farm site during construction.
- Hours of transport would be restricted to periods of the day when vehicular traffic is typically light, as follows:
  - Monday through Saturday from 9:00 p.m. to 5:00 a.m.; loaded equipment must be off of the roadways between the hours of 5:00 a.m. and 9:00 p.m.
  - No oversized loads would be transported on Sundays or holidays.

Transport of oversized and/or overweight equipment is being coordinated with both the DOT Highways Division and the City and County of Honolulu Department of Transportation Services (DTS). Permits have been issued by DOT for transport of each of the turbine components; permitting through DTS is underway.

Other project-related traffic would vary over the course of construction. On average, delivery of other equipment for the wind farm (such as materials for the substation and BESS facilities) would require approximately five trips between Honolulu Harbor and the wind farm site per day. Select material (such as cement and aggregate) would also be brought from the plant to the project area for construction of the turbine pads, roadways and other purposes. Approximately 45 cement truck trips and 25 dump trucks of aggregate would be needed per day. During the 12-month construction period, an average of 75 employees would be traveling to the site each day, with an anticipated maximum of 129 employees.

Of these trips, the turbine and cement deliveries would all occur at nighttime (between 9 p.m. and 5 a.m.) and the remainder of the construction materials would generally be delivered during the day (7 a.m. to 6 p.m.), resulting in an average of 50 nighttime trips and 30 daytime trips per day. At the peak of construction, a total of approximately 163 daytime truck and construction worker commute trips (including light delivery vehicles) would be expected to occur each day. It is assumed that approximately 10 percent of these trips would occur during peak hours (6 to 9 a.m. and 3 to 6 p.m.), with the remaining trips occurring during non-peak hours. Based on a 2009 traffic count of 1,329 vehicles on Kamehameha Highway during the highest peak-hour period (3:45 to 4:45 p.m.) (DOT 2009), the anticipated construction traffic would represent an approximately 1.4 percent increase in traffic levels.

An approximately 1.4 percent increase in the highest peak-hour traffic levels, which would be short-term and localized in nature, would not be expected to have a measurable impact on traffic conditions. All truck trips with oversize and/or overweight loads would comply with specified permit conditions, and any road damages that might be incurred would be reported and repaired, such that no significant impacts would occur to State and County roadways. Improvements to the existing onsite roadways may periodically inconvenience others who use those roadways to access farm plots or other permitted uses in the project area. However, the amount of local onsite vehicle movement is negligible and prior coordination with other users of the roadways would be expected to mitigate any impacts to other roadway users.

During operation, the majority of the vehicular traffic associated with the proposed wind farm would be employees reporting to or leaving the facility and service trips by HECO maintenance personnel. Typically, the maximum number of vehicle trips during operation would be eight trips per day. The amount of vehicular traffic associated with the proposed facilities during operation would be minimal and the proposed project would not be anticipated to noticeably increase traffic volumes on Kamehameha Highway or roadways in the area over the long-term. Operation of the wind farm would not impact access for other users who use or transit through Kamehameha School's Kawailoa properties.

Use of the existing single-lane access road at Mt. Kaala would be coordinated with the Kaala JUCC to avoid or minimize disruptions to the use of the access road by the proposed project's construction and operations activities. Impacts to the roadway are not anticipated.

Airports and Airfields

With respect to the impact of the Proposed Action on airspace, Part 77 of the FAA Federal Aviation Regulations (CFR Title 14 Part 77.13) applies to objects that may obstruct navigable airspace. Proposed projects more than 200 feet above ground level must file FAA Form 7460-1, Notice of Proposed Construction or Alteration with the FAA before construction. A Notice of Proposed Construction or Alteration-Off Airport was filed with the FAA in December 2010 for the wind turbines, as well as for the temporary and permanent meteorological towers.

On March 9, 2011, the FAA issued its Determination of No Hazard to Air Navigation for each of the structures as well as an approved marking and lighting plan. The determination for each structure stated that the structure "*would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities*."

The determination for the structures proximate to the TFTA received additional information:

> *This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation.*

Revisions have been filed with the FAA for one wind turbine and one meteorological tower within the project site because of micro-siting considerations. In both cases, the movement of both structures is toward the west, either out of, or closer to the edge of, the TFTA. An additional request will be filed to the FAA for the installation of lighting on all turbines in the TFTA.

Impacts to aviation training within the TFTA as a result of construction and operation of the proposed project are also being addressed through a working group, referred to as the Regional Mission Compatibility Review Team (RMCRT), which is composed of the affected Department of Defense services, First Wind, and the site's landowner, Kamehameha Schools. The RMCRT has been meeting on an ongoing basis to identify potential impacts, alternative solutions and mitigation measures. These meetings have resulted in changes to the initial wind farm layout, including the relocation of wind turbines away from the training areas and the undergrounding of proposed electrical lines to avoid and minimize potential conflicts with flight lines. Project-related impacts have, and will continue to be resolved through the RMCRT, such that project-related impacts to the TFTA would be mitigated to a less than significant level.

<u>Harbors</u>

The major components of the wind farm, such as the blades, towers, and nacelles, would be transported by sea and offloaded at Kalaeloa Harbor. Temporary storage of these components would require the use of vacant areas at Kalaeloa Harbor for a minimal amount of time to conduct inspections of the equipment and to prepare them for transport to the Kawailoa Site. To minimize disruption to harbor operations, all activities related to the shipment, unloading, storage and transport of these components would be coordinated directly with the DOT Harbors Division Oahu District Office and/or engineering maintenance section.

It is anticipated that the smaller turbine components and other equipment required for the project would be offloaded and transported from Honolulu Harbor. In general, the individual pieces of equipment are of a size and nature that allows them to be handled as general containerized cargo; therefore, import of equipment for the project is not expected to place an unusual demand on the harbor facilities.

<u>Minimization Measures During Construction:</u>

The following measures would be implemented to mitigation transportation impacts:

- All tower and blade components would have a minimum of four police escorts per load. Police escorts would direct traffic at intersections along each proposed route where necessary to allow oversized trailers to navigate turns.
- Police escorts and/or flagmen would provide traffic direction at the entrance to the wind farm site during construction.

- Hours of transport would be restricted to periods of the day when vehicular traffic is typically light, as follows: Monday through Saturday from 9:00 p.m. to 5:00 a.m. (and loaded equipment must be off of the roadways between the hours of 5:00 a.m. and 9:00 p.m.) and no oversized loads would be transported on Sundays or holidays.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any effect on transportation and traffic.

Impacts of Mitigation Measures

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.

4.11.2 Alternative 2 (Alternative Communications Site Layout)

Use of the existing single-lane access road at Mt. Kaala would be coordinated with the Kaala JUCC to avoid or minimize disruptions to the use of the access road by the proposed project's construction and operations activities. Impacts to the roadway are not anticipated. Transportation and traffic impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.11.3 Alternative 3 (No Action Alternative)

If the proposed project were not built, there would be no change from existing conditions. No transportation and traffic impacts due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.12 Military Operations

4.12.1 Alternative 1 (Proposed Action)

To address concerns of the wind farm's impacts on military training and to explore alternatives that could resolve those concerns while still allowing for a wind farm development at Kawailoa, the Department of Defense services formed a working group composed of the affected Department of Defense services, First Wind, and the site's landowner, Kamehameha Schools. The working group has met on five occasions (November 10, 2010, December 15, 2010, January 24, 2011, March 4, 2011, and June 2, 2011) to discuss potential impacts, alternative solutions and mitigation measures. These meetings have resulted in changes to the initial wind farm layout, such as the relocation of wind turbines away from the training areas and the undergrounding of proposed electrical lines to avoid and minimize potential conflicts with flight and ground training.

At the January 24 meeting, the group's named was changed to the Regional Mission Compatibility Review Team (RMCRT) to reflect recent Federal legislation (Section 358 of the 2011 National Defense Authorization Act). The Department of Defense is developing an interim policy to enable a central clearinghouse, the Energy Siting Clearinghouse, in the Office of the Secretary of Defense, to evaluate whether proposed renewable energy projects would interfere with mission capabilities across the Department of Defense. Final determination of the project's impacts will be made by the Department of Defense Renewable Energy Clearinghouse in accordance with Section 358. Topics that have been discussed by the local RMCRT as related to the proposed Kawailoa wind farm project are as follows:

- Effect on day and night aviation training
- Effect on day and night ground training
- Copter NDB 152 and use of airspace over the wind farm

- Lighting on the wind turbine towers
- Markings on the towers and blades to alert pilots during the day, night, and during night-vision device training
- Radar interference
- Electromagnetic interference
- Overhead electrical lines

Based on these discussions, potential conflicts and associated mitigation measures that were identified by the RMCRT are as follows (based on the notes from the March 4, 2011 meeting of the RMCRT):

- Alert Area-311:The proposed Kawailoa wind farm would impact Alert Area-311. The proximity of the turbines poses a high safety risk to helicopters operating in the low level training area. The proximity of the turbines would also require the closure of one of only four authorized nap of the earth (NOE) training routes on Oahu. To mitigate for impacts to the Alert Area-311, Kawailoa Wind Power removed the 4 turbines that were closest to the yellow flight line. The 25th CAB would create a new flight route for day, night, and NVD NOE flight training.

- NVD Entry Control Point: The proposed turbines would bound the NVD Entry Control Point C12 on both the east and west sides. To mitigate this impact, the 25th CAB would move or discontinue use of the NVD Control Point.

- Landing Zones: Puu Kapu is a high density LZ used for air assault, sling loading and helicopter landing zone operations. The turbines would be located approximately 5,900 feet from this LZ and would increase risk to flight operations in and around the LZ. To mitigate for impacts to the Puu Kapu LZ, Kamehameha Schools has agreed to identify a new area for training.

- Copter NDB 152:Wind turbines would overlap with the Copter NDB 152 instrument approach to Wheeler Army Airfield, which is used primarily for recovery to the airfield from the TFTA and Kahuku Training Area. The FAA determination indicated that the turbines in the NDB 152 area would not pose a hazard to air navigation. While the FAA did not identify a significant impact, if other stakeholders identify this as a potential concern, the RMCRT can identify an appropriate solution in future meetings.

- Turbine Marking or Lighting: Not all turbines in the TFTA are marked. Unmarked turbines pose a flight hazard for pilots during day, night, and NVD flight operations. To mitigate for these impacts, Kawailoa Wind Power has agreed to put FAA-compliant red strobes on each turbine in the TFTA and to implement NVD-compatible blade marking or lighting.

- Overhead Electrical Lines: Overhead electrical lines pose a flight hazard for pilots during day, night, and NVD flight operations. To mitigate for these impacts, overhead electrical lines have been removed from the TFTA.

- Construction Activities: The crane used to install the turbines could pose a safety risk to helicopters operating in the low-level training area, particularly when left in a fully-extended, upright position. To mitigate this potential impact, Kawailoa Wind Power would notify the affected Department of Defense services of the anticipated plans for crane position and transit across the site.

In general, the RMCRT has determined that the proposed mitigation for each of these potential conflicts would reduce the impact to a less-than-significant level. For several of the topics discussed by the RMCRT, it was determined that impacts would not be likely to occur; these include radar interference, electromagnetic interference and ground training. Radar interference was not identified as a concern by the FAA in their determination and information from the turbine manufacturer indicated that electromagnetic interference generated by the project would not be significant.

The RMCRT has been an important forum to identify and address potential impacts of the Kawailoa Wind Power project on military activities. Going forward, the RMCRT will continue to serve as a communication mechanism between Kawailoa Wind and Department of Defense stakeholders to continue to develop mitigation measures for impacts.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any effect on military operations.

Impacts of Mitigation Measures

The monitoring and implementation of mitigation measures will not significantly affect military operations as the military will not be using the land at or airspace above the proposed mitigation sites.

4.12.2 Alternative 2 (Alternative Communications Site Layout)

Impacts associated with this alternative would be the same as those described for installation of the Mt. Kaala communication facilities under the Proposed Action. Impacts to military operations due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.12.3 Alternative 3 (No Action Alternative)

Under the No Action alternative, the wind farm facility and Mt. Kaala communications facilities would not be constructed, and therefore, no impacts relative to military training would occur. No impacts to military operations due to avoidance and minimization measures or mitigation measures are expected as these measures will not be implemented under Alternative 3.

4.13 Hazardous Substances and Materials

4.13.1 Alternative 1 (Proposed Action)

Other than the potential that chemicals related to former agricultural use of the property are present, no hazardous material or hazardous wastes are known to be present within the proposed wind farm project site. With the exception that chemicals related to former agricultural practices may be encountered, construction of the project is not expected to uncover or result in the release of an existing contaminant into the environment. An evaluation would be conducted before construction to evaluate for the presence of agricultural-related chemicals in site soils. If chemicals of potential concern are detected, mitigation measures would be implemented based on the nature and extent of contamination. Mitigation measures would include BMPs to minimize exposure of workers to contaminants during construction, and measures to store excavated materials using methods that would prevent release of potentially hazardous chemicals to the environment. Mitigation measures may include onsite monitoring and use of exclusion zones during construction, use of proper personal protective equipment by personnel at the site, placing stockpiled soils on bermed liners, covering stockpiled materials with impermeable liners, and proper characterization and disposal of contaminated materials.

Construction, operation, and decommissioning activities associated with the proposed project would require the use of some hazardous materials. Types of hazardous materials to be used would include fuels (for example, gasoline, and diesel fuel), lubricants, cleaning solvents, and paints. Facility construction personnel would follow BMPs to prevent spills or releases of hazardous materials during construction activities.

Construction activities (which include soil disturbing activities such as clearing, grading, excavating, stockpiling, etc.) that disturb one or more acres, or smaller sites that are part of a larger common plan of development or sale, are regulated under the NPDES stormwater program. Operators of regulated construction sites are required to develop stormwater pollution prevention plans; to implement sediment, erosion, and pollution prevention control measures; and to obtain coverage under a state or EPA NPDES permit. Kawailoa Wind Power will obtain a NPDES permit for construction activities. Incorporated in the NPDES permit for the wind farm construction will be effluent limitations guidelines (ELGs) and new source performance standards (NSPS) to control the discharge of pollutants from the construction site.

Operation of the proposed project would require the use of a possible BESS, an emergency back-up generator, electrical transformers, and the potential need for heavy equipment for maintenance and replacement activities. These activities would involve the use of hazardous materials, including oil, diesel fuel, propane, mineral oil, petroleum-based lubricants and/or solvents, and coolants, as well as the contents of the battery system.

SPCC plans are required by EPA's SPCC regulations for regulated facilities to avoid oil spills and minimize impacts of spills on public health and the environment. Regulated facilities are non-transportation-related facilities with an aboveground oil storage capacity greater than 1,320 gallons or underground tanks with an oil storage capacity greater than 42,000 gallons that can be reasonably expected to discharge oil into navigable U. S. waters or shorelines.

Because the wind farm would have aboveground oil storage (mineral oil in electrical transformers), and smaller quantities of other oils and hazardous materials, the wind farm facility will be designed in accordance with good engineering practices including applicable industry standards and applicable Federal Regulations.

In addition, Kawailoa Wind Power would prepare and implement a SPCC Plan for the facility to prevent oil spills from occurring, and to perform safe, efficient and timely response in the event of a spill or leak. The SPCC Plan would identify the following:

- Where hazardous materials and wastes are stored or located onsite
- Volume of each type of hazardous material stored or located onsite
- Spill prevention measures to be implemented, training requirements during routine operations
- Periodic training requirements for facility operations personnel, and records of training completed
- Appropriate spill response actions for each material or waste
- Locations of spill response kits onsite
- A procedure for ensuring that the spill response kits are adequately stocked at all times
- Procedures for making timely notifications to authorities.

The plan would identify and address storage, use, transportation, and disposal of each hazardous material anticipated to be used at the facility. It would establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials, and would include material safety data sheets of hazardous materials. The SPCC plan would also identify key Kawailoa Wind Power management, State and Federal regulatory contacts, and appropriate spill reporting requirements. The plan would provide instructions for notification of local emergency response authorities (Fire and Police) and include emergency response plans. Facility operations personnel would receive periodic training, to include the following:

- An introduction to pollution control laws
- Rules and regulations pertaining to the use and storage of petroleum products

- BMPs during routine operations and maintenance procedures in order to prevent spills
- Periodic inspection of spill control or containment equipment to ensure it is adequately maintained and functional
- Periodic inspection and maintenance of spill response kits
- Spill response and cleanup
- Spill notification and recordkeeping

In addition, in the event of a spill, Kawailoa Wind Power would provide the manpower, equipment and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful to the environment. If waste management is required, Kawailoa Wind Power would hire licensed contractors to characterize, transport, and properly dispose of contaminated materials.

There are no known existing environmental conditions at the two communications facilities sites at Mt. Kaala; however, a UST release was previously reported at the existing Hawaiian Telcom facility. Because the new antennae would be mounted on existing structure, no ground disturbance would occur under the Proposed Action. Therefore, no hazardous materials that could be associated with the UST release are expected to be encountered during construction.

Operation and maintenance of the equipment would require the use of some hazardous materials. Types of hazardous materials to be used would include lubricants, cleaning solvents, and paints. It is anticipated that these types of materials would be transported to the site during maintenance and replacement activities.

If hazardous materials are stored at the site that are of a nature or at volumes that trigger SPCC regulations, Kawailoa Wind Power would prepare and implement a SPCC Plan for the facility.

The SPCC Plan will identify the following:

- Where hazardous materials and wastes are stored or located onsite
- Volume of each type of hazardous material stored or located onsite
- Spill prevention measures to be implemented during routine operations
- Periodic training requirements for facility operations personnel, and records of training completed
- Appropriate spill response actions for each material or waste
- Locations of spill response kits onsite
- A procedure for ensuring that the spill response kits are adequately stocked at all times
- Procedures for making timely notifications to authorities

The plan will identify and address storage, use, transportation, and disposal of each hazardous material anticipated to be used at the facility. It would establish inspection procedures, storage requirements, storage quantity limits, inventory control, nonhazardous product substitutes, and disposition of excess materials, and would include material safety data sheets of hazardous materials. The SPCC plan would also identify key Kawailoa Wind Power management, State and Federal regulatory contacts, and appropriate spill reporting requirements. The plan would provide instructions for notification of local emergency response authorities (Fire and Police) and include emergency response plans.

Facility operations personnel would receive periodic training including:

- An introduction to pollution control laws
- Rules and regulations pertaining to the use and storage of petroleum products
- Best management practices during routine operations and maintenance procedures in order to prevent spills,
- Periodic inspection of spill control or containment equipment to ensure it is adequately maintained and functional

- Periodic inspection and maintenance of spill response kits
- Spill response and cleanup
- Spill notification and record keeping

In addition, in the event of a spill, Kawailoa Wind Power would provide the manpower, equipment and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful to the environment. If waste management is required, Kawailoa Wind Power would hire licensed contractors to characterize, transport, and properly dispose of contaminated materials.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any effect on hazardous materials.

Impacts of Mitigation Measures

Fuel (diesel or gasoline) will be used to operate vehicles to transport staff and equipment to the mitigation sites 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.

4.13.2 Alternative 2 (Alternative Communications Site Layout)

Because there are no known existing environmental conditions at the two communications facilities sites at Mt. Kaala, it is not expected that installation of the new microwave dishes would uncover or result in the release of an existing contaminant into the environment. However, because a UST release was reported at the existing Hawaiian Telcom facility, measures would be taken to identify and mitigate potential issues that could arise during construction if residual contamination is encountered. Mitigation measures could include BMPs to minimize exposure of workers to contaminants during construction, and measures to store excavated materials using methods that would prevent release of potentially hazardous chemicals to the environment. Mitigation measures may include onsite monitoring and use of exclusion zones during construction, use of proper personal protective equipment by personnel at the site, placing stockpiled soils on bermed liners, covering stockpiled materials with impermeable liners, and proper characterization and disposal of contaminated materials.

Impacts associated with operation and maintenance of this alternative would be similar to those described for operation of the Mt. Kaala communication facilities under the Proposed Action.

Impacts of hazardous materials due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.13.3 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. No impacts due to hazardous materials are expected as avoidance and minimization measures or mitigation measures will not be implemented under Alternative 3.

4.14 Socioeconomic Characteristics

4.14.1 Alternative 1 (Proposed Action)

Potential direct socioeconomic effects of the proposed facilities would include (1) construction employment and business activity; (2) lease revenue for use of the project sites; (3) revenues for the State in the form of excise taxes and property taxes; (4) substantial fuel cost savings to HECO, which potentially translate into ratepayer savings; (5) ongoing employment of facility operation and maintenance staff (which would be relatively limited); and (6) ongoing expenditures for materials and outside services. During the construction phase, Kawailoa Wind Power may employ an average of 75 people per day, with an anticipated maximum level of 129 employees. The work would include general construction and more specialized installation of electrical equipment and wind turbine components, potentially providing employment opportunities for those trained in renewable energy industries. Local residents of the North Shore or Oahu may be employed during the general construction of the project. Following construction, the operation of the wind facility would be staffed by four to eight full-time, regular employees working onsite Monday through Friday. These employees would include biologists, road maintenance workers, engineers, and technicians. Local residents of the North Shore or Oahu may be employed during operation of Kawailoa Wind Power; however, because the operations staff would be small, the project is not expected to result in a substantial long- term employment increase for the area. Collectively, these effects would be expected to provide socioeconomic benefits at both the regional and State-wide scale.

Adverse short-term or long-term impacts to the social or economic condition of the area are not expected to occur as a result of the Proposed Action. The Proposed Action would not result in a large number of new residents moving to the North Shore or the island of Oahu. 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 expected to increase because of increase energy availability; therefore, the project would not be considered growth inducing. The Proposed Action is not anticipated to impact housing costs or availability.

4.14.1.1 Environmental Justice

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 15.7% 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 Whites 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).

The Haleiwa and Pupukea CDPs are more predominately White than Asian in comparison to Hawaii as a whole. The percentage of Native Hawaiian and other Pacific Islanders and those listing two or more races in the CDPs was comparable to Hawaii as a whole. Approximately 13% of families and 16% of individuals had incomes below the poverty level, which is somewhat a higher percent than Hawaii as a whole but less than the 20% considered by the U. S. Census Bureau to be considered low income (U. S. Census Bureau 2000). Thus, there are no concentrations of minority or low income populations in the vicinity of the project area.

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

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any effect on the socioeconomic characteristics of the area.

Impacts of Mitigation Measures

The implementation of mitigation measures will likely result in the hiring of local contractors or subcontractors. These may be long-term or short-term employments. Overall, mitigation measures may have a small positive effect on the socioeconomics of Oahu. No effect (positive or negative) is expected for minorities or low-income persons.

4.14.2 Alternative 2 (Alternative Communications Site Layout)

Similar to the installation of the Mt. Kaala communication facilities under the Proposed Action, this alternative would not be expected to result in either short-term or long-term adverse impacts to the social or economic condition of the area surrounding Mt. Kaala. Socioeconomic impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.14.3 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. No socioeconomic impacts are expected due avoidance and minimization measures or mitigation measures as these measures will not be implemented under Alternative 3.

4.15 Natural Hazards

4.15.1 Alternative 1 (Proposed Action)

Neither construction nor operation of the proposed project is expected to affect the incidence rate of a natural hazard, with the exception of an increased potential for wildfires associated with use of vehicles and electrical equipment in the project area. Construction and operation of the project could be adversely affected by a natural hazard, such as a hurricane or earthquake, should one occur; however, the occurrence rate is expected to be very low.

Wind turbines are not generally susceptible to wildfires, and grass and other flammable materials are kept well back from the base of the tower as a matter of regular maintenance. However, consistent with the requirements of the Honolulu Fire Department, an appropriate access road for fire apparatus would provide access to within 150 feet of all onsite facilities and buildings. In addition, the O&M Building and BESS would be supported by an exterior fire hydrant, supplied from water tanks with a total capacity of approximately 60,000 gallons. Interior areas would include accessible fire extinguishers.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any effect on the incidence of natural hazards in the area.

Impacts of Mitigation Measures

The implementation of mitigation measures will not have any effect on the incidence of natural hazards in the area.

4.15.2 Alternative 2 (Alternative Communications Site Layout)

Similar to the discussion of construction and operations of the Mt. Kaala communication facilities under the Proposed Action, implementation of this alternative would not be expected to result in impacts related to natural hazards.

Incidences of natural hazards due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.15.3 Alternative 3 (No Action Alternative)

Under the No Action alternative, the wind farm facility and Mt. Kaala communications facilities would not be constructed, and therefore, there would be no change in the existing condition relative to natural hazards. No effect on the incidences of natural hazards is expected due avoidance and minimization measures or mitigation measures as these measures will not be implemented under Alternative 3.

4.16 Public Safety

4.16.1 Alternative 1 (Proposed Action)

In general, the wind farm facilities are greater than 1 mile away from the nearest residence, and are not publicly accessible. As such, the unlikely event of a tower collapse, blade throw or stray voltage significantly impacting public safety is minimal.

During the construction phase of the project, ignition sources for accidental fires include errant sparks from a variety of vehicles, equipment and tools, and improperly discarded matches and cigarette butts. These are of limited intensity, and under most conditions are unlikely to spark a grass or other fire. Fire-fighting equipment would be maintained in work vehicles and staging areas of the project site and would be available if needed.

During operation of the project petroleum-fueled mobile equipment (such as trucks and cranes), petroleum-based lubricants, and other flammable materials means would be present at the site. If a fire does occur, there is potential for equipment damage, but it is not expected to be significant. The towers supporting the turbines are of 3/4-inch plate steel, mounted on concrete foundations; the interconnecting electrical systems are below ground; and the operations and maintenance facilities would be constructed of noncombustible construction and exterior finishes. Damage from fire could occur to the onsite substation and would potentially disrupt the facility's provision of electricity to HECO, though it would not jeopardize HECO’s ability to provide electricity services to its customers. Basic onsite fire-fighting resources would include fire extinguishers in the maintenance facility, at the substation, and in all project vehicles, as well as shovels and backpack pumps in the maintenance facility and maintenance vehicles.

During construction, firefighting resources would include the provision of fire extinguishers in all construction vehicles and trailers. In addition, during some periods of construction, earthmoving equipment would be present onsite and able to assist in creating fire breaks. Lastly, water that is stored in water tanks during construction can also be used for firefighting.

The results of a shadow flicker analysis for the project indicated that areas of potential shadow flicker effect extend 4,577feet from each turbine. Because the project is located in an agricultural area, no residences are located within the areas within which detectable shadow flicker would be created. The closest residences lie in the corridor along the Kamehameha Highway south of Waimea Bay. These and the other residential areas in this part of the island are more than 4,577 feet from the nearest turbine locations, and outside of the areas within which detectable levels of shadow flicker effect would occur. Shadow flicker could potentially occur along the edges of Waimea Valley: approximately 5 percent of Waimea Valley Park could experience 0 to 10 hours of shadow flicker on an annual basis, approximately 4 percent of the park could experience 10 to 30 hours on an annual basis, and approximately 2 percent of the park could experience 30 to 100 hours on an annual basis. The potential for shadow flicker within these areas may be further diminished by the vegetation canopy within the valley. In general, these results indicate that the potential for shadow flicker would be almost entirely contained within the wind farm site, and the amount of potential flicker extending onto adjacent areas would be relatively short in duration.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any negative effects on public safety in the area. The speed limit of 15 mph on site will likely reduce the risk of vehicular accidents.

Impacts of Mitigation Measures

The implementation of mitigation measures will not have any negative effects on public safety in the area. In fact, mitigation measures such as fencing, eradication/control of ungulates and introduced mammals are likely to improve the safety of the mitigation site when accessed by people.

4.16.2 Alternative 2 (Alternative Communications Site Layout)

Similar to the discussion of construction and operations of the Mt. Kaala communication facilities under the Proposed Action, implementation of this alternative would not be expected to affect public safety. Public safety impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at Alternative 1.

4.16.3 Alternative 3 (No Action Alternative)

Under the No Action alternative, the wind farm facility and Mt. Kaala communications facilities would not be constructed, and therefore, there would be no change in the existing levels of public safety. No effects on public safety are expected due avoidance and minimization measures or mitigation measures as these measures will not be implemented under Alternative 3.

4.17 Public Infrastructure and Services

4.17.1 Alternative 1 (Proposed Action)

Activities associated with wind energy generation may generate small amounts of solid waste, wastewater and hazardous waste, which would be transported by truck to the appropriate local disposal facility for reclamation or landfill, as described below. The potential for electromagnetic interference as a result of the project is also addressed below. Public services including fire and police, health care, education, and recreation would not be significantly affected, and will not be discussed further.

Energy

With the 70 MW of power potentially generated by the proposed facility, HECO would be able to eliminate the use of approximately 304,200 barrels of oil annually that would otherwise be used to produce conventional power. Reducing the proportion of its energy that comes from fossil fuel would decrease the amount of money that HECO spends on imported fuel and buffer the system from the energy cost fluctuations that accompany volatile oil prices.

The proposed project would contribute to the goals outlined in the Hawaii's RPS and the HCEI by increasing the percentage of the state's energy that is derived from clean, renewable sources. The exact percentage is unknown; however, Kawailoa Wind Power is expected to generate enough clean energy to power up to approximately 14,500 of the 337,152 homes on Oahu (DBEDT 2008b). It also would support recently passed state statutes designed to promote energy efficiency and renewable energy sources.

The proposed project would consume only small amounts of electrical power, which would be either generated by the facility or back-fed through utility's sub-transmission lines.

Solid Waste

Construction and operation of the proposed project is not anticipated to generate a significant amount of solid 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 2009). During construction, all waste would be transported to and stored within the temporary use area and periodically carried out and properly disposed of in a permitted landfill. During operation, waste would be collected by a private solid waste management company once a week and disposed of in an approved landfill. Some solid waste may be recycled. These materials would be stored and hauled separately to the appropriate recycling company. An onsite septic tank system would be constructed in the project area to handle sewage.

The vast majority of waste created during construction and operation of wind energy facilities is nonhazardous solid waste, such as shipping crates, boxes, and packing material. No hazardous solid waste is expected to be generated as a result of construction or operation of the proposed project. Because only a small amount of solid waste is expected to be generated during construction and operation, and appropriate management practices would be implemented, impacts to solid waste disposal or processing are expected to be minor.

Water and Wastewater

Wastewater generated by employees of the proposed facility can easily be accommodated in existing treatment and disposal facilities. Therefore, no significant impact to wastewater treatment facilities is expected from the proposed project.

Telecommunication Services

Voltage and elevation are the primary factors in the amount of corona produced by a transmission line. The electric field gradient that causes corona is the rate at which the strength of the electric field changes with distance and is directly related to the line voltage. Corona typically becomes a design concern for transmission lines at voltages of 345 kV and above. Corona increases at higher elevations where the density of the atmosphere is less than at sea level. Given the low voltage (46 kV) and the elevation near sea level, the power lines for the proposed project would produce very low levels of corona.

Corona-generated radio interference could potentially affect the amplitude modulation (AM) radio broadcast band (535 to 1,605 kilohertz); frequency modulation (FM) radio is rarely affected. Even at higher voltages and elevations, only AM receivers located very near to transmission lines that are tuned to a weak station have the potential to be affected. Moderate corona-generated television interference may occur during wet weather; however, interference should not occur for televisions located more than 200 feet from the lines, or for televisions receiving signals from a satellite dish. Given that the distance of the transmission lines from the adjacent community is more than 200 feet, the project is not expected to significantly affect telecommunication services.

Mt. Kaala Communication Facility Sites

The communication facilities proposed for installation on Mt. Kaala are similar in type and function to the existing on-site facilities, and would not require any public services or affect any public infrastructure.

Impacts of Avoidance and Minimization Measures

The avoidance and minimization measures prescribed in the HCP will not have any negative effects public service and infrastructure in the area.

Impacts of Mitigation Measures

The implementation of mitigation measures will not have any negative effects on public service and infrastructure in the area.

4.14.2 Alternative 2 (Alternative Communications Site Layout)

Overall, impacts to public infrastructure and services as a result of Alternative 2 would be expected to be the same as those described for the Proposed Action (Alternative 1). Public service and infrastructure impacts due to avoidance and minimization measures or mitigation measures are expected to be the same at 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 public infrastructure and 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 Oahu, with the exception of the Kahuku Wind Power facility. No effects on public service and infrastructure are expected due avoidance and minimization measures or mitigation measures as these measures will not be implemented under Alternative 3.

4.18 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 the Kawailoa area and the Island of Oahu. "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.

The Kawailoa project area encompasses a predominantly rural area. It is situated on agricultural 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 Oahu. 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 Kawailoa region only.

Past and future development in the Kawailoa project area is generally limited to diversified agriculture. Agricultural activities may result in on-going impacts to soils, vegetation, and wildlife, including the Covered Species. Other projects planned in Kawailoa region include a Kamehameha Schools outdoor education program. The only other wind project is the Kahuku wind farm, located approximately seven miles northeast of the Kawailoa wind farm site. A second wind farm project, Na Pua Makani has also been identified in the vicinity of the Kahuku wind farm site. Table 4-2 lists all existing and potential wind farms in Hawaii.

Table 4-2. Existing and Potential Wind Energy Facilities throughout the State.

Facility Name	Operator	Energy Generated	Island
Lalamilo Wind Farm replacement (P)	Hawaii Electric Light Company	N/A	Hawaii
Pakini Nui	Tawhiri Power, LLC	20.5 MW	Hawaii
Upolu Point	Hawi Renewable Development	10.5 MW	Hawaii
Auwahi Wind Project (P)	Auwahi Wind Energy LLC	21 MW	Maui
Kaheawa Wind Power (KWP)	First Wind	30 MW	Maui
Kaheawa Wind Power (KWP) II (P)	First Wind	22 MW	Maui
Kahuku Wind Power	First Wind	30 MW	Oahu
Kawailoa Wind Power(P)	First Wind	70 MW	Oahu
Na Pua Makani (P)	Oahu Wind Partners LLC	25 MW	Oahu
Unknown (P)	Castle & Cooke	300 MW	Lanai
Kauai Wind Power (P)	UPC Kauai Wind Power	10.5 – 15 MW	Kauai
(P) = Potential wind facility DBEDT (2011)			

4.18.1 Alternative 1 (Proposed Action)

To assess cumulative impacts, other projects in the vicinity of the project area that occurred in the recent past, present and reasonably foreseeable future and involved impacts to resources for which the Proposed Action could contribute incrementally were considered. To date, the only relevant action that has been identified is the Kahuku wind farm project, located approximately 7 miles northeast of the Kawailoa wind farm site. A second wind farm project, Na Pua Makani has also been identified in the vicinity of the Kahuku wind farm site; however, the project is not believed to be proceeding at this time. As part of their master planning effort, Kamehameha Schools identified several potential projects to be implemented on their property, including diversified agriculture and outdoor education programs; these projects are all believed to be in the early stages of development.

Analyses of potential cumulative impacts associated with the Kahuku wind farm project focused on the resource areas most relevant to potential cumulative impacts: climate change, military operations, and wildlife. Because Kahuku is located more than 7 miles away from the Kawailoa wind farm site, and is separated by steep topography, cumulative impacts to sound and visual resources are not anticipated.

4.18.1.1 Climate

The release of anthropogenic greenhouse gases and their potential contribution to global warming are inherently cumulative phenomena. Greenhouse gas emissions resulting from the Proposed Action would be relatively small compared to the 54 billion tons of CO_2-equivalent anthropogenic greenhouse gases emitted globally in 2004 (IPCC 2007a, b). However, emissions from the Proposed Action in combination with past and future emissions from other sources would contribute incrementally to climate change impacts. At present there is no methodology that allows quantification of the specific impacts (if any) this increment of climate change would produce in the vicinity of the facility or elsewhere.

Greenhouse gas emissions caused by construction and operation of the proposed project and the Kahuku wind farm project would be more than offset by the reduction of emissions resulting from the decrease in the amount of fossil fuels currently burned on Oahu to generate electricity. The energy potentially generated by the Proposed Action would eliminate the use of approximately 304,200 barrels of oil, which in turn would reduce emissions of CO_2 by more than 134,400 tons. The 30 MW of power generated by the Kahuku Wind Power facility is expected to eliminate the use of approximately 154,550 barrels of oil annually, and thereby reduce emission of approximately 79,800 million pounds of CO_2. These amounts far exceed those which would be produced by construction and operation of the wind facilities. Given this, the projects are expected to result in beneficial cumulative effects on local and statewide levels of greenhouse gas emissions.

4.18.1.2 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 (though considerably less emissions than carbon-based forms of energy generation). 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.

4.18.1.3 Geology, Topography and Soils

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.

4.18.1.4 Hydrology and Water Resources

The Proposed Action would 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 to ensure no significant impacts to the water quality of receiving waters as a result of the proposed 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 wind energy 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 Kawailoa, 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.

4.18.1.5 Biological Resources

Take for the Covered Species has been authorized for projects occurring on Oahu, Maui and Kauai through HCPs and Safe Harbor Agreements (SHAs) (Table 4-3). Under the Federal Endangered Species Act (16 U.S.C. 1531-1544) HCPs are required to minimize and mitigate the effects of the incidental take to the maximum extent practicable. In addition to the above requirements, the State of Hawaii requires that all HCPs and their actions authorized under the plan should be designed to result in an overall net benefit to the threatened and endangered species in Hawaii being authorized for incidental take (Section 195D-30). Under a SHA, property owners voluntarily undertake management activities on their property to enhance, restore, or maintain habitat benefiting species listed under the ESA. These agreements assure property owners they will not be subjected to increased property use restrictions if their efforts attract listed species to their property or increase the numbers or distribution of listed species already on their property. The USFWS issues the applicant an "enhancement of survival" permit, which authorizes any necessary future incidental take through Section 10 (a)(1)(A) of the ESA. Accordingly, all impacts associated with these take authorizations have been mitigated.

In addition to the take that has already been authorized (Table 4-3), the proposed Na Pua Makani wind facility project on Oahu, the Kaheawa Wind Power II and Auwahi Wind Project on Maui and Kauai Wind Power project on Kauai (Table 4-2) also have the potential to result in incidental take of, and contribute to cumulative impact to, the Covered Species. However, it is expected that if the HCPs for any or all of the potential projects are approved, the impacts and mitigation measures will resemble those discussed for Kawailoa Wind Power, where the proposed mitigation measures are expected to offset the anticipated take and provide a net benefit to the species.

Table 4-3. Current and Pending Take Authorizations for Covered Species on Oahu, Maui, and Kauai through HCPs and SHA.

Applicant	Permit Duration	Location	Species and Total Take Authorization
Kahuku Wind Power	05/27/2010-05/27/2030	Kahuku, Oahu	Newell's shearwater (12 adults, 6 chicks) Hawaiian duck (12 adults, 12 ducklings) Hawaiian stilt (12 adults, 6 chicks) Hawaiian coot (12 adults, 6 chicks) Hawaiian moorhen (12 adults, 8 chicks) Hawaiian short-eared owl (12 adults, 12 owlets) Hawaiian hoary bat (18 adults, 14 juveniles)
Kaheawa Wind Power	01/30/2006-01/30/2026	Maalaea, Maui	Newell's shearwater (40 individuals) Hawaiian hoary bat (20 individuals)
Kaheawa Wind Power II	Pending	Maalaea, Maui	Newell's shearwater (5 adults,3 chicks)[11] Hawaiian hoary bat (9 adults,6 juveniles)[12]
Auwahi Wind Energy	Pending	Ulupalakua Ranch, Maui	Hawaiian hoary bat (19 adults, 8 juveniles)[13]
Kauai Island Utility Cooperative (KIUC)	2011-2015	Kauai	Newell's shearwater (625 individual mortalities, 275 non-lethal injuries)
Chevron SHA	09/23/2005-9/23/2011	Kapolei, Oahu	Hawaiian stilt Hawaiian coot

At a broader scale, Kawailoa Wind Power represents one of many projects that can be expected to occur on the Island of Oahu, Maui and Kauai. Oahu, Maui and Kauai have experienced increasing human population growth and real estate development, and will likely continue increasing in the future. Some of the causes of decline of the Covered Species (such as mammal predation, light disorientation, pesticide use, and loss of nesting or roosting habitats) may be on the increase due to this growth. Through mitigation, projects like Kawailoa Wind Power are among the few that are implementing measures to offset take and provide a net benefit to the affected species. In general, it is assumed that future development projects will be conducted in compliance with all applicable local, State, and Federal environmental regulations.

6.4.1 Seabirds (Newell's Shearwater)

Currently, take for Newell's shearwater has been authorized on Oahu, Maui and Kauai (Table 4-3). Mitigation for Kahuku Wind Power on Oahu consists of colony-based management on Maui or Kauai. The colony based management is expected to consist of erecting a cat and mongoose-proof fence around an identified colony, eradicating the cats and mongoose within and trapping for rats to protect the nesting seabirds within. Social attraction and artificial burrows could also be used to enhance the colony numbers by attracting seabirds to a managed site, safe from predation. The predator exclusion and trapping is expected to increase adult and juvenile survival and also increase the overall productivity of the colony within the protected area and offset the requested take and provide a net benefit to the species by contributing knowledge to new management techniques for the species such as social attraction.

Mitigation for take of Newell's shearwater at Kaheawa Wind Power and the pending Kaheawa Wind Power II project also consists of colony-based management using social attraction and artificial

[11]pending project approval
[12] pending project approval
[13] pending project approval

burrows to attract seabirds to an already protected site on Maui. The protection of the Newell's shearwaters is expected to increase productivity and survival within the protected colony which will offset the requested take for the two projects. Net benefit is expected as this will be the first viable Newell's colony on Maui that will be managed and the colony is expected to show net growth (versus a declining population at most unmanaged colonies) with the protection provided.

Mitigation by KIUC for their Short-term Seabird HCP is comprehensive. It consists of implementing the Save our Shearwaters (SOS) Program which rehabilitates downed seabirds, colony-based management and research and additional take monitoring. The SOS Program rescues and rehabilitates downed seabirds that would otherwise have died, primarily as a result of powerline collisions and light attraction. It provides a conservation benefit to these seabirds, which supplements KIUC's main mitigation effort of implementing colony-based management. Seabird colony management will occur at Limahuli Valley and Hono o Na Pali Natural Area Reserve. The measures that will be implemented at Limahuli Valley include ungulate-proof fencing, ungulate removal, feral cat removal, rodent control, alien plant control, and monitoring the breeding success of the seabirds. Measures to be implemented at Hono o Na Pali Natural Area Reserve include cat-trapping, rodent control, barn owl removal and monitoring of breeding success of the seabirds. Research initiatives include a two-year auditory survey to locate additional breeding colonies and updating at-sea seabird population estimates. Funds will also be provided to implement an appropriate monitoring program. These measures are expected to benefit the seabirds by increasing productivity and survival at the protected colonies and are expected to offset the requested take for KIUC. The research will also enhance the knowledge of the population size of the seabirds and their collision rates with overhead utility lines. The research is expected to better inform the threats that the seabirds face both at sea and on land.

Take authorization for this species may also be requested by Na Pua Makani on Oahu and Kauai Wind Power on Kauai (Table 4-2).

The proposed mitigation measures described for Newell's shearwater from the various HCPs are expected to produce a measurable net benefit in the form of off-setting the requested take and result in an increase in the species' population by increasing productivity and survival rates of birds through predator control and other management measures such as fencing and ungulate control and supplementary programs such as SOS. The research and development of new management techniques proposed by the different projects (such as the development of a self-resetting cat trap by Kawailoa Wind Power) will also improve effectiveness of the management of the seabird colonies. The research and development will also have far reaching effects beyond the mitigation measures implemented by any of the project applicants. All the improved management measures will be available to be utilized by most parties involved in the management of Newell's shearwater colonies once developed. This is expected to result in better protection and greater reproductive success and adult survival for many colonies, including those that are currently unmanaged. For these reasons, no significant adverse impacts to the species' overall population, and no significant cumulative impacts to the species, are anticipated.

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

Currently, only the Kahuku Wind Power facility has been authorized to take the Hawaiian duck, Hawaiian stilt, Hawaiian coot, or Hawaiian moorhen on Oahu. Take authorizations for this project are shown in Table 4-3. No observed take of waterbirds has been recorded at Kahuku since the project began operating in May 2010. Take authorization for these Federally listed waterbirds is assumed for Na Pua Makani on Oahu and Kauai Wind Power on Kauai (Table 4-2).

The most important causes of decline of Hawaiian waterbirds are the loss of wetland habitat and predation by introduced animals. Other factors that have contributed to population declines include altered hydrology, alteration of habitat by invasive nonnative plants, disease, and possibly environmental contaminants (USFWS 2005a). Development of the Kawailoa Wind Power project will not increase losses due to these other causes. However, some of these causes (loss of wetlands and pesticide use) may be on the increase due to continued real estate development on Oahu, and will likely continue increasing in the future. Thus, the possibility of cumulative impacts in addition to the anticipated take at Kawailoa Wind Power exists.

Kahuku Wind Power is conducting wetland management consisting of predator control and vegetation management for waterbird mitigation. These measures are expected to increase waterbird productivity and survival at the managed site and are expected to offset the requested take for Kahuku Wind Power. The mitigation measures are also expected to result in the production of waterbird fledglings in excess of the take requested by Kahuku Wind Power, thereby providing a net conservation benefit (SWCA 2010d). The proposed mitigation measures are expected to produce a measurable net benefit in the form of a marginal increase in the species' population by increasing productivity and survival rates of birds through predator control and other management measures such as fencing and ungulate control. Similar mitigation measures are being implemented by Kawailoa Wind Power and assumed for Na Pua Makani and Kauai Wind Power on Kauai (if constructed). For these reasons, no significant adverse impacts to the species' overall population, and no significant cumulative impacts to the Federally listed waterbirds, are anticipated.

6.4.3 Hawaiian Short-eared Owl

Currently, the only authorized take of Hawaiian short-eared owls is at Kahuku Wind Power. Over the 20-year project life, Kahuku Wind Power is authorized to take eight owls and four owlets (Table 4-3). No observed take of Hawaiian short-eared owls has been recorded at Kahuku since construction of the project began in May 2010. Take authorizations for this species is also assumed for Na Pua Makani on Oahu (Table 4-2).

Loss and degradation of habitat, predation by introduced mammals, and disease threaten Hawaiian short-eared owls. Hawaiian short-eared owls appear particularly sensitive to habitat loss and fragmentation, as they require relatively large tracts of grassland and are ground nesters. Ground nesters are more susceptible to the increased predation pressure that is typical within fragmented habitats and near rural developments (Wiggins et al. 2006). These nesting habits make them vulnerable to predation by rats, cats, and the small Indian mongoose (Mostello 1996; Mitchell et al. 2005). Trauma (apparently from vehicular collisions), emaciation and infectious disease (pasteurellosis) (Thierry and Hale 1996) also causes death of Hawaiian short-eared owls throughout the state. Thus, the possibility of cumulative impacts from these threats, in addition to the anticipated take at Kawailoa Wind Power, exists.

However, Kawailoa Wind Power has proposed mitigation measures for the species that will contribute to the rehabilitation of injured owls and/or a greater understanding of the species' occurrence and status as well as management measures to aid in the recovery of the species. These measures should result in an overall net conservation benefit for the species by rehabilitating owls that would otherwise have died or by increasing adult survival or productivity due to the management measures. Similar mitigation measures are being implemented for Kahuku Wind Power and are assumed for Na Pua Makani. For these reasons, no significant adverse impacts to the species' overall population are expected, and no significant cumulative impacts to the species, are anticipated.

6.4.4 Hawaiian Hoary Bat

Currently, only the Kahuku Wind Power facility has been authorized to take Hawaiian hoary bats on Oahu (Table 4-3). Take authorization for this species is assumed for Na Pua Makani on Oahu. Kaheawa Wind Power is authorized for Hawaiian hoary bat take on Maui. Take authorizations for Kaheawa Wind Power II and Auwahi Wind Power on Maui are assumed (Table 4-2).

Because the population of this species is not known, it is difficult to gauge whether the take of Hawaiian hoary bat will result in a significant impact on the overall population. Research was the main component of Kaheawa Wind Power mitigation due to the need to help determine some basic life history parameters and identify effective management measures. Kahuku Wind Power, Kaheawa Wind Power II, and Auwahi Wind Energy will mitigate for bats by restoring forest habitat to increase the amount of foraging, breeding and roosting habitat. The acreage to be restored is based on the estimated core territory area size of a bat, which is considered the minimum habitat requirement for a bat. All projects are restoring acreages commensurate with their impacts on Hawaiian hoary bat. The forest restoration will consist of ungulate fencing, removal of ungulates, removing or managing invasive species and conducting native forest restoration activities. These restorations are expected to compensate for the requested take of the Hawaiian hoary bat by the three projects. The Auwahi Wind

Energy forest restoration is also expected to create a travel corridor between two forest reserves (Kula Forest Reserve and Kanaio Forest Reserve) and the Auwahi Forest Restoration Project, which will reduce habitat fragmentation and genetic concerns and provide a net benefit to the species (Tetra Tech EC LLC 2011). Kawailoa Wind Power's proposed mitigation for the anticipated take of Hawaiian hoary bat will also contribute to restoration of native bat habitat (either wetland or forest) with a research component and are anticipated to have similar benefits. Similar mitigation measures are assumed Na Pua Makani on Oahu, and Kauai Wind Power on Kauai. Therefore, there are no anticipated cumulative impacts to the Hawaiian hoary bat.

4.18.1.6 Historical, Archaeological, and Cultural Resources

The Proposed Action would avoid impacts to archaeological, historic, or cultural resources during construction or operation. Thus, cumulative impacts to these resources are not anticipated.

4.18.1.7 Visual Resource

Construction of the Proposed Action would add to the amount of structural development within the visual landscape of the North Shore and specifically in the Kawailoa area, adding additional wind energy visual features into the viewshed. The Kahuku wind farm is located nearby and the Na Pua Makani wind farm, also nearby, is under consideration.

4.18.1.8 Noise

Cumulative noise impacts from the Proposed Action and other sources are not expected due to the distance between the project and potential receptors. The nearest potential receptors are residents of Waimea Valley; however, predicted sound levels during the day are lower than the Community Noise Control Rule limits and would be completely masked by ambient noise sources such as birds and wind. At night, wind turbine sounds would be just barely perceptible at Waimea Valley. 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.

4.18.1.9 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

4.18.1.10 Transportation and Traffic

Transportation and 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.

4.18.1.11 Military Operations

The Kawailoa Training Area and Kahuku Training Area comprise the TFTA, an FAA-designated alert area of high-density air traffic from the ground surface to 500 feet above ground level, known as the A-311 alert area. These areas are used by several branches, or services, of the Department of Defense including the U. S. Army, Marine Corps, Navy, and Air Force. The eastern portion of the proposed Kawailoa wind farm site overlaps with the TFTA. First Wind's already constructed Kahuku wind farm site is located near the Kahuku Training Area, and is proximate to flight lines within the TFTA.

Several potential conflicts have been identified relative to the Kawailoa wind farm project and activities in the TFTA. A local RMCRT, comprised of the affected Department of Defense services, First Wind and Kamehameha Schools, has been formed to help identify actions to avoid, minimize, or mitigate the potential conflicts.

The subject of cumulative impacts of the Kawailoa and Kahuku wind farms on military training was generally discussed by the RMCRT, but the mitigation that has been identified addresses the impacts of each wind farm site individually. The overall concern relative to cumulative impacts is that the total aviation training areas not decrease in size as a result of the existing, proposed or future wind farms. Mitigation for Kawailoa includes identification of a new training area, implementation of NVD-compatible marking or lighting for turbine blades, and installation of strobe lighting. For the Kahuku wind farm project, mitigation includes installation of an additional strobe light on one of the turbines to improve visibility for military aviators.

Cumulative impacts were also considered as part of the FAA review process and were addressed in their Determination of No Hazard to Air Navigation, issued on March 9, 2011. Specifically, the determination for the structures that are proximate to the TFTA stated:

> *"This aeronautical study considered and analyzed the impact on existing and proposed arrival, departure, and en route procedures for aircraft operating under both visual flight rules and instrument flight rules; the impact on all existing and planned public-use airports, military airports and aeronautical facilities; and the cumulative impact resulting from the studied structure when combined with the impact of other existing or proposed structures. The study disclosed that the described structure would have no substantial adverse effect on air navigation."*

4.18.1.12 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.

4.18.1.13 Socioeconomic Characteristics

The Proposed Action would not result in new residents moving to the region or Oahu. 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.

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.

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.

4.18.1.14 Natural Hazards

The wind farm is not expected to contribute to any natural hazards; thus, there are no anticipated cumulative impacts.

4.18.1.15 Public Safety

Public safety issues associated with the Proposed Action are expected to be minimal given the project location; thus, there are no anticipated cumulative impacts.

4.18.1.16 Public Infrastructure and 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. Other recent renewable energy projects that are planned or have been constructed in Hawaii are listed in Table 4-2. These wind farms also contribute to the State's renewable energy portfolio. Thus, the Proposed Action would provide beneficial cumulative impacts to public infrastructure and services on the islands by increasing the share of wind energy in the State's renewable energy portfolio.

4.18.2 Alternative 2 (Alternative Communications Site Layout)

Cumulative impacts are expected to be the same as Alternative 1.

4.18.3 Alternative 3 (No Action Alternative)

The No Action Alternative would not cause any change to the existing environment (because a wind energy 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, Kawailoa Wind Power 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)
- HawaiiState 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
- Hawaiian Electric Company, Inc. (HECO)
- Honolulu Advertiser
- Honolulu Star-Bulletin

CHAPTER 7: LITERATURE CITED

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APPENDIX A: Cultural Impact Assessment

Cultural Impact Assessment for the Proposed Kawailoa Wind Farm Project, Multiple Ahupua‘a, Waialua District, O‘ahu Island

TMK: [1] 6-1-005:001, 003, 007, 014, 015, 016, 019, 020, 021, 022; 6-1-006:001, 6-1-007:001, 6-1-008:025, 6-2-002:001, 002, 025; 6-2-009:001; 6-2-011:001; & 6-7-003:024

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Prefatory Remarks on Language and Style

A Note about Hawaiian and other non-English Words:

Cultural Surveys Hawaiʻi (CSH) recognizes that the Hawaiian language is an official language of the State of Hawaiʻi, it is important to daily life, and using it is essential to conveying a sense of place and identity. In consideration of a broad range of readers, CSH follows the conventional use of italics to identify and highlight all non-English (i.e., Hawaiian and foreign language) words in this report unless citing from a previous document that does not italicize them. CSH parenthetically translates or defines in the text the non-English words at first mention, and the commonly-used non-English words and their translations are also listed in the *Glossary* (Appendix A) for reference. However, translations of Hawaiian and other non-English words for plants and animals mentioned by community participants are referenced separately (see explanation below).

A Note about Plant and Animal Names:

When community participants mention specific plants and animals by Hawaiian, other non-English or common names, CSH provides their possible scientific names (Genus and species) in the *Common and Scientific Names of Plants and Animals Mentioned by Community Participants* (Appendix B). CSH derives these possible names from authoritative sources, but since the community participants only name the organisms and do not taxonomically identify them, CSH cannot positively ascertain their scientific identifications. CSH does not attempt in this report to verify the possible scientific names of plants and animals in previously published documents; however, citations of previously published works that include both common and scientific names of plants and animals appear as in the original texts.

Abbreviations

AIS	Archaeoalogical Inventory Survey
AMS	Army Mapping Service
Board of Commissioners to Quiet Land Titles	Land Commission
CIA	Cultural Impact Assessment
CSH	Cultural Surveys Hawai‘i
DNLR	Department of Land and Natural Resources
EIS	Environmental Impact Statement
HAR	Hawai‘i Administrative Rules
HCP	Habitat Conservation Plan
HECO	Hawaiian Electric Company
HRS	Hawai‘i Revised Statutes
Kawailoa Wind	Kawailoa Wind, LLC
First Wind	First Wind, LLC
KS	Kamehameha Schools
LCA	Land Commission Award
OEQC	Office of Environmental Quality Control
OHA	Office of Hawaiian Affairs
OIBC	O‘ahu Island Burial Council
OR&L	Oahu Railway and Land Company
SHPD	State Historic Preservation Division
SIHP	State Inventory of Historic Properties
TCP	Traditional Cultural Property
TMK	Tax Map Key
turbines	wind turbine generators
USDA	United States Department of Agriculture
USGS	United States Geological Survey

Management Summary

Reference	Cultural Impact Assessment for the Proposed Kawailoa Wind Farm Project, Multiple Ahupuaʻa, Waialua District, Oʻahu Island (TMK: [1] 6-1-005:001, 003, 007, 014, 015, 016, 019, 020, 021, 022; 6-1-006:001, 6-1-007:001, 6-1-008:025, 6-2-002:001, 002, 025; 6-2-009:001; 6-2-011:001; & 6-7-003:024) (Genz and Hammatt 2011)
Date	June 2011
Project Number	Cultural Surveys Hawaiʻi (CSH) Job Code: KAWAILOA 8
Agencies	State of Hawaiʻi Department of Health/Office of Environmental Quality Control (DOH/OEQC)
Project Location	The proposed Project involves a wind farm site in the *mauka* (inland) regions of Kawailoa Ahupuaʻa that are traversed by existing onsite access roads, as well as a communication site near the summit of Mount Kaʻala in Kamananui Ahupuaʻa.
Land Jurisdiction	The permanent Project footprint of the wind power facilities Project is located on Kamehameha Schools (KS) property (private). Lands owned by other entities are included as existing onsite access roads traverse these properties. KS currently has reciprocal agreements with these landowners for access through their properties; it is anticipated that these rights would be extended to Kawailoa Wind for construction and operation of the project. Microwave communication facilities for the Project will be installed at existing communication sites on State-owned land (public), leased to Hawaiian Telcom, on Mount Kaʻala.
Project Description	Kawailoa Wind, LLC (Kawailoa Wind) was formed by First Wind, LLC (First Wind), a Boston-based wind energy company, for the express purpose of developing a wind power facility at the former Kawailoa Plantation on the North Shore of Oʻahu in order to supply clean, renewable energy for the State of Hawaiʻi. Kawailoa Wind is proposing to construct, operate, and maintain a wind farm with a generating capacity of up to 70 megawatts. Specific Project components would include 30 wind turbine generators (turbines), underground and overhead electrical collector lines to carry the electrical power from each wind turbine generator to an electrical substation, a battery energy storage system, electrical switching station facilities and sub-transmission lines, an operations and maintenance building, Hawaiian Electric Company (HECO) control buildings, a communication tower with microwave dishes, meteorological

	monitoring equipment, and onsite roads to facilitate access to each of these facilities. The Project would also include installation of additional communication equipment on Mount Ka‘ala in order to provide a dedicated communication link between the wind farm and existing HECO substations in Waialua and Wahiawā.
Project Acreage	The permanent Project footprint, which includes wind turbine generators, collector lines, buildings, meteorological monitoring equipment, and access roads, is 21.7 acres (see the Environmental Impact Statement [EIS] for a detailed description of the Project's components). Since the communication facility on Mount Ka‘ala will be installed on top of an existing structure, there is no additional acreage.
Permanent Project Footprint and Cultural Survey Area	For this Cultural Impact Assessment (CIA), the cultural survey included the entire *ahupua‘a* (land division usually extending from the uplands to the sea) of Kawailoa (and Lauhulu, Kuikuiloloa, Punanue, and Kāpaeloa; see Section 3.3 for clarification of these land divisions), and Kamananui, including the permanent Project footprint.
Document Purpose	The Project requires compliance with the State of Hawai‘i environmental review process (Hawai‘i Revised Statutes [HRS] Chapter 343), which requires consideration of a proposed project's effect on cultural practices and resources. CH2M HILL requested CSH conduct this CIA. Through document research and ongoing cultural consultation efforts, this report provides information pertinent to the assessment of the proposed Project's impacts to cultural practices and resources (per the *Office of Environmental Quality Control's Guidelines for Assessing Cultural Impacts*) which may include Traditional Cultural Properties of ongoing cultural significance that may be eligible for inclusion on the State Register of Historic Places, in accordance with Hawai‘i State Historic Preservation Statute (Chapter 6E) guidelines for significance criteria according to Hawai‘i Administrative Rules (HAR) §13-275 and §13-284 under Criterion E. The document is intended to support the Project's environmental review and may also serve to support the Project's historic preservation review under HRS Chapter 6E and HAR Chapter 13-275 and 13-284.
Consultation Effort	Hawaiian organizations, agencies and community members were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the permanent Project footprint and the vicinity. The organizations consulted included the State Historic Preservation Division, the Office of Hawaiian Affairs, the O‘ahu Island Burial Council, Hui Mālama I Nā Kūpuna O Hawai‘i

	Nei, the Waialua Hawaiian Civic Club, and community members of Kawailoa and Kamananui Ahupua‘a.
Results of Background Research	Background research for this Project yielded the following results (presented in approximate chronological order): 1. The *moku* (district) of Waialua contained a set of centrally located productive lands and peripheral areas that were ecologically marginal but that had access to abundant ocean resources. The fertile center consisted of the area surrounding Kaiaka and Waialua Bays located in the *makai* (seaward) regions of the *ahupua‘a* of Kamananui, Pa‘ala‘a, and Kawailoa. This core productive region likely supported the majority of the Waialua population. In marked contrast, small fishing communities were located on marginal lands at the edges of Waialua, including Kāpaeloa. 2. The earliest settlements along the northern coastal areas of O‘ahu have yet to be recovered archaeologically, but a settlement complex in Anahulu Valley, which was most likely a peripheral extension of the core Waialua production lands, dates to A.D. 1300. This complex, located next to the southern section of the Kawailoa permanent Project footprint, includes numerous habitation sites, rock shelters, irrigation systems, and dryland agricultural remains (Kirch 1992). 3. *Mo‘olelo* (oral traditions) chronicle the rise of divine kingship in the uplands of Waialua. Located near what some people consider the *piko* (navel or center) of O‘ahu, the site of Kūkaniloko was a birthing place of *ali‘i kapu* (sacred chiefs), who were the *akua* (gods) of the land (Kamakau 1964:12). The *ahupua‘a* system of territorial land units was established in approximately A.D. 1400 by Mā‘ilikūkahi, an *ali‘i kapu* who was born at Kūkaniloko in the uplands of Waialua, and whose chiefly title was consecrated at the *heiau* (sacred place of worship, temple) of Kapukapuākea (Kirch 2010:84–90) 4. *The Wind Gourd of La‘amaomao* tells the story of how Pāka‘a and his son Kuāpāka‘a, descendants of the wind god La‘amaomao, controlled the winds of Hawai‘i through a gourd that contained the winds and could be called forth by chanting their names (Nakuina 1992). Pāka‘a’s chant traces the winds of O‘ahu and the *moku* of Waialua, including the wind that blows at Mount Ka‘ala, called Pu‘u-ka‘ala. Other *mo’olelo* connect the gourd of La‘amaomao to the god Lono, a cosmic gourd from whence came the winds, clouds, and rain (Handy and Handy 1972:220; *Ka Na‘i Aupuni* 1906). A cultural connection

	can be made between the *moʻolelo* of the wind goddess Laʻamaomao and modern wind farms: Wind farms (such as First Wind), just like the descendants of Laʻamaomao, involve the capturing and harnessing of wind energy. 5. The summit of Kaʻala, the highest point on Oʻahu, is considered a sacred place (Waiʻanae Ecological Characterization 2011). *Kāhuna* (priests) described the summit plateau as being "clothed in the golden cloak of Kane," a resting place for spirits of the dead (McGrath et al. 1973:11). It is possible that this resting place was for souls heading down the spine of the Waiʻanae mountains toward Kaʻena Point, a *leina ʻuhane* (leap of the soul), or place where the souls of the dead leaped into the next world (McAllister 1933:125–126). Other *moʻolelo* relate the significance of the Kaʻala summit for weather forecasting and making prophecies (Kalākaua 1890:155–173; 455–480). 6. The distant lands of the proposed Project, from the southwest mountainous peak of Kaʻala to the northeast coastal region of Kāpaeloa, were once connected culturally and politically prior to the introduction of private property with the Māhele of 1848. The proposed microwave communications facility Project area near the summit of Mount Kaʻala is part of Kamananui Ahupuaʻa, formerly the political and ritual center of Waialua. The *konohiki* (stewards) of Kamananui also managed detached, outlying lands, including the fishing community of Kāpaeloa at the eastern border of Waialua. Then, in the 1820s, the ruling chief of Kamananui Ahupuaʻa moved to Anahulu Valley in the *ahupuaʻa* of Kawailoa, which resulted in a redrawing of *ahupuaʻa* boundaries. Kāpaeloa and other outlying sections of Kamananui were thus subsumed into the land of Kawailoa (Sahlins 1992:20–21). The proposed wind power facility permanent Project footprint is located in this expanded region of Kawailoa. 7. Previous archaeological research and recent cultural resource management work indicate that the *ahupuaʻa* of Kawailoa and Kamananui contain numerous cultural sites and *wahi pana* (storied places) indicative of ancient settlement patterns. *Moʻolelo* suggest that the summit swamp of Mount Kaʻala near the microwave communication facility Project area was formerly a freshwater fishpond called Luakini. McAllister (1933) documented two sites in the vicinity of the *makai* access roads of the Kawailoa permanent Project footprint —a *heiau* called ʻIliʻilikea (Site 237), which was destroyed in 1916 by W.

	Harpham for the Waialua Agricultural Company (but according to Mr. Jan Becket, part of it is still standing, although not in the permanent Project footprint; see Results of Community Consultation), and a complex of partially enclosed terraces, platforms, and walls called Kahōkūwelowelo (Site 240) that has been variously described as a priestly dwelling, monastery, and *heiau* (*Honolulu Advertiser* 1933; McAllister 1933:143; Thrum 1906). The accompanying Archaeological Inventory Survey (AIS) (Rechtman et al. 2011) confirmed that there are not any *heiau* or other Native Hawaiian cultural sites in the permanent Project footprint. 8. Previous archaeological research and recent cultural resource management work indicate numerous burials in Kawailoa and Kamananui. In proximity to the Kawailoa permanent Project footprint are burials within and near the early settlements in the upper Anahulu Valley (Kirch 1992:88, 94,104, 112) and along the coastal strip of Kawailoa on the inland side of Kamehameha Highway (State Inventory of Historic Properties [SIHP] No. 50-80-01-3724, Bath 1988; SIHP No. 50-80-01-4670, Avery and Kennedy 1993; SIHP No. 50-80-01-5495, Borthwick et al. 1998). 9. Land Commission Award documentation of the Māhele indicates a wide range of indigenous Hawaiian subsistence practices in the vicinity of the permanent Project footprint in Kawailoa prior to 1850. The land claims reveal that Hawaiian households had multiple *ʻāpana* (lots) in different geographical locations, involving the cultivation of taro, bananas, bitter gourds, melon, corn, sugarcane, and sweet potatoes, and *pali* (cliffs) were exploited for the collection of *wauke* (paper mulberry) (Waihona ʻAina 2000). 10. The landscape of Kawailoa and Kamananui Ahupuaʻa shifted dramatically during the last two decades of the nineteenth century with rice, sugar, and pineapple cultivation. The development of the Oahu Railway and Land Company (OR&L) led to the rise of the Waialua Agricultural Company, later named the Waialua Sugar Company. The Kawailoa Plantation, situated on the rolling ridges above Haleʻiwa, included 6,000 acres of sugar cultivation. After the Waialua Sugar Company closed in 1998, Kamehameha Schools began managing the Kawailoa Plantation as a diversified farming operation (*Imua* 2005:15–16). The accompanying AIS (Rechtman et al. 2011) did identify 17 historic sites associated with the former plantation (and military) activities in the permanent Project

	footprint. 11. Philip Ninomiya and Manabu Nonaka, descendants of Japanese immigrants in Waialua, describe in previously recorded oral histories a diet of mostly fish for the Japanese plantation workers and their families, including *aji* (*akule*, big-eyed scad fish), *pāpio* (young stage of *ulua*, crevalle, jack, or pompano), *āholehole* (young stage of *āhole*, Hawaiian flagtail), *moi* (threadfish), *‘oama* (young stage of *weke*, goatfish), and *tako* ([Japanese] squid, octopus), as well as *ogo* ([Japanese] seaweed). They also constructed rafts out of *akakai* (reeds) that grew along Anahulu Stream (UH 1977).
Results of Community Consultation	CSH attempted to contact 37 community members and government agency and community organization representatives. Of the 17 people that responded, nine *kūpuna* (elders) and/or *kama‘āina* (Native-born) participated in formal interviews for more in-depth contributions to the CIA. This community consultation indicates: 1. Community participants share a range of *mana‘o* (thoughts, opinions) and views on the proposed wind farm. Four participants support the Project. Mr. Thomas Shirai states that the Project will not have any cultural impacts, Ms. Gladys Awai-Lennox does not have any cultural concerns, Mrs. Lavina Agader believes that the wind farms will be a good use of the land since it is no longer supporting agriculture, and Mr. Kawika Au is supportive if the Project is done *pono* (in the correct way). Other participants articulated their *mana‘o* as to how the Project may impact cultural sites, beliefs, and practices: 2. Community participants describe and map the locations of numerous cultural sites in the *makai* section of Kawailoa, several of which are located near the Project’s access roads. Based on the teaching of *kupuna* Rudy Mitchell, Mr. Jan Becket maps the locations of the following cultural sites in the vicinity of the permanent Project footprint: Kahōkūwelowelo Heiau, Kahōkūwelowelo Hale, burials, an enclosure, a wall, a rock carving, an altar, and other rock structures (see Figure 35). Mrs. Emmaline Causey describes the locations of two Japanese graveyards just *makai* and *mauka* of her property very close to Old Cane Haul Road and Kawailoa Road, and Mrs. Agader describes three burials at the former Kawailoa Camp. Having previously noticed how the transport of wind turbines required the entire width of a two-lane road, she is concerned that the transport of wind turbines along Old Cane Haul Road and

	Kawailoa Road may disturb these two graveyards, which are only maintained twice a year and may thus be at times obstructed from view. In addition, Ms. Coochie Cayan, the History and Culture Branch Chief of the SHPD, states that the proposed Project will have an impact on the area's well documented *mo'olelo*, historic sites, archaeological sites, and burials. The accompanying AIS (Rechtman et al. 2011) has not identified any cultural sites in the permanent Project footprint; however, 17 historic sites associated with the former plantation activities or former military operations have been identified within the permanent Project footprint and archaeological monitoring is recommended. 3. Mr. Becket draws attention to intensive archaeological investigations in the upper Anahulu Valley (Kirch and Sahlins 1992) and suggests that parallel groupings of upper valley settlements may be located in the gulches in the northern *mauka* sections of Kawailoa, including the permanent Project footprint. Ms. Awai-Lennox and Mr. Butch Helemano also describe, in general terms, several *heiau* in the *mauka* lands of Kawailoa, and Mr. Au is aware of numerous cultural sites in the *mauka* portions of Kawailoa, including *three* heiau, several former habitation sites, and walls, although he does not specify their location. The accompanying AIS (Rechtman et al. 2011) has not identified any *heiau* or other cultural sites in the permanent Project footprint, and is avoiding the gulches and steep slopes where burials could be found. 4. The entire landscape of Waialua was covered in sugarcane during the first half of the twentieth century, according to Mrs. Agader. Immigrants settled in various "camps," including Japanese, Chinese, Korean, and Filipino laborers and their families at Kawailoa Camp near the southern access roads of the Project. 5. The *makai* and *mauka* lands of Kawailoa contain abundant ocean and forest resources. Along the coast at Kāpaeloa, Mrs. Causey and her family used to gather *'ōpihi* (limpet), *pipipi* (pearl oyster), and *limu* (seaweed), including *ogo* and *wāwae'iole*, and catch *akule*, *kūmū* (goatfish), *'āweoweo* (big eye), *manini* (convict tang), and *āholehole*. Near Hale'iwa, Ms. Gladys Awai-Lennox and her family used to cultivate taro, breadfruit, and bananas. Her family also fished extensively

	along the coast, catching *nenue* (chub fish), *kala* (surgeon fish), *ʻoama*, and gathered *wana* (spiny urchins), *haʻukiʻuki* (shingle urchins), *pipipi*, and several kinds of *limu* including *wāwaeʻiole*, *ogo*, *ʻeleʻele*, and *kohu*. Her family also collected the seed pods of *kiawe* (mesquite) for cattle and pig fodder, and made leis from the red *hala* (pandanus) fruit. In addition, she also describes the importance to her family of the *ʻalae ʻula* (Common Hawaiian Moorhen). Mrs. Agader also relates that Kamehameha Schools recently planted *koa* in the *mauka* portions of Kawailoa. Ms. Cayan, as the History and Culture Branch Chief of the SHPD, recommends that access and gathering rights should not be prevented, as certain families, practitioners, and groups continue to practice Hawaiian spirituality, traditional burials, and other activities, such as hunting and hiking. Although community members have not identified such cultural practices, First Wind will work with Kamehameha Schools to facilitate access in the wind farm permanent Project footprint and the *mauka* Kawailoa property for hiking, hunting, gathering, and cultural practices. 6. Drawing from the Kumulipo, a cosmological creation chant, and *kūpuna*, Mr. Tom Lenchanko articulates an expansive view of Kūkaniloko (the current State of Hawaiʻi five-acre park site noted to be Kūkaniloko Birthstones State Monument, a sacred site for the birth of *ali'i* [chiefs]) that extends geographically to encompass 36,000 acres of land within a network of *ka'anani'au* (boundary markers). This area, which has *mana* (divine power), includes the *mauka* portions of Kawailoa and Kamananui. Mr. Lenchanko is concerned that the proposed Project will trespass upon his family's *ʻāina* (land) and *iwiawaloa* (ancestral burial places). He also asserts his belief that the wind turbines will forever impact the traditional cultural properties of the *mauka* sections of Kawailoa and Mount Ka'ala—they will impede the vision of the traditional natural landscape and interfere with the view plane of those who are buried in the land. The accompanying AIS (Rechtman et al. 2011) has not identified any burial features in the permanent Project footprint. According to First Wind, the wind farm Project will not make a permanent change to the landscape—the wind turbine equipment will either be replaced or removed after 20 years. 7. Mr. Moki Labra and Mr. Helemano are concerned about the massive scale of development (30 wind turbines) in Kawailoa:

	Mr. Labra states that "parts of the *ahupua'a* need to be rested" and that the *'āina* (land) needs to "get balance," and Mr. Helemano criticizes land stewardship that enables the desecration of "our sacred lands and fragile natural resources." Mr. Au and Ms. Betty Jenkins concur with Mr. Labra that if the Project is not done in the correct way (*pono*), the "winds might not listen and could stop blowing altogether." Mr. Labra questions the company name, 'Kawailo Wind,' and the location of the Project—'Kawailoa' is not the name of the wind that blows through the *ahupua'a* and other places on O'ahu have much stronger winds. Mr. Au summarily states that he could support the Project if it benefits local Hawaiian people and is not only to make outsiders rich.
Impacts and Recommendations	Based on the information gathered for the cultural and historic background and community consultation detailed in this CIA report, the proposed Project may potentially impact Native Hawaiian burials and cultural beliefs. CSH identifies these potential impacts and makes the following recommendations: 1. The accompanying AIS has not documented any burial features in the permanent Project footprint (Rechtman et al. 2011), and it is unlikely that burials will be encountered due to previous disturbance from former plantation activities and military operations. However, community participants Mr. Becket and Mrs. Causey express concerns of the proximity of the Project's *makai* access roads to cliff burials and Japanese graveyards, and Ms. Cayan, as the History and Culture Branch Chief of the SHPD, states that the Project will impact burials. Since land-disturbing activities may uncover presently undetected burials, personnel involved in the construction activities of the permanent Project footprint should be informed of the possibility of inadvertent cultural finds, including human remains. The accompanying AIS (Rechtman et al. 2011) recommends archaeological monitoring as appropriate mitigation to address (in part) the possibility of presently unidentified burials. Should burials (or other cultural finds) be identified during ground disturbance, the construction contractor should immediately cease all work and the appropriate agencies notified pursuant to applicable law. 2. Community participants Mr. Lenchanko, Mr. Labra, and Mr. Helemano express that the wind turbines will impact the visual landscape and the integrity of the cultural landscape of Kawailoa. Although these community participants did not

	describe visual impacts from any specific cultural sites, First Wind notes that some of the wind turbines will be visible from cultural sites, such as Puʻu o Mahuka Heiau, and culturally significant locations, including Waimea Valley, which was nominated as a Traditional Cultural Property (Monahan 2008), and Haleʻiwa, which is a State Historic, Cultural, and Scenic District. Other community members, such as Mr. Shirai, Ms. Awai-Lennox, Mrs. Agader, and Mr. Au, are supportive of the Project for a variety of reasons if it is conducted *pono*. According to First Wind, although the Project cannot be implemented in a way that entirely avoids all potential cultural impacts, particularly those related to visual impacts, First Wind's goal is to develop and operate the Project in a way that is respectful to Hawaiʻi's unique cultural and natural resources while also contributing to the local community where the Project is located, so as to balance any perceived negative effects. The intent of these measures is to balance the beliefs and traditions of the past with the need for clean, renewable energy to sustain future generations. For other wind farm projects, First Wind has sought community input about the Project and how the wind farm should support community priorities so as balance the perceived negative impacts. For this Project, First Wind has already engaged the Waialua community and intends to form a long-term partnership with Waimea Valley to support their efforts to promote Hawaiian culture. First Wind should continue to brief and consult with community members and organizations as the Project design and construction progresses in order to inform the community of any changes that could result in unanticipated adverse cultural impacts and to better understand and incorporate the Hawaiian cultural worldview.

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Section 1 Introduction

1.1 Project Background

At the request of CH2M HILL, Cultural Surveys Hawai‘i, Inc. (CSH) conducted a Cultural Impact Assessment (CIA) for the proposed Kawailoa Wind Farm Project, Multiple Ahupua‘a, Waialua District, O‘ahu Island and includes the following parcels:

- Wind Farm Site: TMK [1] 6-1-005:001; 6-1-006:001; 6-1-007:001; 6-2-011:001
- Traversed by Existing Onsite Access Roads: TMK [1] 6-1-005:003, 007, 014, 015, 016, 019, 020, 021, 022; 6-1-008:025; 6-2-002:001, 002, 025; 6-2-009:001 (Figure 1 to Figure 3)
- Mount Ka’ala Communication Sites: TMK [1] 6-7-003:024 (Figure 4 to Figure 6)

The permanent Project footprint, which includes wind turbine generators, collector lines, buildings, meteorological monitoring equipment, and access roads, is 21.7 acres (see the Environmental Impact Statement [EIS] for a detailed description of the Project’s components). Since the communication facility on Mount Ka‘ala will be installed on top of an existing structure, there is no additional acreage. For this CIA, the cultural survey included the entire *ahupua‘a* (land division usually extending from the uplands to the sea) of Kawailoa (and Lauhulu, Kuikuiloloa, Punanue, and Kāpaeloa; see Section 3.3 for clarification of these land divisions), and Kamananui, including the permanent Project footprint.

Kawailoa Wind, LLC (Kawailoa Wind) was formed by First Wind, LLC (First Wind), a Boston-based wind energy company, for the express purpose of developing a wind power facility at the former Waialua Sugar Plantation on the North Shore of O‘ahu in order to supply clean, renewable energy for the State of Hawai‘i. Kawailoa Wind is proposing to construct, operate, and maintain a wind farm with a generating capacity of up to 70 megawatts on Kamehameha Schools (KS) property located on the North Shore of O‘ahu. The proposed wind farm facilities would be located on KS land at the former Waialua Sugar Plantation (Kawailoa, Lauhulu, Kuikuiloloa, Punanue, and Kāpaeloa Ahupua‘a). The proposed wind farm would support the fiduciary responsibility of this *ali‘i* (chiefly) land trust. Lands owned by other entities are included as existing onsite access roads traverse these properties. KS currently has reciprocal agreements with these landowners for access through their properties; it is anticipated that these rights would be extended to Kawailoa Wind for construction and operation of the Project. Microwave communication facilities for the Project will be installed at existing communication sites on State-owned land, leased to Hawaiian Telcom, on Mount Ka‘ala (Kamananui Ahupua‘a).

Specific Project components would include 30 wind turbine generators (turbines), underground and overhead electrical collector lines to carry the electrical power from each wind turbine generator to an electrical substation, a battery energy storage system, electrical switching station facilities and sub-transmission lines, an operations and maintenance building, Hawaiian Electric Company (HECO) control buildings, a communication tower with microwave dishes, meteorological monitoring equipment, and onsite roads to facilitate access to each of these facilities (Kawailoa Road, Mid-Line Road, Ashley Road, and Cane Haul Road). The Project would also include installation of additional communication equipment on Mount Kaʻala in order to provide a dedicated communication link between the wind farm and existing HECO substations in Waialua and Wahiawā.

At each of its wind projects in Hawaiʻi, First Wind works to study and understand the important environmental and cultural resources in and around the project area. First Wind's goal is to develop and operate wind energy projects in a way that is respectful to Hawaiʻi's unique cultural and natural resources while also contributing to the local communities where its wind farms are located. First Wind has conducted previous cultural and environmental mitigation and community outreach on other wind farm projects, and is planning on conducting mitigation and outreach for the Kawailoa wind farm (see Section 7.4 for proposed mitigation and community outreach).

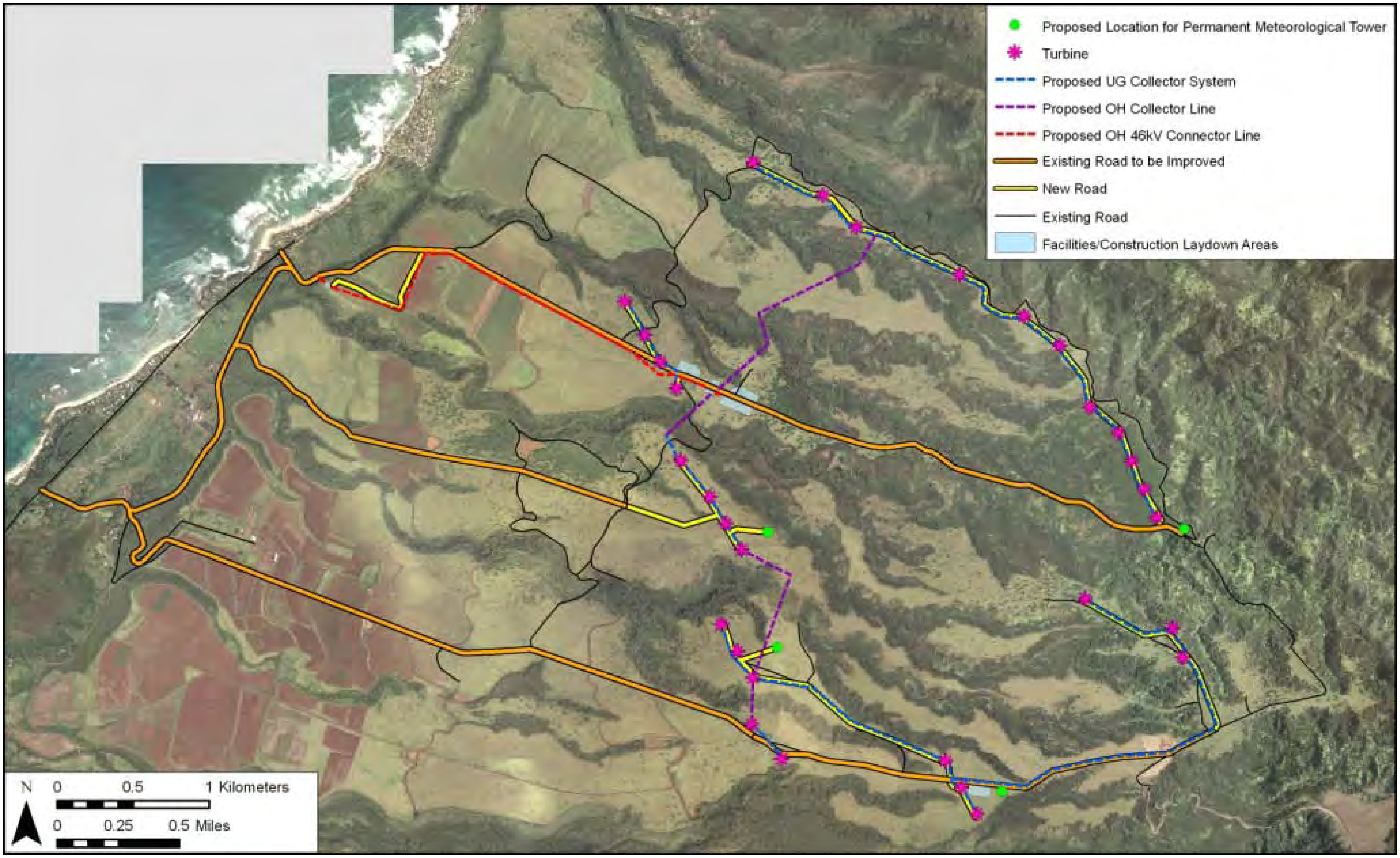

Figure 1. Portion of the orthoimagery of the 2005 U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle showing the proposed Project in Kawailoa

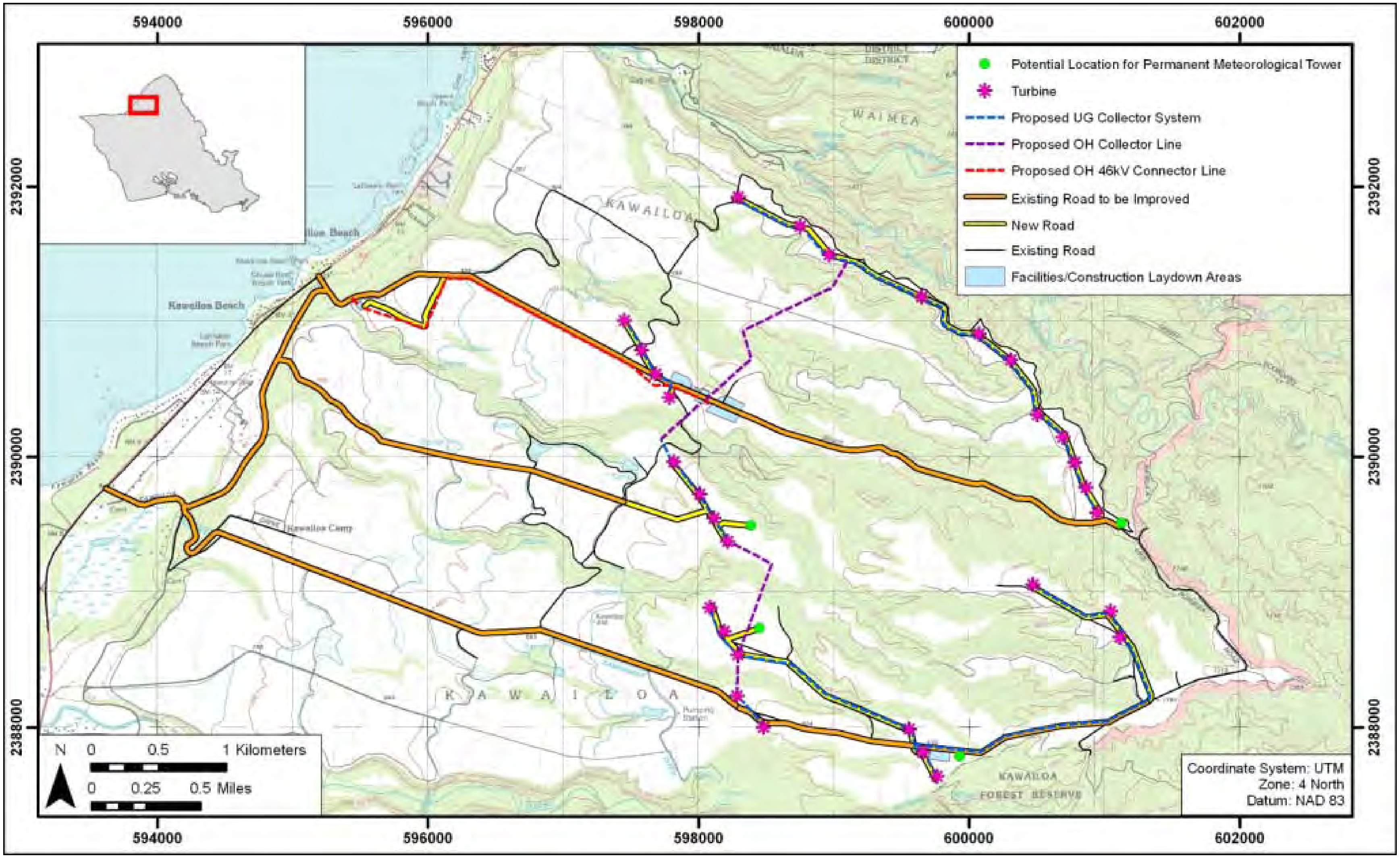

Figure 2. Portion of the USGS 7.5-minute series topographic map, Waimea (1998), Hale‘iwa (1999), and Hau‘ula (1992) quadrangles, showing the proposed Project in Kawailoa

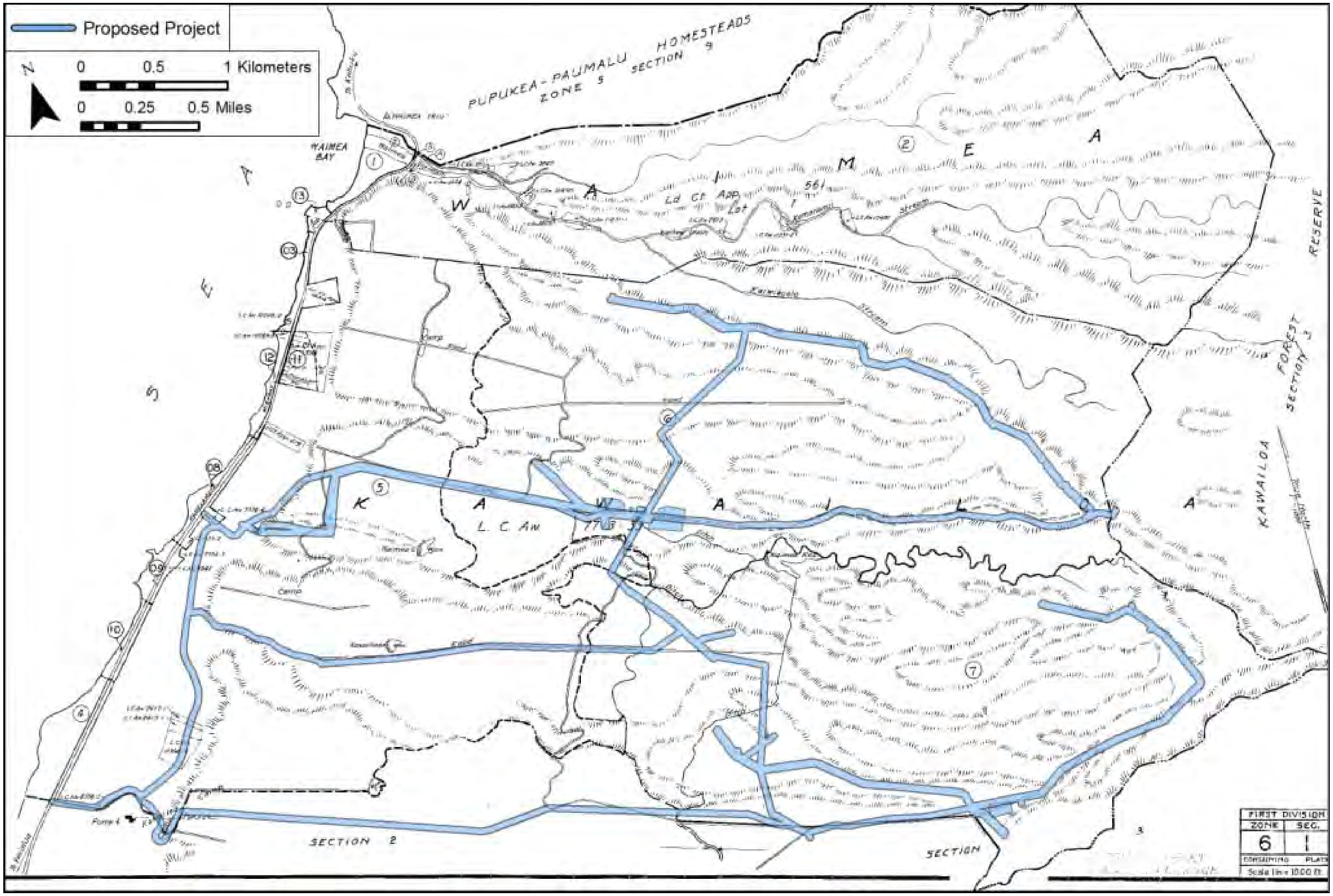

Figure 3. Tax Map Key (TMK): [1] 6-1 showing the proposed Project in Kawailoa (Hawai‘i TMK Service 2011)

Figure 4. Portion of the orthoimagery of the 2005 USGS 7.5-minute topographic quadrangle showing the Project area on Mount Ka‘ala

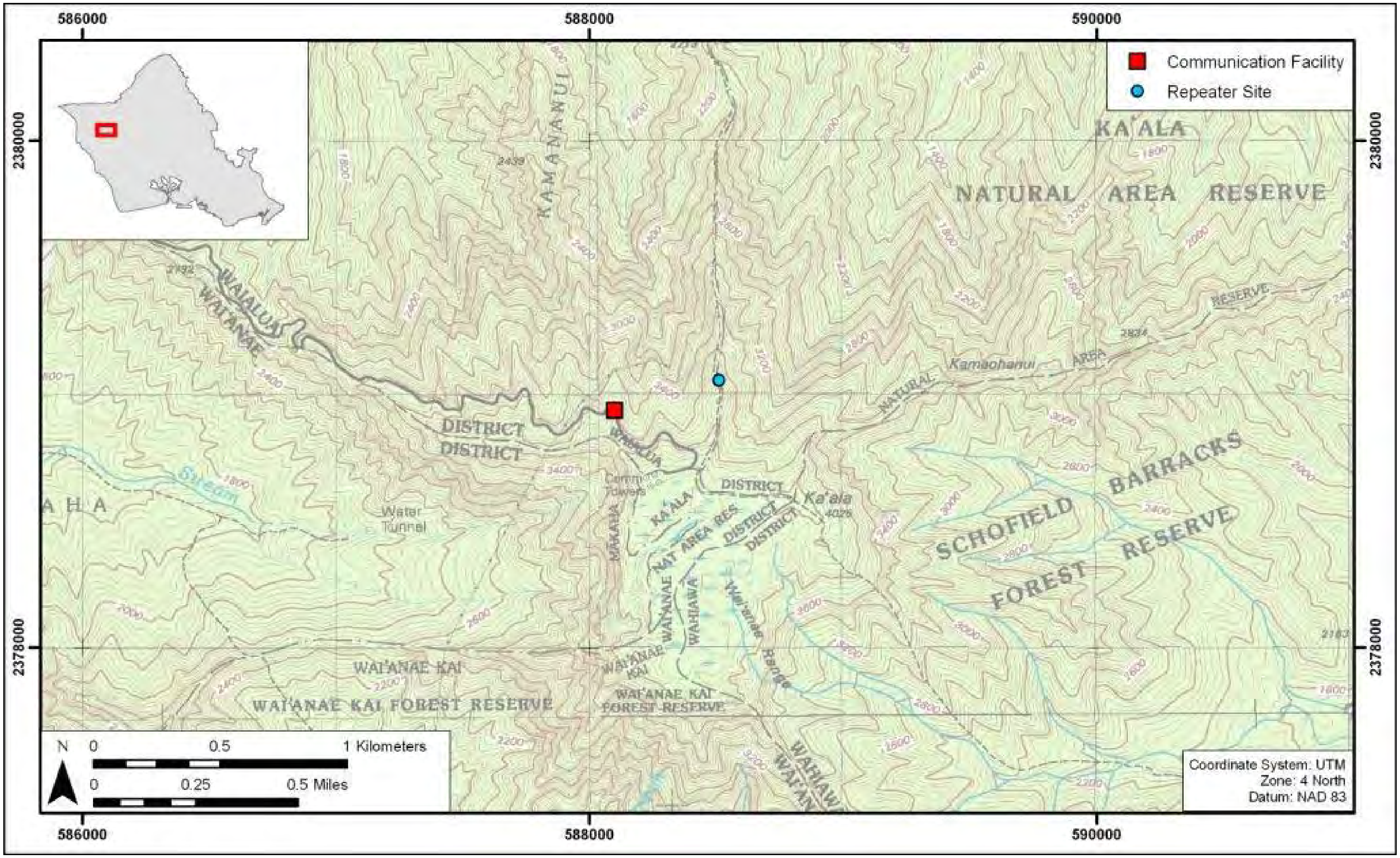

Figure 5. Portion of the U.S. Geological Survey 7.5-minute series topographic map, Ka‘ena (1998), Hale‘iwa (1999), and Hau‘ula (1992) quadrangles, showing the Project area on Mount Ka‘ala

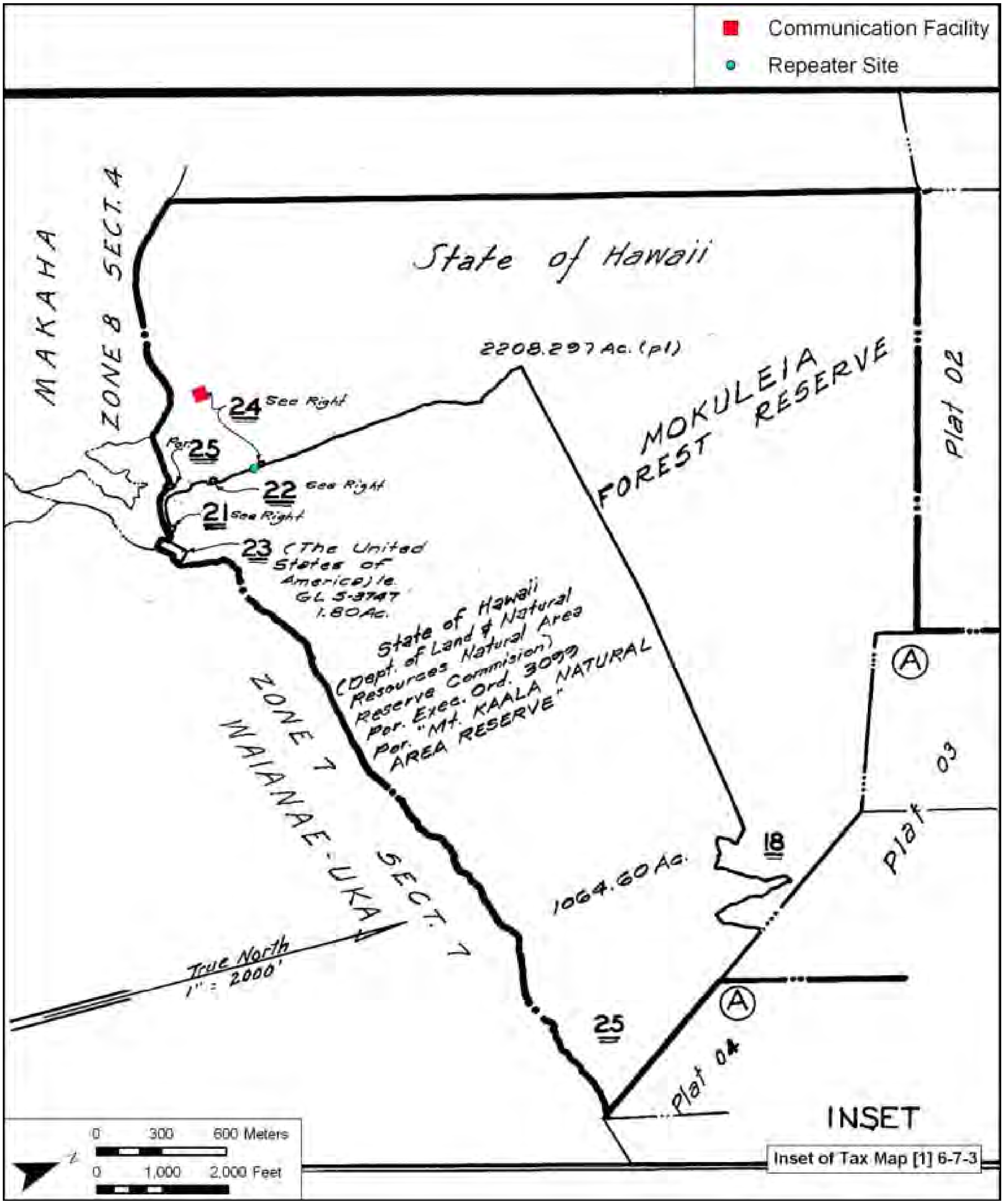

Figure 6. TMK [1] 6-7-003 showing the Project area on Mount Kaʻala (Hawaiʻi TMK Service 2011)

1.2 Document Purpose

The Project requires compliance with the State of Hawaiʻi environmental review process (Hawaiʻi Revised Statutes [HRS] Chapter 343), which requires consideration of a proposed project's effect on cultural practices. CSH conducted this CIA at the request of CH2M HILL. Through document research and ongoing cultural consultation efforts, this report provides information pertinent to the assessment of the proposed Project's impacts to cultural practices and resources (per the *Office of Environmental Quality Control's Guidelines for Assessing Cultural Impacts*), which may include Traditional Cultural Properties (TCPs) of ongoing cultural significance that may be eligible for inclusion on the State Register of Historic Places, in accordance with Hawaiʻi State Historic Preservation Statute (Chapter 6E) guidelines for significance criteria in Hawaiʻi Administrative Rules (HAR) §13-275 and §13-284 under Criterion E, which states that to be significant an historic property shall:

> Have an important value to the Native Hawaiian people or to another ethnic group of the state due to associations with 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 document is intended to support the Project's environmental review and may also serve to support the Project's historic preservation review under HRS Chapter 6E and HAR Chapter 13-275 and 13-284.

Rechtman Consulting, LLC conducted an Archaeological Inventory Survey (AIS) for the permanent Project footprint. The results of this archaeological study are presented in a companion report (Rechtman et al. 2011) (see Section 3.4.5).

1.3 Scope of Work

The scope of work for this CIA includes:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities; and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel; present and past uses of the parcel; and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report that summarizes the results of these research activities and provides recommendations based on findings.

1.4 Environmental Setting

1.4.1 Natural Setting, Geology, and Topography

The wind farm permanent Project footprint is located within the coastal lowlands, extending *mauka* (inland) towards the base of the Koʻolau mountain range. The proposed wind farm turbines and facilities are located within moderately sloping lands that range in elevation from 200 to 1,280 feet above mean sea level. The proposed communication facilities Project area is located along steep (nearly vertical) mountainous ridges near the summit of Mount Kaʻala at an elevation of 3,600 and 3,200 feet above mean sea level.

1.4.2 Streams, Rainfall, Soils, and Vegetation

Two streams flank the permanent Project footprint in Kawailoa—Anahulu River flows to Waialua Bay and Kaiwikoʻele Stream flows to Waimea Bay. Other streams occur within the permanent Project footprint but are primarily dry throughout most of the year. The *mauka* and *makai* (seaward) regions of Kawailoa Ahupuaʻa receive moderate rainfall annually (between 800 and 1,500 millimeters) (Giambelluca, et al. 1986).

According to U.S. Department of Agriculture (USDA) soil survey data (Foote et al. 1972), sediments in the Kawailoa permanent Project footprint consist (generally from *mauka* to *makai*) of Paaloa Silty Clay (PaC), Leilehua Silty Clay (LeB, LeC), Wahiawā Silty Clay (WaA, WaB, WaC), Lahaina Silty Clay (LaB, LaC), Ewa Stony Silty Clay (EwC), Waialua Silty Clay (WkB), Jaucas Sand (JaC) (Figure 7). The predominant soil types at the permanent Project footprint are in the Lahaina, Leilehua, and Wahiawa series, all of which are typically well-drained soils derived from weathered basalt that form in upland areas. Alluvial fans are present along the base of the Koʻolau mountain range, as well as colluvial deposits along the sides of stream gulches.

Typical vegetation in the Kawailoa permanent Project footprint includes (generally from *mauka* to *makai*) Bermuda grass, guava, *koa haole* (common shrub), *honohono* (dayflower), lantana, *ʻōhiʻa* (native tree), ferns, *koa*, California grass, Formosa *koa*, eucalyptus, feather fingergrass, *ʻilima* (native shrub), *kiawe* (Algaroba tree), lantana, *ʻuhaloa* (a small American weed), klu, brisly foxtail, and Australian saltbush (Foote et al. 1972:30, 48, 79, 81, 106, 124, 128).

The mountainous region of the communication facility Project area near the summit of Mount Kaʻala receives heavy rainfall annually (2,000 millimeters) (Giambelluca et al. 1986). A large bog exists at the summit plateau of Mount Kaʻala, as well as intermittent streams and pools. According to USDA soil survey data (Foote et al. 1972), the Project area on Mount Kaʻala consists of areas of Tropohumults-Dystrandepts association (rTP) (Figure 8). These are areas dominated by deep drainages and narrow ridges, with slopes reaching 90 percent. Tropohumults, which occur at the highest elevations, are well-drained soils with a surface layer of reddish-brown silty clay, subangular subsoils, and an underlying structure of ironstone pan or saprolite (Foote et al. 1972:122). Typical vegetation near the summit of Mount Kaʻala includes *ʻōhiʻa*, *koa*, *ʻaʻaliʻi* (native hardwood shrubs), and ferns (Foote et al. 1972:122).

1.4.3 Built Environment

The *mauka* portion of these lands was leased to Waialua Sugar Company for the cultivation of sugar cane from 1889 to 1996. During this period of cultivation, the land was heavily disturbed by activities including construction of site access roads and stockpiling of soil and vegetative debris. Several roads extend *mauka* into the Kawailoa permanent Project footprint, some of which are proposed to be improved for site access. In addition, an existing meteorological tower is located in the northeastern section of the permanent Project footprint.

The proposed sites for the Project's microwave communication facilities near the summit of Mount Kaʻala are already being used as communication facilities by Hawaiian Telcom, and are accessed with a paved single-lane road. Existing structures include small buildings, towers, and several antennas and antennae dishes.

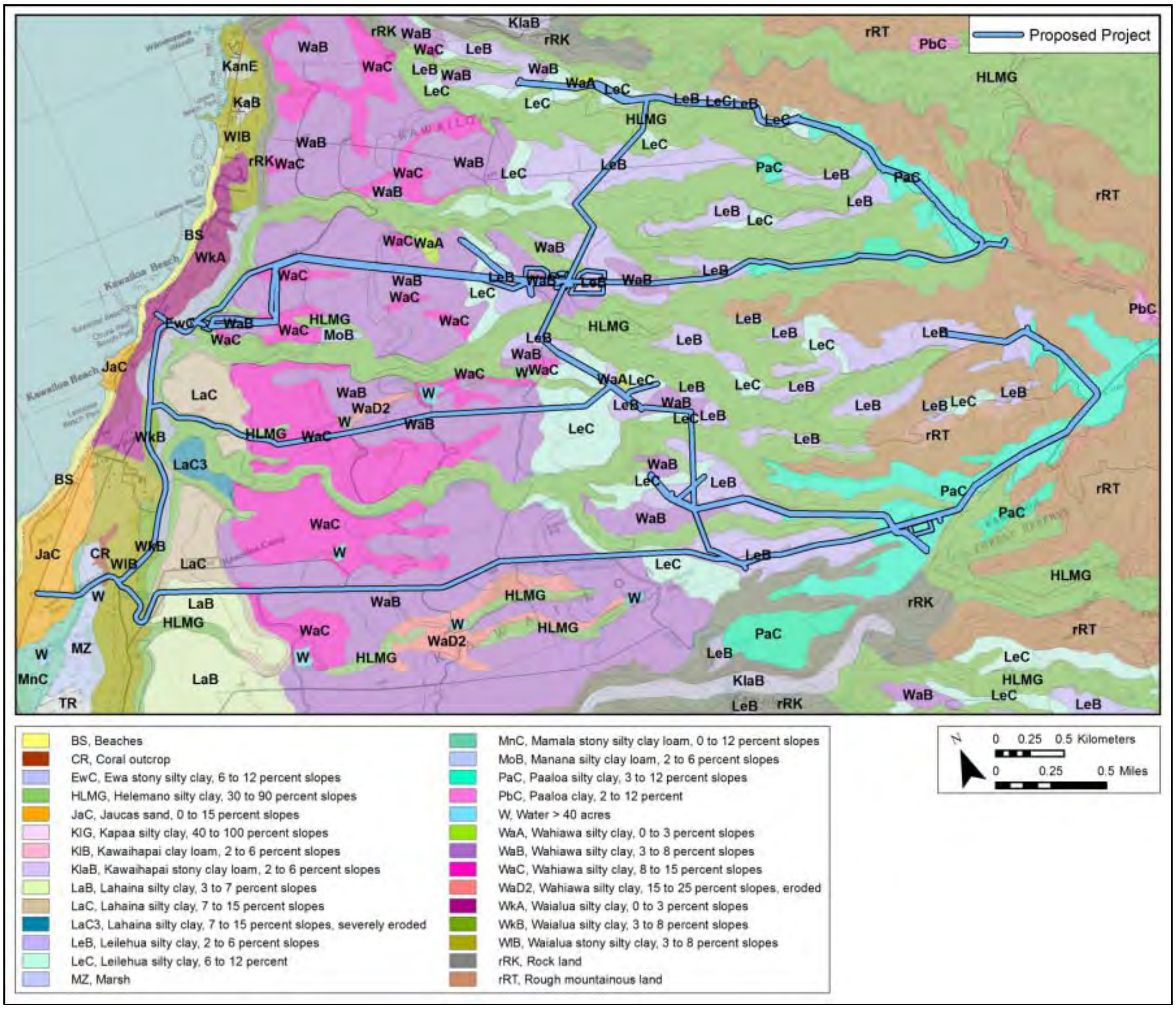

Figure 7. Portion of the USGS 7.5-minute series topographic map, Waimea (1998), Haleʻiwa (1999), and Hauʻula (1992) quadrangles, showing the permanent Project footprint in Kawailoa with soil overlay (Foote el al. 1972)

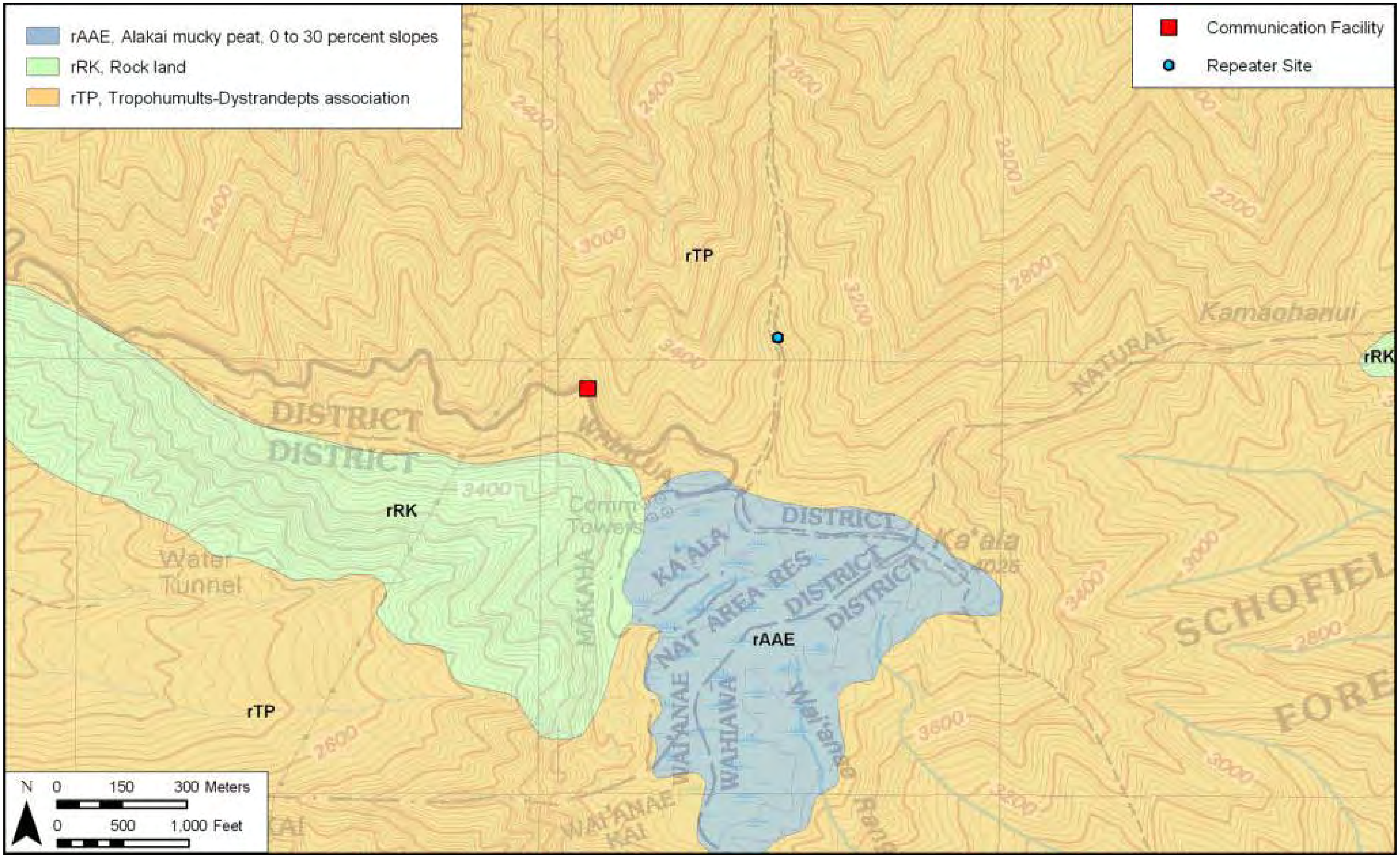

Figure 8. Portion of the USGS 7.5-minute series topographic map, Ka‘ena (1998), Hale‘iwa (1999), and Hau‘ula (1992) quadrangles, showing the Project area on Mount Ka‘ala with soil overlay (Foote el al. 1972)

Section 2 Methods

2.1 Archival Research

Historical documents, maps and existing archaeological information pertaining to Kawailoa and Kamananui Ahupuaʻa were researched at the CSH library and other archives including the University of Hawaiʻi at Mānoa's Hamilton Library, the State Historic Preservation Division (SHPD) library, the Hawaiʻi State Archives, the State Land Survey Division, and the archives of the Bishop Museum. Previous archaeological reports for the area were reviewed, as were historic maps and photographs and primary and secondary historical sources. Information on Land Commission Awards (LCAs) was accessed through Waihona ʻAina Corporation's Māhele data base as well as a selection of CSH library references. Research for the Cultural and Historical Background section centered on the following cultural and historic resources, practices, and beliefs: religious and ceremonial knowledge and practices; traditional subsistence land use and settlement patterns; gathering practices and agricultural pursuits; *wahi pana* (storied places) and associated *moʻolelo* (stories, oral traditions), *mele* (songs), *oli* (chants), and *ʻōlelo noʻeau* (proverbs); and historic land transformation, development, and population changes (see Scope of Work above).

2.2 Community Consultation

2.2.1 Sampling and Recruitment

A combination of qualitative methods, including purposive, snowball, and expert (or judgment) sampling, were used to identify and invite potential participants to the study. These methods are used for intensive case studies, such as CIAs, to recruit people that are hard to identify, or are members of elite groups (Bernard 2006:190). Our purpose is not to establish a representative or random sample. It is to "identify specific groups of people who either possess characteristics or live in circumstances relevant to the social phenomenon being studied….This approach to sampling allows the researcher deliberately to include a wide range of types of informants and also to select key informants with access to important sources of knowledge" (Mays and Pope 1995:110).

We began with purposive sampling informed by referrals from known specialists and relevant agencies. For example, we contacted the SHPD, Office of Hawaiian Affairs (OHA), Oʻahu Island Burial Council (OIBC), and community and cultural organizations in Kawailoa (and Lauhulu, Kuikuiloloa, Punanue, Kāpaeloa) and Kamananui Ahupuaʻa for their brief response/review of the Project and to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the permanent Project footprint and vicinity, cultural and lineal descendants, and other appropriate community representatives and members. Based on their in-depth knowledge and experiences, these key respondents then referred CSH to additional potential participants who were added to the pool of invited participants. This is snowball sampling, a chain referral method that entails asking a few key individuals (including agency and organization representatives) to provide their comments and referrals to other locally recognized experts or stakeholders who would be likely candidates for the study (Bernard 2006:192). CSH also employs expert or judgment sampling which involves assembling a group of people with recognized experience and expertise in a specific area (Bernard 2006:189–191). CSH maintains a database that draws on over two decades of established relationships with community consultants: cultural practitioners and specialists, community representatives and cultural and lineal descendants. The names of new potential contacts were also provided by colleagues at CSH and from the researchers' familiarity with people who live in or around the study area. Researchers often attend public forums (e.g., Neighborhood Board, Burial Council and Civic Club meetings) in (or near) the study area to scope for participants. Please refer to Table 4, Section 4, for a complete list of individuals and organizations contacted for this CIA.

CSH focuses on obtaining in-depth information with a high level of validity from a targeted group of relevant stakeholders and local experts. Our qualitative methods do not aim to survey an entire population or subgroup. A depth of understanding about complex issues cannot be gained through comprehensive surveying. Our qualitative methodologies do not include quantitative (statistical) analyses, yet they are recognized as rigorous and thorough. Bernard (2006:25) describes the qualitative methods as "a kind of measurement, an integral part of the complex whole that comprises scientific research." Depending on the size and complexity of the project, CSH reports include in-depth contributions from about one-third of all participating respondents. Typically this means three to twelve interviews.

2.2.2 Informed Consent Protocol

An informed consent process was conducted as follows: (1) before beginning the interview the CSH researcher explained to the participant how the consent process works, the Project purpose, the intent of the study and how his/her information will be used; (2) the researcher gave him/her a copy of the Authorization and Release Form to read and sign (Appendix C); (3) if the person agreed to participate by way of signing the consent form or providing oral consent, the researcher started the interview; (4) the interviewee received a copy of the Authorization and Release Form for his/her records, while the original is stored at CSH; (5) after the interview was summarized at CSH (and possibly transcribed in full), the study participant was afforded an opportunity to review the interview notes (or transcription) and summary and to make any corrections, deletions or additions to the substance of their testimony/oral history interview; this was accomplished either via phone, post or email or through a follow-up visit with the participant; (6) the participant received the final approved interview and any photographs taken for the study for record. If the participant was interested in receiving a copy of the full transcript of the interview (if there is one as not all interviews are audio-recorded and transcribed), a copy was provided. Participants were also given information on how to view the report on the OEQC website and offered a hardcopy of the report once the report is a public document.

2.2.3 Interview Techniques

To assist in discussion of natural and cultural resources and cultural practices specific to the study area, CSH initiated semi-structured interviews (as described by Bernard 2006) asking questions from the following broad categories: cultivation, gathering practices and *mauka* and *makai* (seaward) resources, burials, trails, historic properties, and *wahi pana*. The interview protocol is tailored to the specific natural and cultural features of the landscape in the study area identified through archival research and community consultation. For example, for this study, cultivation and gathering practices were emphasized over other categories less salient to Project participants. These interviews and oral histories supplement and provide depth to consultations from government agencies and community organizations that may provide brief responses, reviews and/or referrals gathered via phone, email and occasionally face-to-face commentary.

2.2.3.1 In-depth Interviews and Oral Histories

Interviews are conducted with individuals or in focus groups comprised of *kūpuna* (elder) and *kamaʻāina* (Native-born) who have a similar experience or background (e.g., the members of an area club, elders, fishermen, *hula* dancers). Interviews are conducted initially at a place of the study participant's choosing (usually at the participant's home or at a public meeting place) and/or—whenever feasible—during site visits to the proposed Project. Generally, CSH's preference is to interview a participant individually or in small groups (two–four); occasionally participants are interviewed in focus groups (six–eight). Following the consent protocol outlined above, interviews may be recorded on tape and in handwritten notes, and the participant photographed. The interview typically lasts one to four hours, and records the—who, what, when and where of the interview. In addition to questions outlined above, the interviewee is asked to provide biographical information (e.g., connection to the study area, genealogy, professional and volunteer affiliations, etc.).

2.3 Compensation and Contributions to Community

Many individuals and communities have generously worked with CSH over the years to identify and document the rich natural and cultural resources of these islands for cultural impact, ethno-historical and, more recently, TCP studies. CSH makes every effort to provide some form of compensation to individuals and communities who contribute to cultural studies. This is done in a variety of ways: individual interview participants are compensated for their time in the form of a small honorarium and/or other *makana* (gift); community organization representatives (who may not be allowed to receive a gift) are asked if they would like a donation to a Hawaiian charter school or nonprofit of their choice to be made anonymously or in the name of the individual or organization participating in the study; contributors are provided their transcripts, interview summaries, photographs and—when possible—a copy of the CIA report; CSH is working to identify a public repository for all cultural studies that will allow easy access to current and past reports; CSH staff do volunteer work for community initiatives that serve to preserve and protect historic and cultural resources. Generally our goal is to provide educational opportunities to students through internships, share our knowledge of historic preservation and cultural resources and the State and Federal laws that guide the historic preservation process, and through involvement in an ongoing working group of public and private stakeholders collaborating to improve and strengthen the Chapter 343 environmental review process.

Section 3 Cultural and Historical Background

This section draws from archaeology and ethnography, histories, *moʻolelo* written by Native Hawaiians, and an archive of historic documents and images to present a portrait of Hawaiian culture and history as it relates to the specific permanent Project footprint. It first explores Hawaiian cosmogonic and genealogical origins (Section 3.1). Focusing in on geographic and temporal scales, this section then traces the exploration of the Pacific Ocean and the subsequent discovery, settlement, and expansion of the Hawaiian archipelago (Section 3.2). This broad overview of Hawaiian history introduces key concepts and terms used throughout the report and leads to a general history of the *moku* of Waialua (Section 3.3). The focus then narrows to the two *ahupuaʻa* of Kamananui and Kawailoa (Section 3.4) regarding the earliest known settlement and subsistence patterns, a compilation of *wahi pana* and associated *moʻolelo*, successions of chiefly rule, the introduction of private property, shifting land uses, and previously recorded oral histories, with particular emphasis on the permanent Project footprint.

3.1 Cosmogonic and Genealogical Origins

Cosmogonic narratives and origin genealogies are indigenous forms of knowledge that account for the creation of the world and the first Hawaiians. Complementing this is an anthropological perspective informed primarily by archaeology (and genetics and linguistics) that traces the path of ancestral voyagers across the Pacific through their material remains (and genes and languages) (see Section 3.2). These two ways of understanding the past are often contrasted as “indigenous knowledge” and “Western scientific knowledge,” respectively. Recent studies, however, emphasize a plurality of knowledges that are epistemologically equivalent (Agrawal 1995; Meyer 2001). Following recent studies that blend oral traditions and archaeology to better understand Hawaiian history (Kirch 2010; Kirch and Sahlins 1992), accounting for the origins of Hawaiians is a quest that requires attention to both the stories of Hawaiian procreation and the anthropology of voyaging.

There are several founding narratives of the origin of the Hawaiian world, including the *Kumulipo*. This cosmogonic, genealogical prayer chant, which is over two thousand lines in length, was used to trace the divine origins of *aliʻi* through ruling chiefs, deified ancestors, and gods backwards in time through the animals, plants, and elements to the beginning of the universe. The *Kumulipo* is one of a class of such cosmological chants, but no others of such length are preserved (Silva 2004:103). This chant, titled *He Pule Hoʻolaʻa Aliʻi* (A prayer to consecrate [an] *aliʻi*) (Silva 2004:98), was composed for the Hawaiʻi Island *aliʻi* Kaʻīʻīmamao, also known as Lonoikamakahiki, when several *kapu* (sacred) rituals were performed that elevated him to the status of a god (Beckwith 1970:311), or divine king, in approximately A.D. 1600 (Kirch 2010:83). The text of the *Kumulipo* was first recorded by David Kalākaua in 1889 and translated by Queen Liliʻuokalani (1897), which was not available when folklorist Martha Beckwith completed her own translation and detailed study (1951).

Starting from, “*O ke kumu o ka lipo*” (At the beginning of the deep darkness), the *Kumulipo* divides the genesis of the world into 16 *wā* (epochs, time periods) (Beckwith 1951). These 16 *wā* are categorized into two periods, *pō* (darkness, the realm of the gods) and *ao* (light). During the first period of *pō* there was a continuous birthing of the lower life forms to sea life, plants, and eventually mammals. During the second period of *ao* came the opening of light and the appearance of the first woman and man, La'ila'i and Ki'i, respectively, and the coming of the gods, including Kāne and Kanaloa, which resulted in over a thousand genealogical pairs (Beckwith 1970: 310–11). Significantly, Hawaiian identity today is derived from origin genealogies such as the Kumulipo: "…every aspect of the Hawaiian conception of the world is related by birth, and as such, all parts of the Hawaiian world are one indivisible lineage" (Kame'eleihiwa 1992:2).

3.2 Discovery, Settlement, and Expansion of the Hawaiian Islands

Complementing the cosmogonic and genealogical origins of Hawaiians detailed in the *Kumulipo* is an anthropological perspective on ancient patterns of voyaging. Archaeological studies have shown that by 10,000 years ago, humans had migrated to occupy nearly all the habitable land on the planet. Aside from crossing a series of short water gaps to reach Australia and New Guinea, they had reached it all by walking. The remaining unexplored region was the vast Pacific Ocean. Approximately 4,500 years ago, coastal dwellers of southeast China began a wave of migration through the closely-spaced, inter-visible islands of Southeast Asia. Advances in sailing strategies, canoe technology, and navigation techniques enabled their descendents to sail past the familiar insular waters a millennium later. These precocious seafarers systematically explored the remote, uninhabited regions of the Pacific Ocean to the east, as well as the Indian Ocean to the west. This led to the eventual discovery and colonization of virtually every habitable island in the Pacific Ocean, as well as coastal trading along the Indian sub-continent and settlement as far west as Madagascar (Howe 2007; Irwin 2007).

The ancient wayfinders most likely employed an expansionary strategy of first staging a series of exploratory probes to find likely islands, followed by returns to the homeland, and then launching colonizing expeditions (Irwin 1992). To do so, they sailed their double-hulled voyaging canoes eastward against the direction of the dominant trade winds by waiting for westerly wind shifts. After mentally mapping the positions of newly discovered islands in terms of celestial referents, they returned to their homelands to share the sailing directions for future voyages of colonization (Finney 1996). As most of the Pacific Islands are volcanic in origin, the exploratory seafarers, also horticulturalists, necessarily transported a living landscape. They brought with them taro, yams, breadfruit, bananas, and coconuts, as well as domesticated pigs, dogs, and chickens, and, possibly with intention, rats (Irwin 2007; Kirch 2000).

Later voyagers discovered and settled the distant archipelagoes of western Polynesia (e.g., Samoa, Tonga, and Fiji), the northwestern archipelagoes of Micronesia (e.g., Marshall Islands and Caroline Islands), and eastern Polynesia (e.g. Tahiti and Marquesas), and from there settled the widely-separated archipelagoes of Hawai'i and Aotearoa as well as the solitary island of Rapa Nui (Irwin 2007; Kirch 2000). Anthropologist Ben Finney suggests that a waxing and waning rhythm of voyaging characterized the large, high-island archipelagoes of eastern Polynesia: "a flurry of back and forth sailings as the islands are being discovered, settled and supplied; then some continued long-range travel for personal, religious or other reasons; and then by a contraction of voyaging as populations grew and rival chiefdoms fought over land and power" (Finney 2007:145).

Archeological excavations, linguistic reconstructions, and genetic studies suggest that the initial settlement of Hawaiʻi came from eastern Polynesia (Kirch 2000) around A.D. 700–800 (Athens et al. 2002). *Moʻolelo* link Hawaiʻi to Kahiki—the generic word for the ancestral homeland of Hawaiians, not a specific island—through accounts of the discovery of certain Hawaiian islands and subsequent inter-archipelago return trips (Beckwith 1970). The first settlers of Hawaiʻi from within the region of Kahiki were probably from the Marquesas Islands (Kirch 2000:291). The archaeological record suggests that early Hawaiians formed settlements of hamlets along the coasts, interred the dead, ate domesticated pigs, dogs, and chickens, and began to clear tracts of forest between A.D. 600–1100 (Kirch 2000:293).

The early settlers of the Hawaiian archipelago would have been especially attracted to windward Oʻahu with its coral reefs, bays, and sheltered inlets for fishing, dense basalt dikes for the production of stone adzes and other tools, and amphitheatre-headed valleys and broad alluvial floodplains that contained fertile soils, numerous permanently flowing streams, and abundant rainfall for the cultivation of crops (Kirch 1985:69). Excavation data from the coastal region of Waimānalo provide a glimpse into the life of the settlers' descendants. The Bellows Beach sand dune occupation site (O18) reveals a particularly rich cultural stratigraphy that has recently been radiocarbon dated after 40 years of dispute (e.g., Dye 2000; Kirch 1985:71; Pearson et al. 1971; Tuggle and Spriggs 2001) to A.D. 1040–1219 (Dye and Pantaleo 2010), several centuries after the current estimates of first settlement. Archaeological excavation data from this site indicate that the settlers' descendants, like their east Polynesian ancestors, lived in pole-and-thatch dwellings, interred the dead beneath these structures, cooked in small hearths, and manufactured stone tools as well as bone and shell fishhooks, and supported themselves by cultivating inland crops, raising domesticated animals, hunting seabirds on offshore islets, fishing, and gathering shellfish (Kirch 1985:71–74). As they adapted to local conditions, they invented distinctive Hawaiian artifacts, including two-piece fishhooks and the *lei niho palaoa* (*lei* of rock oyster shell), which, in addition to other ornaments interred with individuals, suggests a degree of social stratification (Kirch 1985:71–74). Hawaiians also cared for the dead with a variety of *ilina* (burials, graves) depending on the social status of the deceased, including cremation burials, burial caves, burials in the sand and earth, burials directly underneath house floors, burials in the platforms of *heiau* (temples), and burials marked on the surface by stone terraces, mounds, platforms, and other monuments (Kirch 1985:238–242).

New fishhook styles discovered in Hawaiian archaeological sites and Tahitian words entering into the Hawaiian language suggest contact with Tahiti around A.D. 1200 (Kirch 2000:291). In addition, numerous *moʻolelo* chronicle the era of two-way voyaging between the archipelagoes of Tahiti and Hawaiʻi by detailing the feats of specific navigators (Cachola-Abad 1993). The Hawaiʻi-Tahiti voyaging corridor eventually ceased as Hawaiians and Tahitians began to focus more on local initiatives, such as building, maintaining, and deploying fleets of war canoes rather than guiding them on overseas adventures (Finney 2007:145). According to Abraham Fornander's synthesis of *moʻolelo*, the *aliʻi* Laʻamaikahiki closed the era of voyaging between Tahiti and Hawaiʻi when he returned to his ancestral homeland 21 generations before the 1870s (Fornander 1878:168-169). With an average of 20 years between generations, that places the cessation of Hawaiian long-distance voyaging at about A.D. 1450 (Fornander 1878:168–169).

The archaeological record suggests that Hawaiians experienced exponential population growth, intensification of production, and increased social stratification around A.D. 1100–1650. Hawaiians converted valley floors and hillsides to *loʻi* (terraced fields) with *ʻauwai* (canals and ditches) that diverted stream water to irrigate *kalo* and other crops in flooded pond fields, developed dryland field systems for the cultivation of *ʻuala* (sweet potato) and other crops, and constructed stone-walled *loko iʻa* (fishponds) on shallow reef flats to grow and harvest fish (Kirch 2000:293–295). By A.D. 1600, the population, which had burgeoned to at least several hundred thousand people, expanded from the fertile windward regions into the most arid and marginal regions of the archipelago—the leeward valleys and coasts (Kirch 2007). This agricultural and aquacultural intensification supported emerging classes of *aliʻi* and *makaʻāinana* (commoners), whose labor created enduring *heiau* and other monumental architecture that survive in the archaeological record (Kirch 2000:295–296).

The original settlers and their descendents had likely organized themselves into kin-based social groups. The necessity of defining territorial boundaries increased as the population rapidly grew, the amount of available land diminished, voyaging spheres contracted, and the society became more differentiated, hierarchical, and competitive (Kirch 1985:306). The original lineage territories and associated chiefdoms were most likely *mokuʻāina*, or *moku*, (districts) that were sequentially divided (Ladefoged and Graves 2006). Between A.D. 1400–1500, Hawaiians developed a hierarchically nested system of land tenure that centered on the *ahupuaʻa*, a territorial unit that typically extended from the peaks of the mountains down to the sea, encompassing the entire ecology of an island and incorporating its main resource zones, including interior uplands and mountains, coastal lowlands, and fringing reefs (Kirch 2000:296). The *makaʻāinana* remained on the land they cultivated, but *aliʻi* governed this *ahupuaʻa* pattern of territorial units. These *ahupuaʻa* territories changed through time; the regions in a *moku* with greater predictability of resources were most likely settled first and defined according to topographic features, and later divided into separate communities if increases in production could support larger populations (Ladefoged and Graves 2006). Based on the distribution of sites in the most arid and marginal lands, virtually all of Oʻahu was territorially claimed and possibly occupied by A.D. 1650 (Kirch 1992:15). Then, on the eve of European contact (1778), critical transformations in the social structure took place that shifted Hawaiʻi from a chiefdom to an emerging state-level society, especially the rise of divine kingship legitimated in a new religious ideology (the state cults of the gods Kū and Lono) with a formal priesthood (including human sacrifice) and maintained by a monopoly of force (Kirch 2010).

3.3 Waialua Moku

The earliest settlements along the northern coastal areas of Oʻahu have yet to be recovered archaeologically, but the discovery in Haleʻiwa of a basalt adze similar in form to adzes of the Bellows Beach sand dune occupation site (O18) in Waimānalo strongly suggests early occupation (Kirch 1992:14). Indeed, rich marine resources, alluvial floodplains, and permanent streams at the confluence of the Anahulu, Helemano, and Kamananui Valleys would have been particularly attractive to early settlers of the region (Kirch 1992:14). A settlement complex in Anahulu Valley, which was most likely a peripheral extension of the core Waialua production lands, dates to A.D. 1300, a time of inland expansion (Kirch 1992:27).

Moʻolelo chronicle the rise of divine kingship in the uplands of Waialua (Kirch 2010). Located near what some people consider the *piko* (navel or center) of Oʻahu (Becket and Singer 1999:64), Kūkaniloko was a site of *mana* (divine power) that the gods recognized in the child born there (Mililani High School 2001), "an *aliʻi*, an *akua*, a *wela*—a chief, a god, a blaze of heat," (Kamakau 1992:38) starting with Kapawa around A.D. 1100 (Fornander 1916:247; Kamakau 1964:12). This was a sacred birthing place of *aliʻi kapu* (sacred chiefs), who were "the *akua* [gods] of the land" (Kamakau 1992:53). These *aliʻi* were Lo Aliʻi, a class of *aliʻi* who lived in the mountains above Waialua, preserving their chiefly *kapu* by intermarrying among themselves (Kamakau 1964:5; Sahlins 1992:23).

In approximately A.D. 1310 (a time estimate based on an average length of generational intervals in chiefly genealogies), Māweke partitioned Oʻahu into three districts: the Kona region, the ʻEwa, Waiʻanae, and Waialua region, and the windward Koʻolau region. Then, in approximately A.D. 1490, the *ʻaha aliʻi* (council of chiefs) chose Māʻilikūkahi, an *aliʻi kapu* who was born at Kūkaniloko, to be the new *aliʻi nui* (paramount chief) of Oʻahu. After his paramountship was installed at the *heiau* of Kapukapuākea (Site 225; McAllister 1933:140) in central Waialua, Māʻilikūkahi instituted an explicit land division and administration structure: Oʻahu was divided into six *moku*—Kona, ʻEwa, Waiʻanae, Waialua, Koʻolauloa, and Koʻolaupoko—that were further divided into 86 *ahupuaʻa* and smaller territorial units (Kirch 2010:84–90).

The *moku* of Waialua contained a set of centrally located productive lands and peripheral areas that were ecologically marginal but that had access to abundant ocean resources. The fertile center consisted of the area surrounding Kaiaka and Waialua Bays located in the *makai* regions of the *ahupuaʻa* of Kamananui, Paʻalaʻa, and Kawailoa. Large irrigated taro fields were located on the floodplains of four major streams that flowed from mountain gorges to these bays, and two large fishponds, ʻUkoʻa and Lokoea, were located around Waialua Bay. This core productive region likely supported the majority of the Waialua population (approximately 6000–8000 people prior to Western contact). In marked contrast, small fishing communities were located at the extreme western and eastern edges of Waialua—Kaʻena and Kāpaeloa—in sandy coastal soils. These marginal lands were offset by access to very rich deep-sea fishing grounds (Sahlins 1992:20).

The distant lands of the permanent Project footprint, from the southwest mountainous peak of Kaʻala to the northeast coastal region of Kāpaeloa, were once connected culturally and politically. According to anthropologist Marshall Sahlins, Kamananui Ahupuaʻa was once the dominant political and ritual center of Waialua Moku that included detached, outlying lands, including the remote fishing community of Kāpaeloa at the eastern border of Waialua with its prime marine resources, that were controlled by stewards (*konohiki*) of Kamananui proper (Sahlins 1992:20-21). Then, in the 1820s, the ruling chief of Kamananui Ahupuaʻa moved to Anahulu Valley in the *ahupuaʻa* of Kawailoa, which resulted in a redrawing of *ahupuaʻa* boundaries. Kāpaeloa and other outlying sections of Kamananui were thus subsumed into the land of Kawailoa.

This history suggests that prior to the middle nineteenth century land reforms known as the Māhele, the *ahupuaʻa* of Kawailoa extended from its current northern boundary to Kāpaeloa at the northern border of Waialua. Other sources depict relatively small *ahupuaʻa* in this region during pre-Māhele times that were considered to be sub-units of neighboring *ahupuaʻa*, including Kāpaeloa, Punanue, Kuikuiloloa, and Lauhulu. Since these lands were never surveyed during the Māhele process of dividing the land for private ownership, their boundaries are estimated and do not appear to follow natural topographic and geographic features similar to other *ahupuaʻa*. In most references (e.g. LCAs), Kāpaeloa, Punanue, Kuikuiloloa, and Lauhulu are considered *ʻili* (land division smaller than an *ahupuaʻa*) of Kawailoa Ahupuaʻa, while Kāpaeloa is also considered an *ʻili* of Kamananui Ahupuaʻa in the early nineteenth century.

Despite the difficulty in defining the exact type of territorial divisions in the northern lands of the permanent Project footprint (i.e. Kawailoa), converging ethnohistorical and documentary evidence suggests that the discontiguous lands of the Project areas formed two connected cultural areas prior to the Māhele. The proposed microwave communications facility Project area near the summit of Kaʻala is part of Kamananui Ahupuaʻa, formerly the political and ritual center of Waialua. The rulers of Kamananui controlled the detached lands of Kāpaeloa for its rich marine resources, which became subsumed under new leadership with a shift in political domination from Kamananui to Kawailoa. The proposed wind power facility permanent Project footprint is located in this expanded region of Kawailoa. From this perspective, the subsequent cultural and historic background of the permanent Project footprint and surrounding area in this report centers on Kawailoa Ahupuaʻa (including the lands of Kāpaeloa, Punanue, Kuikuiloloa, and Lauhulu) and Kamananui Ahupuaʻa, with a focus on the mountainous region of Kaʻala.

The cultural landscape of the entire *moku* of Waialua has been severely destroyed or obscured during the past two centuries, especially due to the clearing and plowing under of coastal land and sloping uplands between gulches for sugarcane cultivation with the Waialua Agricultural Company (later named the Waialua Sugar Company) (Sahlins 1992:17). Yet, archaeological documentation of sites in the early to mid-twentieth century based in part on the recollections of old Hawaiian residents (McAllister 1933; Thrum 1906), archaeological research (Kirch 1992), and more recent cultural research management surveys and excavations, combined with collected *moʻolelo* and documented observations, illuminate the cultural landscape—patterns of ancient habitation, subsistence, and *wahi pana*—for the *ahupuaʻa* of Kawailoa (Figure 9 and Figure 11, Table 1) and Kamananui (Figure 13, Table 2). While this CIA focuses on the *ahupuaʻa* of Kawailoa and Kamananui, it should be noted that the neighboring *ahupuaʻa* of Waimea in the *moku* of Koʻolaupoko contains numerous cultural and archaeological sites throughout Waimea Valley, which was recently nominated as a Traditional Cultural Property (Monahan 2008).

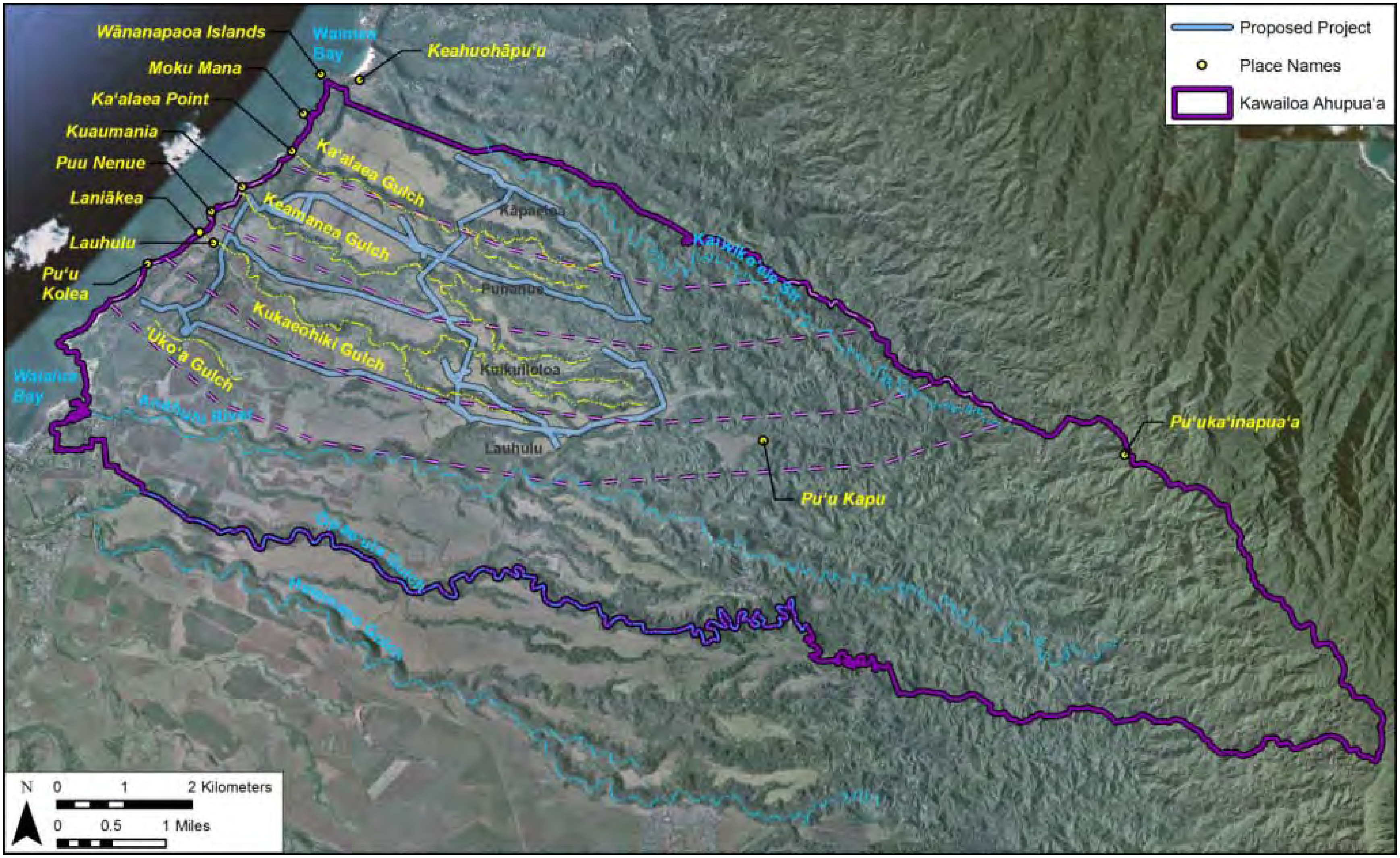

Figure 9. Place names of Kawailoa Ahupua‘a (base image, 2005 USGS 7.5-minute topographic quadrangle)

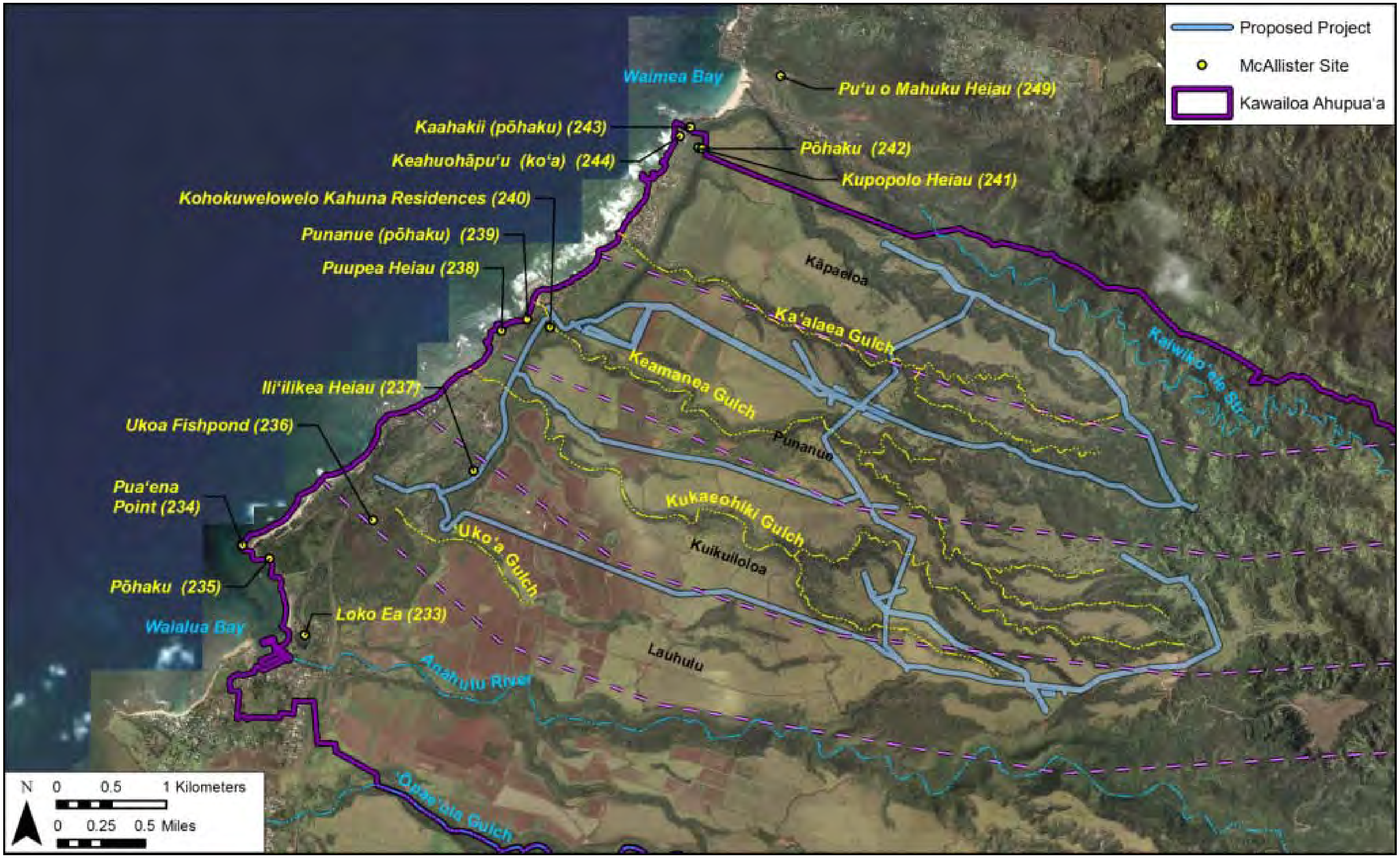

Figure 10. Known locations of *wahi pana* of Kawailoa Ahupua'a in the vicinity of the permanent Project footprint, based on McAllister (1933) (base image, 2005 USGS 7.5-minute topographic quadrangle)

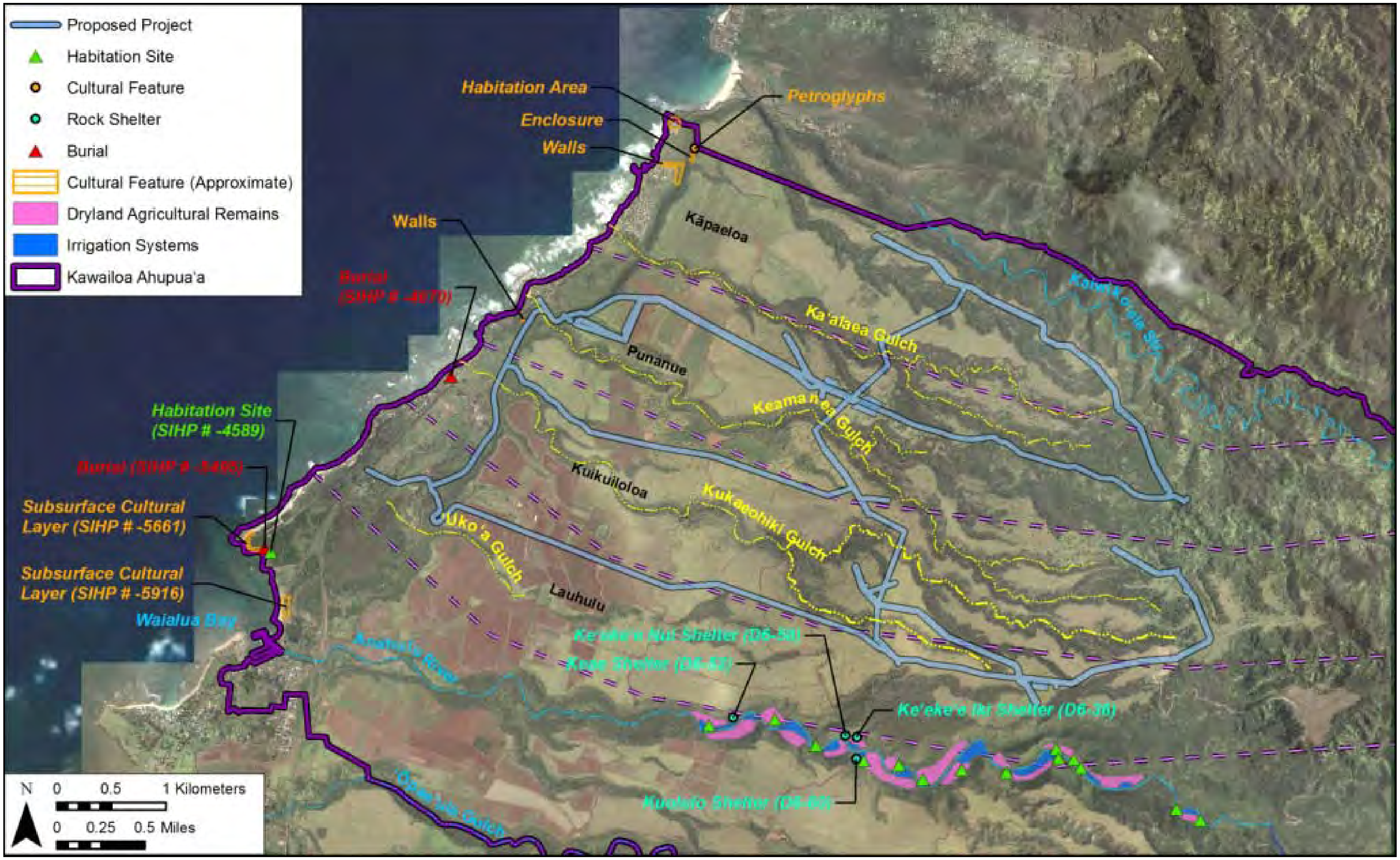

Figure 11. Archaeological sites in Kawailoa Ahupuaʻa, based on Bath (1988); Borthwick et al. (1998); Borthwick at al. (2002); Cluff (1968); Hammatt and Shideler (2006); Kirch and Sahlins (1992); Masterson et al. (1995); Moore et al. (1993); Welch (1981) (base image, 2005 USGS 7.5-minute topographic quadrangle)

Table 1. Archaeological sites in and near Kawailoa Ahupua‘a*

Site Number	Site	Ahupua‘a, Area	Author (date)
233	Lokoea	Pa‘ala‘a	McAllister (1933)
234	Pua‘ena	Pa‘ala‘a	McAllister (1933)
235	Pōhaku	Pa‘ala‘a	McAllister (1933)
236	Loko ‘Uko‘a	Pa‘ala‘a	McAllister (1933)
237	‘Ili‘ilikea Heiau	Kawailoa	McAllister (1933)
238	Puupea Heiau	Kawailoa	McAllister (1933)
239	Punanue (*pōhaku*)	Kawailoa	McAllister (1933)
240	Kahōkūwelowelo	Kawailoa	McAllister (1933)
241	Kūpōpolo	Kawailoa	McAllister (1933)
242	Pōhaku	Kawailoa	McAllister (1933)
243	Kaahakii (*pōhaku*)	Kawailoa	McAllister (1933)
244	Keahuohāpu‘u (*ko‘a*)	Kawailoa	McAllister (1933)
249	Pu‘u o Mahuka Heiau	Kawailoa	McAllister (1933)
D6-17	Petroglyphs, Enclosure	Kawailoa	Cluff (1968)
D6-36	Ke‘eke‘e Iki Rockshelter	Kawailoa, Anahulu Valley	Kirch 1992
D6-52	Keae Rockshelter	Kawailoa, Anahulu Valley	Kirch 1992
D6-58	Ke‘eke‘e Nui Rockshelter	Kawailoa, Anahulu Valley	Kirch 1992
D6-60	Kuolulo Rockshelter	Kawailoa, Anahulu Valley	Kirch 1992
Numerous	Habitation Sites	Kawailoa, Anahulu Valley	Kirch 1992
Numerous	Irrigation Systems	Kawailoa, Anahulu Valley	Kirch 1992
Numerous	Dryland Agricultural Remains	Kawailoa, Anahulu Valley	Kirch (1992)
50-80-01-2483	Midden	Kawailoa	Athens and Shun (1982)
50-80-01-2484	Midden	Kawailoa	Athens and Shun (1982)
50-80-04-3724	Burial	Kawailoa	Bath (1988)
50-80-04-4589	Habitation Site	Kawailoa	Moore et al. (1993)
50-80-04-4670	Burial	Kawailoa	Avery and Kennedy (1993)
50-80-04-5495	Burial	Kawailoa	Borthwick et al. (1988)
50-80-04-5661	Subsurface Cultural Layer	Kawailoa	Borthwick et al. (1988)

Site Number	Site	Ahupuaʻa, Area	Author (date)
50-80-04-4589	Habitation Site	Kawailoa	Moore et al. (1993)
none	Habitation Site	Kawailoa	Welch (1981)
none	Walls	Kawailoa	Hammatt and Shideler (2006)
none	Walls	Kawailoa	Masterson et al. (1995)

*The accompanying AIS did not find any of these specific historic properties or any of these types of historic properties in the area to be disturbed by the Project

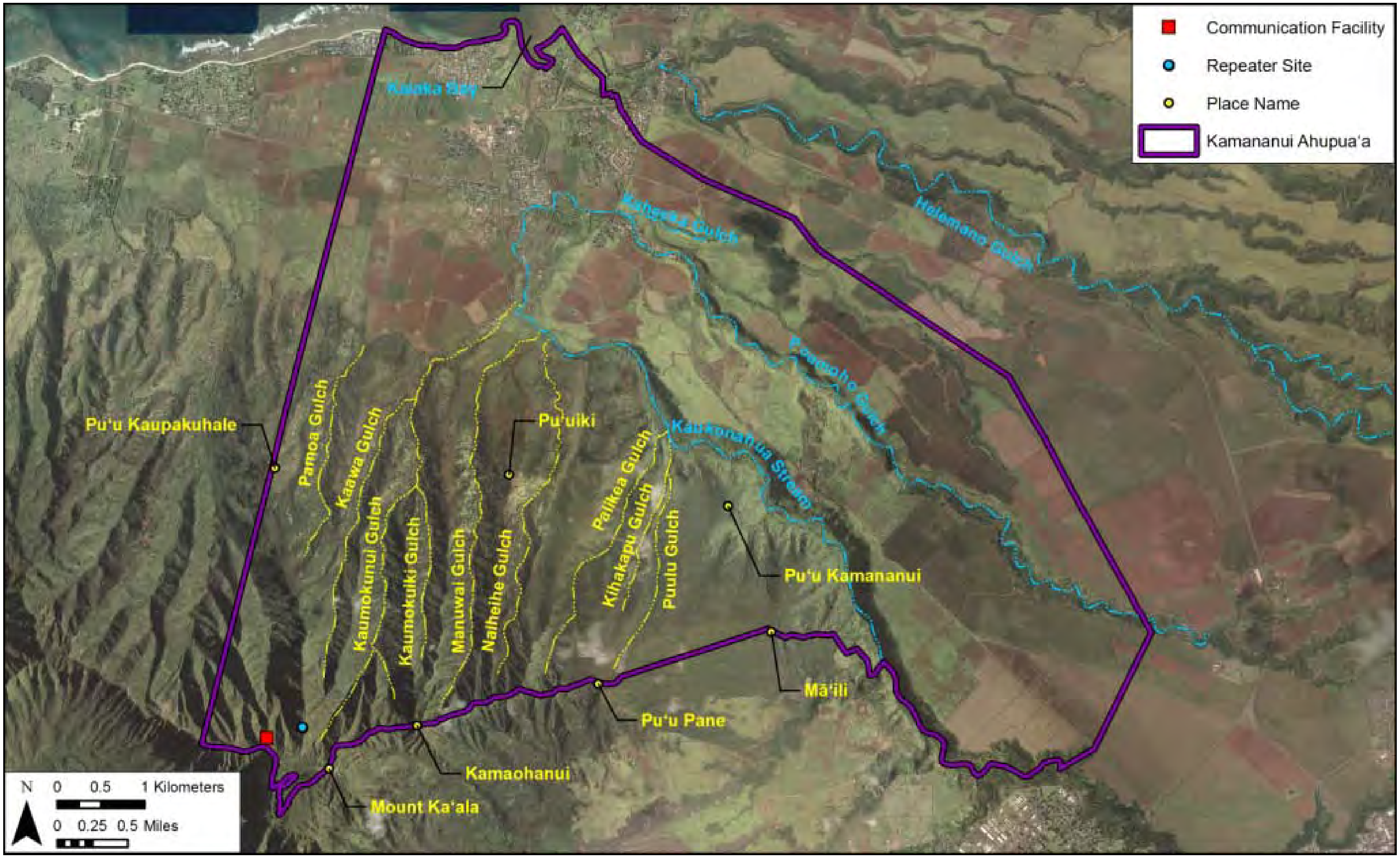

Figure 12. Place names in Kamananui Ahupua‘a (base image, 2005 USGS 7.5-minute topographic quadrangle)

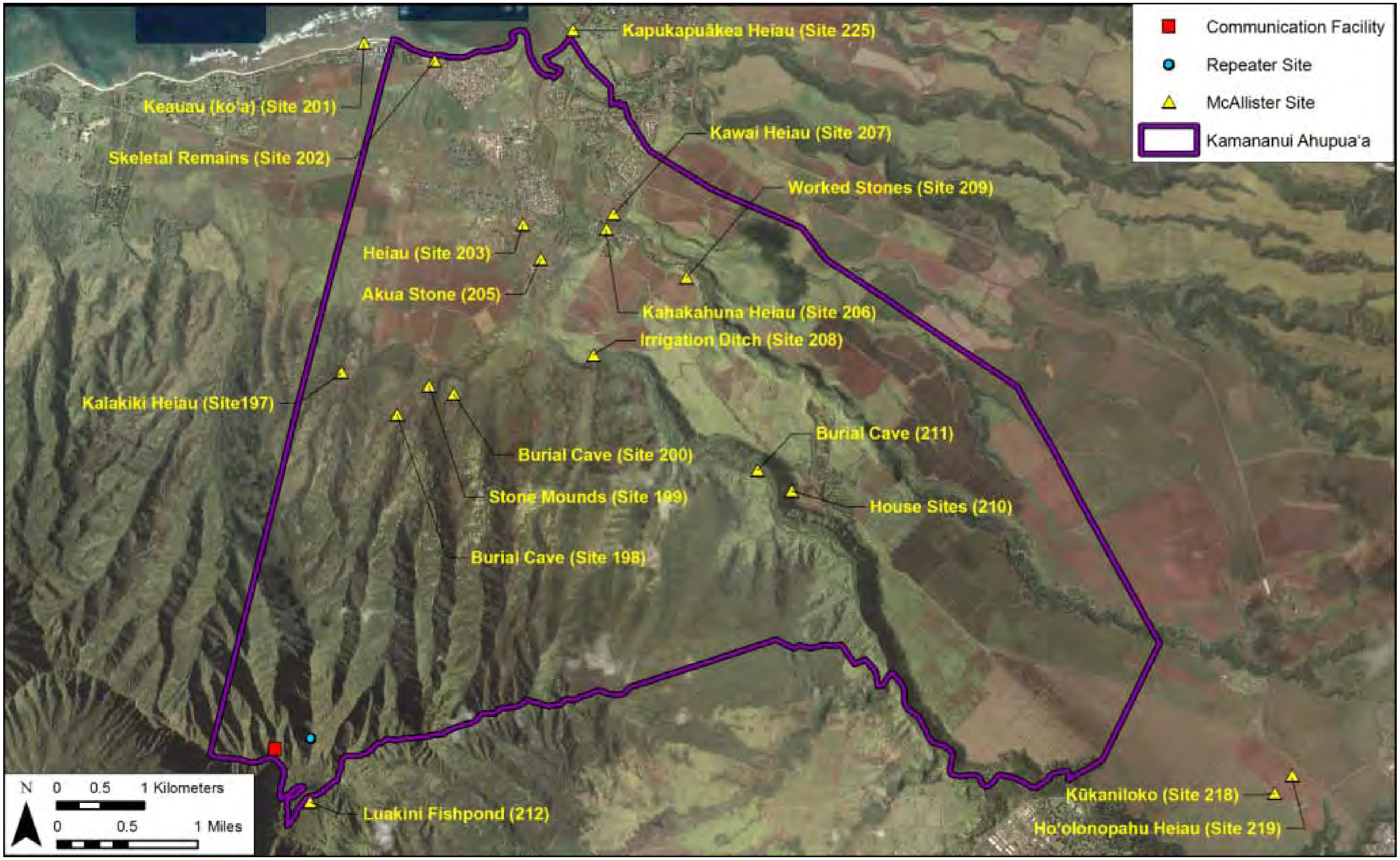

Figure 13. Archaeological sites and known locations of *wahi pana* in Kamananui Ahupua'a, based on McAllister (1933) (base image, 2005 USGS 7.5-minute topographic quadrangle)

Table 2. Archaeological sites in and near Kamananui Ahupuaʻa*

Site Number	Site	Ahupuaʻa	Author (date)
197	Kalkiki Heiau	Kamananui	McAllister (1933)
198	Burial Cave	Kamananui	McAllister (1933)
199	Stone Mounds	Kamananui	McAllister (1933)
200	Burial Cave	Kamananui	McAllister (1933)
201	Keauau (*koʻa*)	Kamananui	McAllister (1933)
202	Skeletal Remains	Kamananui	McAllister (1933)
203	Heiau	Kamananui	McAllister (1933)
205	Akua Stone	Kamananui	McAllister (1933)
206	Kahakahuna Heiau	Kamananui	McAllister (1933)
207	Kawai Heiau	Kamananui	McAllister (1933)
208	Irrigation Ditch	Kamananui	McAllister (1933)
209	Worked Stones	Kamananui	McAllister (1933)
210	House Sites	Kamananui	McAllister (1933)
211	Burial Cave	Kamananui	McAllister (1933)
212	Luakini Fishpond	Kamananui	McAllister (1933)
218	Kūkaniloko	Wahiawā	McAllister (1933)
219	Hoʻolonopahu Heiau	Wahiawā	McAllister (1933)
225	Kapukapuākea Heiau	Paʻalaʻa	McAllister (1933)

*The accompanying AIS did not find any of these specific historic properties or any of these types of historic properties in the permanent Project footprint.

3.4 Kamananui and Kawailoa Ahupua‘a

While the surface archaeological record of Kamananui and Kawailoa Ahupua‘a has been extensively disturbed, obscured, and, in some cases, destroyed over the past two centuries, pioneering efforts in the early twentieth century to document sites (McAllister 1933; Thrum 1906), recent archaeological research (Kirch 1992) and cultural resource management work, combined with *mo‘olelo*, offer a window into the ancient past. Importantly, there is a close spatial association between major *heiau* and intensive agriculture for the entire island of O‘ahu, and residential sites are usually distributed around the margins of irrigation systems and up into lower valleys (Kirch 1992:16–17). Thus, fragments of information about residential sites, cultivation and irrigation, trails, burials, and monumental structures and other *wahi pana* derived from archaeology, ethnography and historical records illuminate ancient settlement patterns, part of the overall cultural landscape.

Reconstructing patterns of ancient settlement draws heavily from *wahi pana*, a term not easily defined or described. A Hawaiian *wahi pana* “physically and poetically describes an area while revealing its historical or legendary significance” (Landgraf 1994:v). *Wahi pana* are sacred places that include such cultural properties as *heiau*, *loko i‘a*, *ala hele* (trails), *ilina* and *iwi kūpuna* (ancestral bone remains), land divisions, and natural geographic locations (place names), such as streams, peaks, rock formations, ridges, and offshore islands and reefs that are associated with culturally significant beliefs or events. A *wahi pana* leaves an imprint on the landscape even if its tangible properties no longer exist, as the *mana* of previous people and events associated with this space continues to manifest itself. For example, the stereotypical *heiau* is composed of terraces, enclosures, walls, mounds, or upright stones, but *heiau* can also be sacred places on a landscape that lack built structures, natural landscape features such as rock outrcoppings, and earthworks where *mana* is concentrated and transferred between the deities and worshippers (Becket and Singer 1999:xix-xx). Further, previously documented and ongoing *mo‘olelo* of *wahi pana* that no longer have material traces are precisely the evidence of their enduring significance (Sahlins 1992:22). For clarity, the locations of *wahi pana* are bolded in the text and labeled (see Figure 9) if their locations are known; all *wahi pana* meanings are cited from Pukui et al. (1974) unless otherwise noted; and spelling and use of diacriticals follow Pukui et al. (1974).

Wahi pana are but one class of numerous cultural properties that create a cultural attachment to the landscape for Hawaiians. Kepā Maly explains the concept of “cultural attachment” from a Hawaiian cultural worldview:

> (Cultural attachment)…embodies the tangible and intangible values of a culture. It is how a people identify with and personify the environment (both natural and manmade) around them. Cultural attachment is demonstrated in the intimate relationship (developed over generations of experiences) that people of a particular culture share with their landscape – for example, the geographic features, natural phenomena and resources, and traditional sites etc., that make up their surroundings. This attachment to environment bears direct relationship to beliefs, practices, cultural evolution, and identity of a people. In Hawai‘i, cultural attachment is manifest in the very core of Hawaiian spirituality and attachment to landscape, the creative forces of nature which gave birth to the islands (e.g.,

> Hawaiʻi), mountains (e.g., Mauna Kea) and all forms of nature, also gave birth to *na kanaka* (the people), thus in Hawaiian tradition, island and mankind share the same genealogy. (Maly 1999:27)

In a Hawaiian cultural worldview, a sense of place relies on keeping the integrity of the cultural landscape (Maly 2001). Maly succinctly articulates this connection between a sense of place and the cultural landscape:

> The integrity of the land- and ocean-scapes [landscape], and their sense of place depends upon the well-being of the whole entity, not only a part of it. Thus, what we do on one part of the landscape has an affect on the rest of it. (Maly 2001:2)

3.4.1 Settlement Patterns

3.4.1.1 Place Names

Hawaiian place names convey a wide variety of information about the relationships among people, landscapes and other natural and cultural resources. Place names may also express cultural, historical and/or spiritual values and concepts important to Hawaiian world views. It is common for places and landscape features to have multiple names, some of which may only be known to certain *ʻohana* (families) or even certain individuals within *ʻohana*, and many of which have been lost, forgotten or kept secret through time. Place names may also convey *kaona* (hidden meanings) and *huna* (secret) information that may even have political or subversive undertones. Before the introduction of writing to the islands, when cultural information was exclusively preserved and perpetuated orally, Hawaiians gave names to literally everything in their environment, including individual garden plots and *ʻauwai*, house sites, intangible phenomena such as meteorological and atmospheric effects, *pōhaku* (rocks), *pūnāwai* (fresh-water springs), and many others.

The *moku* of **Waialua** is not translated by Pukui et al. (1974); however, a literal translation is “two” (*lua*) “water[s]” (*wai*), which may be a reference to the pair of major streams that empty into its two main bays. Sterling and Summers (1978:88) compiled other alternative interpretations of the origins of the meaning of Waialua, including references to a particular *loʻi*, a specific *pūnāwai* at a place called Kemoʻo, and a cruel ancient chief named Waia.

The *ahupuaʻa* of **Kamananui** (the supreme or highest spiritual power; *ka-mana-nui*) is partially delineated by place names of ridges, peaks, and hills. **Mount Kaʻala**, the highest point on Oʻahu and the site of the proposed microwave communication facility Project area, is located along the mountainous border of Waialua and Waiʻanae Moku at the intersection of Kamananui, Mākaha, and Waiʻanae Ahupuaʻa (see Section 3.4.2 for *moʻolelo* of Mount Kaʻala). Along the ridge separating Kamananui from Waiʻanae Ahupuaʻa are the peaks **Kamaohanui**, **Puʻu Pane** (answering hill), and **Māʻili** (pebbly). A ridge called **Puʻu Kaupakuhale** (house ridgepole or roof) lines the extreme western side of the *ahupuaʻa*, and isolated peaks called **Puʻuiki** (small hill) (also the name of a coastal section of land) and **Puʻu Kamananui** are located in the central part of the *ahupuaʻa*. A slope called **Keawawaihe** overlooks the *moku* of Waialua. This place, also called the Valley of Spears, was a place where brigands accosted travelers by disjointing them through the practice of *lua* (hand-to-hand fighting) and sometimes killing them with spears (*Honolulu Advertiser* 1925, cited in Sterling and Summers 1978:107). Three streams permanently flow through gulches from the *mauka* lands of Kamananui (and Paʻalaʻa) Ahupuaʻa toward **Kaiaka Bay** (shadowed sea)**—Poamoho Stream** (and **Gulch**), **Kaukonahua Stream**, and **Helemano Stream** (and **Gulch**) (many snared or many going). Other intermittent streams flow in gulches that punctuate the mountains sections of Kamananui, including **Kaheeka Gulch**, **Naiheihe Gulch**, **Manuwai Gulch**, **Kaumokuiki Gu**lch, **Kaumokunui Gulch**, **Kaawa Gulch**, **Pamoa Gulch**, **Palikea Gulch** (white cliff), **Kihakapu Gulch**, **Puulu Gulch** (*Bryon's Sectional Maps of Oʻahu* 2011).

In the *ahupuaʻa* of **Kawailoa** (the long water), **Anahulu River** (ten days), the longest continuous stream drainage system on Oʻahu (67 miles), flows from the distant *mauka* lands in Kawailoa Ahupuaʻa through **Kawailoa Gulch** toward **Waialua Bay**. In addition, **ʻŌpaeʻula Stream** (red shrimp) flows along the boundary of Kawailoa and Paʻalaʻa Ahupuaʻa toward Kaiaka Bay, and **Kaiwikoʻele Stream** (the rattle bones) flows toward **Waimea Bay**. Other streams flow intermittently in gulches, including **Kaʻalaea Gulch** (the ocherous earth) that terminates at **Kaʻalaea Point** on the coast, **Keamanea Gulch** (also called **Kawailoa Gulch**) that terminates at **Kuaumania** (also called Chuns Reef Beach), **Kukaiohiki Gulch** (also called **Laniākea Gulch**) that terminates at a surfing area called **Laniākea** (wide sky), and **ʻUkoʻa Gulch** (*Bryon's Sectional Maps of Oʻahu* 2011). In the extreme northern coastal point of the *ahupuaʻa*, **Kehuohāpuʻu** (also Keahuohāpuʻu; the-altar-of-[the]-*hāpuʻu* [black sea bass]) refers to a natural rocky point as well as a fishing shrine located upon this point. **Wānanapaoa** (unsuccessful prophecy) is a group of small islets immediately adjacent to Kehuohāpuʻu, and the islet of **Moku Mana** is located farther south. Farther south is a surfing area called **Laniākea** (wide sky). The southern coastal section of Kawailoa Ahupuaʻa is punctuated by **Puʻu Kolea**, **Puaʻena Point** and **Punenue Point**, with the plains of **Lauhulu** running from Punanue Point toward Anahulu Stream. Prominent peaks in the *mauka* lands of Kawailoa include **Puʻu Kapu** (sacred hill) and **Puʻukaʻaumakua** (the family deity hill), which demarcates the intersection of the *moku* of Koʻolaupoko, Koʻolauloa. As mentioned above, **Kāpaeloa** was previously detached lands of Kamananui Ahupuaʻa, and **Punanue**, **Kuikuiloloa**, and **Lauhulu** were *ahupua'a* that became absorbed into Kawailoa prior to the Māhele. These lands are now generally considered *ʻili* of Kawailoa Ahupuaʻa.

3.4.1.2 Subsistence and Habitation

The fertile coastal plains of Kamananui and Kawailoa Ahupuaʻa were watered from the streams flowing from the Koʻolau mountains, and dense settlements and large complexes of irrigated taro fields were located on the floodplains of these streams near the coast (Sahlins 1992:20). Two stream-fed ponds, **Lokoea** (Site 233, McAllister 1933:141) and **Loko ʻUkoʻa** (Site 234, McAllister 1933:142) contributed freshwater fish. Large terraces once extended along the flatlands between the junction of Poamoho Stream and Helemano Stream (in adjacent Paʻalaʻa Ahupuaʻa to the east) and west of Poamoho Stream in the *makai* section of the Kamananui Ahupuaʻa (Handy 1940:85). A rock-lined irrigation ditch extended about two miles from Kaukonahua Stream toward these flatlands (later modified by the Waialua sugar Plantation for the sugar mill) (Site 208, McAllister 1933:133), irrigating *loʻi kalo* (Handy and Handy 1972:466). Smaller terraces were also located in the lower flats of Poamoho and Kaukonahua Valleys, and Hawaiians most likely cultivated sweet potatoes and bananas in the *mauka* gulches (Handy 1940:85). On both sides of Kaukonahua Gulch farther *mauka* are four closely-spaced piles of large stones indicative of former habitations (Site 210, McAllister 1933:133). In the extreme western portion of the Kamananui Ahupuaʻa, several oval-shaped piles of stones are located at the mouth of Kaumoku Gulch and may have been cleared away for agricultural purposes prior to the plantation period in the early twentieth century (Site 199, McAllister 1933:130).

In the high, level saddle region between the two mountain ranges of Oʻahu in the former lands of Kamananui (now Wahiawā), extensive cultivation took place, which suggests sizable populations of ancient Hawaiians (Handy and Handy 1972:464). The present town of Wahiawā, was an area of extensive irrigated sweet potato and yam cultivation (Handy and Handy 1972:464–465) on a plain called Leilehua (*lehua* [the flower of the *ʻōhiʻa* tree] lei). Numerous *loʻi kalo* were maintained at a place called Kukui-o-Lono; *moʻolelo* describe that an ancient high chief, Kūkaniloko, grew the first *loʻi* there (Handy and Handy 1972:465).

Mount Kaʻala, the site of the proposed microwave communication facility Project area, is a circular plateau approximately one mile across. Aside from four radiating ridges, the plateau is bounded by precipices 1,000–2,000 feet high. The following two *ʻōlelo noʻeau* reflect the heavy precipitation that has formed a swamp at the summit:

Ka ua Kolowao o Kaʻala The Mountain-creeper rain of Kaʻala

This rain is accompanied by a mist that seems to creep among the trees (Pukui 1983:169)

Nani Kaʻala, he kiʻowai na ke kēhau Beautiful Kaʻala, a pool that holds the dew

Praise of Mt. Kaʻala, on Oʻahu, a depository for the dew (Pukui 1983:248).

A *moʻolelo* about a woman named Paliuli also mentions a pool at Kaʻala (Manu 1884). Small streams from the swampy plateau cascade as waterfalls into the lower valleys. *Moʻolelo* suggest that the summit swamp was formerly a freshwater fishpond called **Luakini**, in which *hīnālea* (wrasses), *wuwoa* (a kind of mullet), and other fish grew (Site 212; McAllister 1933:133). In addition, a *mele* within a *moʻolelo* of Kūaliʻi references freshwater crabs at Kaʻala:

> *Ka limu kau I ka laau, Ka elemihi ula I ka luna o Kaala-la*
>
> The moss that hangs on the wood, The red crab on the top of Kaala (Fornander 1916:390).

Yet, observations in the mid-twentieth century did not reveal any stone walls, which would have been required to keep water from flowing out of a deep depression in the swamp, and the presence of moss-laden *lehua* trees in the swamp meant that the pond had not been used in a very long time (McGuire 1953, cited in Sterling and Summers 1978:132).

The interior reaches of Anahulu Valley in the southern section of Kawailoa Ahupuaʻa contain archaeological evidence of settlement patterns that extend as far back as A.D. 1300. Kirch's (1992:30–56) excavations at four rock shelters (Kēʻae Shelter, D6-52; Keʻekeʻe Nui Shelter, D6-58; Keʻekeʻe Iki Shelter, D6-36; and Kuolulo Shelter, D6-60) on the cliff faces of Anahulu Gulch uncovered stratified occupation sequences with well-preserved faunal remains (e.g., pig, dog, chicken, birds, fish), floral remains (e.g., pandanus, candlenut), Hawaiian artifacts (e.g., fishhooks, adzes, abraders, hammer stones, awls, flaked basalt and volcanic glass, *‘ulu maika* [ball for bowling game], tattooing needles), foreign artifacts in the upper deposits (glass sherds, ceramics, iron fragments, and gun flints), and features (e.g., hearths with charcoal deposits, *imu* [earth ovens] lined with fire-altered stones, earth-filled terraces with stone retaining walls). From this evidence, Kirch suggests that around A.D. 1300 the Ke‘eke‘e Nui rock shelter was used by coastal residents as an intermittent camp, followed by the other three shelters a few centuries later, for the extraction of mountain resources. A shift occurred between A.D. 1600–1700 with more permanent occupation and expanded cultivation: “A shifting of household groups from the lowlands to the interior hinterlands, whether as a result of dispossession of lands or as a more opportunistic mode of exploiting an upland ecological niche” (Kirch 1992:49).

By the time of the arrival of Kamehameha’s forces in 1795 and their settlement onto the O‘ahu landscape in 1804, shifting cultivation and forest-product extraction had supported several household groups living in the rock shelters in the upper Anahulu Valley, and foreign material goods had begun to arrive from the lowlands. Then, a rapid, radical transformation of land use and agricultural intensification occurred. Kamehameha encouraged the expansion and intensification of agricultural production to sustain his invading forces when they returned to O‘ahu in 1804, including the peripheral lands of the upper Anahulu Valley. The rock shelters were abandoned, and descendants of Kamehameha’s conquering forces constructed a series of open house sites in association with intensive pond field irrigation of taro on the alluvial terraces at the bends of the main stream and adjacent *kula* (dryland agriculture) lands, as well as made clearings in the smaller forested valleys and ravines to cultivate bananas, yams, *wauke* (paper mulberry), sweet potatoes, and dryland taro (Kirch 1992:57–59).

Recent archaeological surveys and excavations for cultural resource management work has revealed numerous cultural features and artifacts along the coastal strip of Kawailoa Ahupua‘a that are indicative of former habitation. In the northern region of Kāpaeloa, the University of Hawai‘i (Cluff 1968) identified Kūpōpolo Heiau (see Section 3.4.1.3 below), two petroglyph concentrations, a stone enclosure that may contain an *akua* stone, and historic artifacts (glass bottles). In the same area, the Bishop Museum identified a small *heiau*, a water hole, enclosures, two stone walls, rock shelters, a midden scatter, a midden deposit, stone platforms, and a railroad bed (Welch 1981). Excavations at two sites (State Inventory of Historic Properties [SIHP] No. 50-80-01-2483 and 50-80-01-2-2484) revealed extensive fish bone and marine shell midden as well as the presence of numerous indigenous Hawaiian artifacts, including fishhooks, coral and sea urchin spine files, volcanic glass flakes, basalt adzes, and an ‘*ulu maika* (Athens and Shun 1982). Nearby, CSH also identified walls of terraces of traditional Hawaiian construction (Hammatt and Shideler 2006). Farther south on an approximately three-acre parcel at Kawailoa Beach, located on the *makai* boundary of the Project’s access road, CSH identified an historic bridge constructed of basalt and mortar, a segment of the Oahu Railway and Land Company (OR&L) right-of-way (SIHP No. 50-80-01-9714), and stacked basalt boulder walls (Masterson et al. 1995). Rudy Mitchell of Waimea Falls Park believed these walls may have been remnants of Pu‘upea Heiau, but based on McAllister’s distant location of the *heiau*, it was determined that the observed walls were not associated with Pu‘upea Heiau (Masterson et al. 1995). Closer to Hale‘iwa, investigations have revealed subsurface cultural layers (SIHP No. 50-80-01-5916, Borthwick et al. 2002; SIHP No. 50-80-01-5661, Borthwick et al. 1998), and a habitation site (SIHP No. 50-80-01-4589, Moore et al. 1993).

3.4.1.3 Heiau, Pōhaku, and other Ceremonial and Religious Structures

Major *heiau* and other ceremonial and religious structures were closely associated with intensive agriculture and residential sites (Kirch 1992:16-17). In the western section of Kamananui Ahupuaʻa, two *heiau* once stood at the crest of a ridge below Puʻu Kaupakuhale. **Kalakiki Heiau**, located about three miles north of the microwave facility Project area, once contained at least two terraces, but only a large front terrace is not covered by dense foliage (Site 197, McAllister 1933:129). **Onehana Heiau**, of *poʻokanaka* class (human sacrifice) formerly adjoined Kalakiki Heiau (Thrum 1906:47), but no physical features remain today (Sterling and Summers 1978:104).

In the *makai* section of Kamananui Ahupuaʻa, a *heiau* of unknown name once occupied a site near Kaukonahua Stream (Site 203, McAllister 1933:132). Nearby, an *akua* stone once sacred to the goddess Pele is located in an area that remained untouched in the midst of sugar cane fields (Site 205, McAllister 1933:132). **Kahakahuna Heiau** and **Kawai Heiau** once flanked the nearby Poamoho Stream; the latter was one of the first *heiau* to be destroyed during the plantation era (Sites 206 and 207, McAllister 1933:132). Farther *makai*, a *koʻa* (fishing shrine) called **Keauau** was formerly located on the beach at Puʻuiki (Site 201, McAllister 1033:132). Artificially worked stones were discovered underground during the digging of the shaft for a pump in Poamoho Gulch in Kamananui Ahupuaʻa. They are reported to have resembled *ʻulu maika* (Site 209, McAllister 1933:133).

About six miles east of the microwave communication facility Project area in the modern *ahupuaʻa* of Wahiawā, which was formerly part of Kamananui until 1913 (Sterling and Summers 1978:138), is the sacred site of **Kūkaniloko** (Site 218, McAllister 1933:134–137), one of two famous birthing places in the Hawaiian archipelago (the other is in Kauaʻi) for the highest ranking chiefs, the *aliʻi kapu* (Figure 14). Located near what some people consider the *piko* of Oʻahu (Becket and Singer 1999:64), Kūkaniloko was a site of *mana*, which the gods recognized in the children born there (Mililani High School 2001). *Moʻolelo* describe that Kahihiokalani, the wife of the *aliʻi* Nanakaoko, gave birth to their son, Kapawa, at a birthing stone called Kūkaniloko in the twelfth century, an event witnessed by 36 chiefs (Fornander 1920:247). With the beating of two special *pahu* (drums) to inform the commoners of the birth of a new *aliʻi*, Kapawa and subsequent newborns were taken to nearby **Hoʻolonopahu Heiau** (sounding the *pahu*) (Site 219, McAllister 1933:137), now destroyed, where 48 chiefs presided over the ceremonial cutting of the naval cord (Thrum 1911). *Kāhuna* prepared each pregnant noble woman for what was hoped to be less painful birth through a strict diet and exercise regime, hence the meaning of Kūkaniloko, "to anchor the cry from within" (Mililani High School 2001). Although the ancient structure had deteriorated, in 1797 Kamehameha I arranged for the birth of his heir, Liholiho, to take place at Kūkaniloko but his wife's illness prevented this from occurring (Fornander 1878, Vol.2:20). As the most sacred site on Oʻahu, Kūkaniloko was protected by the Daughters of Hawaii in 1925 until stewardship was transferred to the Wahiawā Hawaiian Civic Club in the early 1960s, then listed on the National Registers of Historic Places in 1973 and the State Register of Historic Places in 1973, and finally placed under the jurisdiction of State Parks in 1992 (Omandam 1998). Today, the naturally weathered stones of Kūkaniloko still receive offerings (Kirch 1996:34–35).

Farther southeast of Kūkaniloko at the former division between ʻEwa and Waialua Moku (prior to the establishment of Wahiawā Ahupuaʻa) are a pair of stones named **Oʻahu nui** (big), the shape of which resembles the outline of Oʻahu (Site 204, McAllister 1933), and **Oʻahu iki** (small). The mapped location of this *pōhaku* by Sterling and Summers (1978) in the *makai* section of Kamananui appears inconsistent with the description and mapped location by John Papa ʻĪʻī (1959:96) at southern edge of the former boundary of Kamananui.

In the extreme northern coastal section of Kawailoa Ahupuaʻa, three religious sites are located along the boundary line separating the *moku* of Waialua and Koʻolauloa (and the *ahupuaʻa* of Kawailoa and Waimea). A *heiau* called **Kūpōpolo**, which measures 266 feet by 110 feet, is a two-terraced rock-paved structure located near the coast (Site 241, McAllister 1933:144) (Figure 15). Kūpōpolo is associated with one of the most famous prophesies in Hawaiian history by Kaʻopulupulu, who fatefully anticipated Oʻahu's imminent subjugation under powers from the windward direction, which have been interpreted as either Kahekili sailing from Maui to defeat Kahāhana, Kamehameha coming from Hawaiʻi, or the arrival of foreigners (Fornander 1920:287). In a line from Kūpōpolo Heiau to the islets of Wānanapaoa are located a sacred *pōhaku* in a rock shelter (Site 242, McAllister 1933:146), a tongue-shaped *pōhaku* named **Kaahakii** (Site 243, McAllister 1933:146), and a *koʻa* called **Keahuohāpuʻu** (Site 244, McAllister 1933:146). Several ceremonial structures are located just across the *ahupuaʻa* division at Waimea Bay, including **Haleolono** (House of Lono), a restored *heiau* with thatched *hale* (house) and *amuʻu* (towers) (Becket and Singer 1999:106), and **Puʻu o Mahuka Heiau** overlooking Waimea Bay, the largest *heiau* on Oʻahu (Site 249, McAllister 1933:147) (Figure 17).

In the mid-coastal section of Kawailoa Ahupuaʻa, four religious sites are closely-spaced. A *heiau* called ʻ**Iliʻilikea**, which measured 75 feet by 267 feet, was destroyed in 1916 by W. Harpham for the Waialua Agricultural Company (Site 237, McAllister 1933:142). Another *heiau* called **Puupea**, located on the beach of Punanue Point, once measured over 100 feet by 250 feet (Site 208, McAllister 1933:142). Nearby, a small smooth stone is reported to be an *akua* stone called **Punanue** (Site 239; McAllister 1933:143). Slightly *makai* is a complex of partially enclosed terraces, platforms, and walls approximately 140 feet by 120 feet called **Kahōkūwelowelo** (Figure 18) that has been variously described as a priestly dwelling (Site 240; McAllister 1933:143), monastery (*Honolulu Advertiser* 1933), and *heiau* (Thrum 1906). According to Thrum's recorded *moʻolelo*, the *kahuna* Kaʻopulupulu journeyed from Kahōkūwelowelo Heiau across the plains of Lauhulu to Anahulu Stream, and then to Kūkaniloko to make the prophecy of the arrival of foreigners (Thrum 1923:205).

In the southern coastal section of Kawailoa Ahupuaʻa, a stone on the sands of the beach near Puaʻena Point was known for its curative powers (Site 235, McAllister 1933:142).

Figure 14. The site of Kūkaniloko (not the principal stone, also called Kūkaniloko) located at the southern edge of a former boundary of Kamananui Ahupua‘a (now Wahiawā Ahupua‘a) (Becket and Singer 1999:65)

Figure 15. Kūpōpolo Heiau (Becket and Singer 1999:105)

Figure 16. Haleolono (Becket and Singer 1999:107)

Figure 17. Puʻu o Mahuka Heiau (CSH June 23, 2010)

Figure 18. Kahōkūwelowelo Heiau, marred by bunkers from World War II (Becket and Singer 1999:103)

3.4.1.4 Ala Hele

John Papa ‘Ī‘ī depicts and briefly describes a network of *ala hele* connecting the *moku* of Waialua, Wai‘anae, ‘Ewa, and Kona that passed through the central site of Kūkaniloko. From there, a trail traversed Kamananui Ahupua‘a along Kaukonahua Stream and spanned the coastal section of Kawailoa Ahupua‘a (‘Ī‘ī 1959:96) (Figure 19).

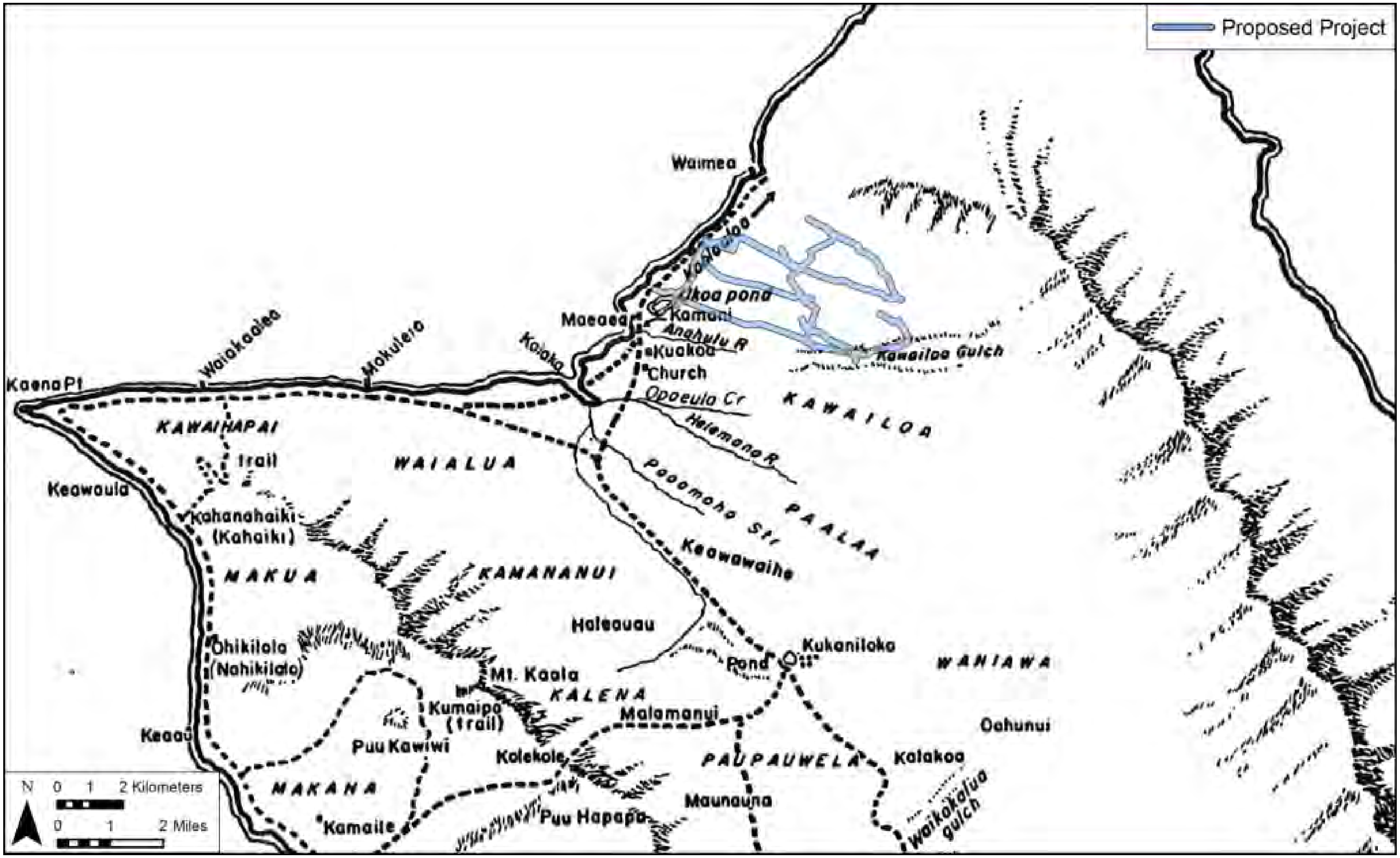

Figure 19. Network of leeward trails described by John Papa ʻĪʻī, map by Paul Rockwood, indicating the central site of Kūkaniloko (ʻĪʻī 1959:96)

3.4.1.5 Ilina

Two burial caves are located about three miles north of the microwave communication facility Project area at the cliffs of Kaumoku Gulch beneath Puʻu Kaupakuhale in Kamananui Ahupuaʻa (Sites 198 and 200, McAllister 1933:130–131). Skeletal remains have also been discovered near the coastal area of Puʻuiki (Site 202, McAllister 1933:132). Hawaiians have also been recently buried in an area near the *akua* stone (Site 205) in the central *makai* portion of the *ahupuaʻa* (McAllister 133:105). Farther *mauka* about two miles northwest of the microwave communication facility Project area, two caves with skeletal remains are located along Kaukonahua Gulch (Sites 210 and 211, McAllister 1933:133).

In the southern coastal section of Kawailoa Ahupuaʻa, the point of Puaʻena was a place where the body of an *aliʻi* named Elani was placed, and corpses of commoners were also placed on the rocks, such that their "the fluids from the decaying body would seep into the sea and attract sharks, which the people killed" (Site 234, McAllister 1933:141–142). Two burial sites were discovered in this coastal area (SIHP No. 50-80-01-4670, Avery and Kennedy 1993; SIHP No. 50-80-01-5495, Borthwick et al. 1998). In the southern mountainous section of Kawailoa Ahupuaʻa, burials are located within and near the settlements in the upper Anahulu Valley, including stone burial crypts, a cliff burial, and a walled burial cave (Kirch 1992:88, 94,104, 112). Along the northern coastal strip of Kawailoa, the SHPD reported findings of human remains (SIHP No. 50-80-01-3724) on the inland side of Kamehameha Highway, although this stretch of coast tends to be rocky and lacking in Jaucas sand deposits (Bath 1988). It is unclear at this time whether this burial find was truly anomalous or whether burial in terrigenous soils was a pattern where Jaucas sand beach deposits were not available.

3.4.2 Remembered Landscape

Moolelo Hawaii o Pakaa a me Ku-a-Pakaa, na Kahu Iwikuamoo o Keawenuiaumi, ke Alii o Hawaii, a o na Moopuna hoi a Laamaomao, concisely rendered into English as *The Wind Gourd of Laʻamaomao*, tells the story of how Pākaʻa and his son Kuāpākaʻa, descendants of the wind goddess Laʻamaomao, control the winds of Hawaiʻi through a gourd, a "wind calabash," that contains the winds and could be called forth by chanting their names (Nakuina 1992). Throughout the *moʻolelo*, the winds respond to the calling of their names and accomplish what the caller desires. In the case of Pākaʻa, it is to summon whatever wind he desired during his voyages. Part of Pākaʻa's chant traces 45 winds of Oʻahu, each with a name and peculiarities of its own. The section on Waialua mentions the wind that blows at Mount Kaʻala (Puʻu-kaʻala):

> The wind of Kaʻena turns in two directions,
>
> Hinakokea is of Mokulēʻia,
>
> The winds of Waialua blow,
>
> Moving silently at the cape of Kaʻena,
>
> Puʻu-kaʻala blows at Kaʻala,
>
> Kehau is of Kapo. (Nakuina 1992:51)

There are numerous other *mo'olelo* of Laʻamaomao. According to the newspaper *Ka Naʻi Aupuni* (June 16, 1906), Laʻamaomao was a name for the sky and the directions from which came the winds and rains, which were important for *ʻuala* planters and the priests of Lono, the god of agriculture and fertility (Handy and Handy 1972:220). Lono was associated with the *kona* (southerly) winds that brought rain to the dry areas where gourds were grown. Thus, the gourds were the *kino lau* (embodiments) of Lono, and Lono was the cosmic gourd: "The cosmic gourd is the heavens whence come winds, clouds, and rain" (Handy and Handy 1972:220).

The practical knowledge of the winds was crucial to the island environment of Hawaiʻi, especially for sailing and navigating: "If you knew the name of the *makani* (wind) that blew through a particular area, you were never lost, both geographically and…epistemologically…To know the winds of a particular place was to know one's precise location, to understand the deities that existed therein, and to be sensitive to the differences in the landscape and seascape in that space" (Iaukea 2009:48–49).

The summit of Kaʻala, the highest point on Oʻahu, is considered a sacred place (Waiʻanae Ecological Characterization 2011):

> Ancient kahunas (priests) spoke of Mount Kaala as being clothed in the golden cloak of Kane, the first deity of the Hawaiian pantheon. Kaala was the guardian of the road to the west, the path of the sun, the resting place on that great road to death where spirits of the dead return to their homeland (McGrath et al. 1973:11).

From the summit plateau of Mount Kaʻala, the spine of the Waiʻanae mountains extends into the sea at Kaʻena Point, the most northeastern extension of Oʻahu. This place was a *leina ʻuhane* (leap of the soul), a place where the souls of the dead leaped into the next world (McAllister 1933:125–126). Perhaps the "resting place" of Kaʻala mentioned by McGrath et al. (1973:11) was for these souls heading toward Kaʻena Point.

Several *moʻolelo* relate the significance of the Kaʻala summit for weather forecasting and making prophecies. In one *moʻolelo* chronicled by Kalākaua (1890:155-173), Hua, the ruling chief of Hāna, Maui in the twelfth century, slays a *kahuna*, Luahoʻomoe. An ensuing drought afflicted Hua and his attendants wherever they went. This terrible scourge follows another Hāna chief and his retainers to Waimalu, ʻEwa, Oʻahu where a celebrated prophet, Naula-a-Maihea, lived. Alarmed at the threat of destruction, Naula-a-Maihea "ascended the highest peak of the Waiʻanae Mountains" (Kalākaua 1890:170). After observing the patterns of clouds, he voyaged to Maui to perform rituals with the sons of Luahoʻomoe so that the rains and fertility of the land would be restored.

Kalākaua (1890:455-480) chronicled another *moʻolelo* involving a search for atmospheric signs from Mount Kaʻala. Two daughters, Laieikawai and Laielohelohe, were sent upon their birth to live with Waka, their grandmother, and a priest in order to avoid being put to death by their father, the *aliʻi* of the two Koʻolau districts. The priest took Laielohelohe to the enclosure of Kūkaniloko and Waka took Laieikawai to a cavern, which, after diving, opened into a pool called Waiapuka. When the pair entered the cavern, a rainbow appeared and was constantly visible so long as the child remained inside. Hulumaniani, a great prophet of Kauaʻi, observed this distant rainbow for twenty days in succession. He sailed toward Oʻahu, landing at Waiʻanae and quickly reaching the pool. Waka noticed the prophet and dove into the water. In the morning, he noticed that the rainbow appeared over Kūkaniloko. Traveling in that direction, “he ascended Mount Ka‘ala, when he saw the rainbow over the island of Molokai” (Kalākaua 1890:458). Still in pursuit, he erected a small *heiau* near Hāna, Maui and conjured the wraiths of Waka and Laieikawai. He then set forth to a rainbow on the windward side of the island of Hawai‘i, but lost all traces of the pair.

3.4.3 Ruling Chiefs

In 1783, Kahekili, the *mō‘ī* (ruler) of Maui, fought for control of O‘ahu from Kahāhana, the *mō‘ī* of O‘ahu. Kahekili killed Elani, the father of Kahāhana, and other O‘ahu chiefs. Elani’s body was left to decompose on a ledge at Pua‘ena Point (McAllister 1933:141–142). Samuel Kamakau records that Kawailoa also figured in the fate of Hu‘eu, one of Kahekili’s Maui chiefs, who had been installed at Waialua. While Kahekili and the other Maui chiefs had been warned of the O‘ahu chiefs’ plot and escaped, “Hu‘eu, who was living at Ka‘owakawaka, Kawailoa, in Waialua, was killed on one of the Kaloa nights while his guards were asleep” (Kamakau 1992:138).

In 1794, Ka‘eokūlani recruited the “warriors of Waialua and Wai‘anae” to make war on his nephew Kalanikūpule, then ruler of O‘ahu (Kamakau 1992:168). By December, 1794, Ka‘eokūlani had been killed and his forces were defeated. Kalanikūpule would himself be deposed the following year when the invading Hawai‘i Island forces of Kamehameha prevailed at the battle of Nu‘uanu in April, 1795. Kamehameha became the sole ruler of O‘ahu, Moloka‘i, Lāna‘i, Hawai‘i and Maui (Kamakau 1992:172–173).

Waialua was spared direct involvement in the battles associated with Kamehameha’s conquest, but Kamehameha’s hegemony on O‘ahu had immediate consequences for the district. In 1804, the old local families were generally stripped of their ancestral lands in order to reward the Big Island warriors with lands to settle. As Waialua was one of the most sought after places to settle, there was a substantial turnover of land holdings in the *moku* in the early decades of the nineteenth century (Sahlins 1992).

At the time of Kamehameha’s conquest, the political and ritual center of Waialua was Kamananui Ahupua‘a. The following *‘ōlelo no‘eau* is suggestive of such power:

> *Pili pono ka lā i Kamananui* The sun is very close to Kamananui
>
> A play on Ka-mana-nui (The-great-power). When the person in power becomes angry, everyone around him feels uncomfortable, as in the scorching, blistering sun. (Pukui 1983:291)

According to anthropologist Marshall Sahlins, Kamananui was a dominant *ahupua‘a* that included detached, outlying lands, including the remote fishing community of Kāpaeloa at the eastern border of Waialua with its prime marine resources and the fishponds ‘Uko‘a and Lokoea, that were controlled by *konohiki* of Kamananui proper (Sahlins 1992:20–21). Then, in the 1820s, the ruling chief of Kamananui Ahupua‘a moved to Anahulu Valley in the *ahupua‘a* of Kawailoa, which resulted in a redrawing of *ahupua‘a* boundaries. Kāpaeloa and other outlying sections of Kamananui were thus subsumed into the land of Kawailoa. The historic shift in political domination from Kamananui to Kawailoa was paralleled by a relocation of the religious center of the *moku*. In the 1830s, the Kawailoa-based Protestant mission of Waialua "usurped the ritual hegemony from the temples of human sacrifice [*poʻokanaka*] that not long before had sanctified the landscape of Kamananui" (Sahlins 1992:21).

Despite the reorganization of Waialua around the new chiefs in Kawailoa and previous intrusions by Kamehameha's invading forces with their settlement onto the Oʻahu landscape in 1804, certain "old Waialuans" continued to live in small hamlets under the informal leadership of ordinary "big men," an older form of leadership based on kinship rather than chiefly status (Sahlins 1992:173–174). A sketch by missionary Edwin Locke of the *makai* portion of Kawailoa reveals the fishponds of ʻUkoʻa (A) and Lokoea (B), Puaʻena Point with its small settlement (C), the fishing hamlet of Kāpaeloa (D), a set of homes belonging to Nāuahi *mā* (Nāuahi folks; *makaʻāinana*) with irrigated taro fields (E), and an area of sweet potato, gourd, and melon cultivation (F) (Sahlins 1992:174) (Figure 20). A massive spring-fed taro complex was located to the left (southwest) of Locke's vantage point and other river-irrigated taro fields were located along the Anahulu River to the right (southeast) of Locke's sketch.

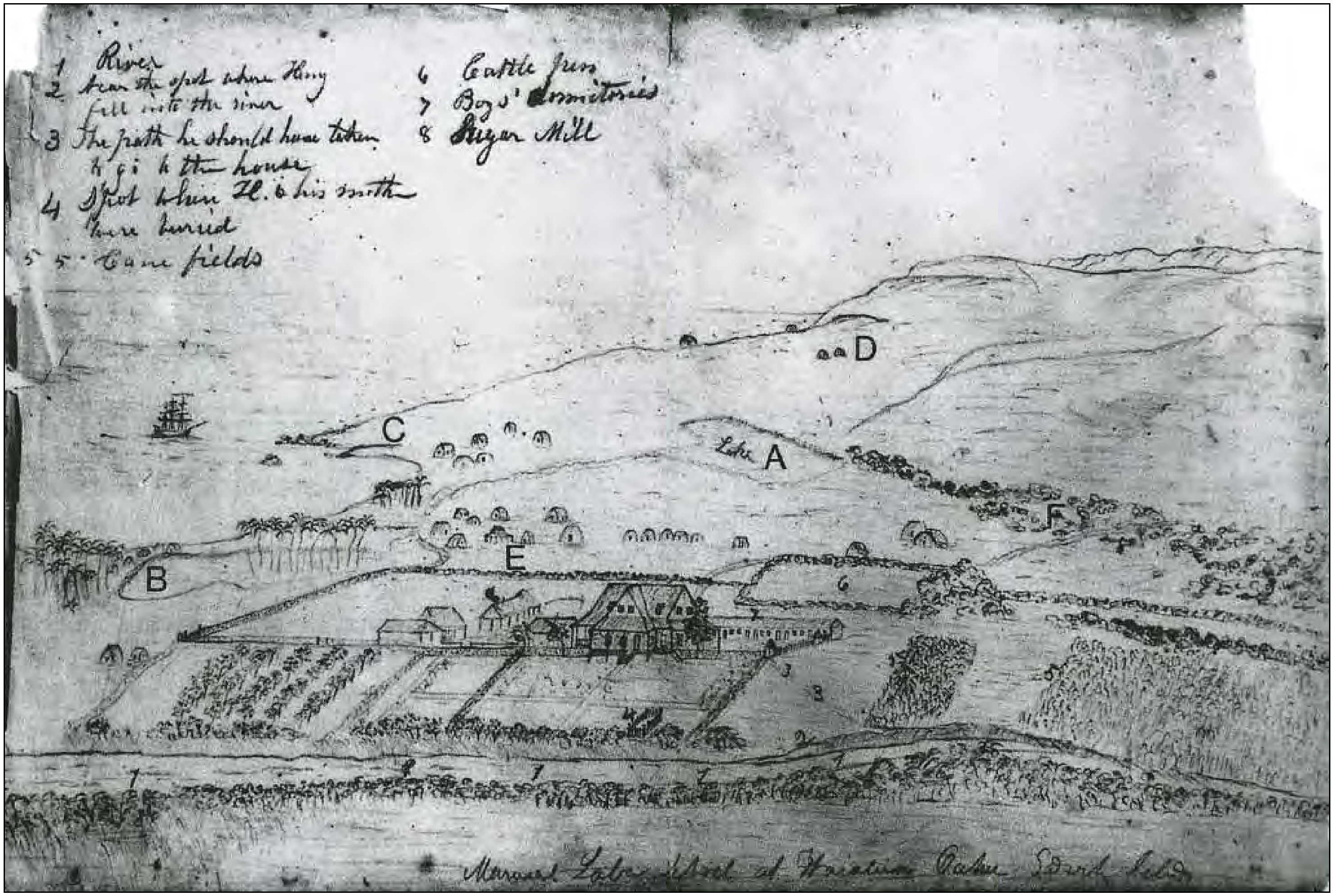

Figure 20. Lower Anahulu River, 1842 or 1853, sketch by Edwin Locke, showing fishponds of ʻUkoʻa (A) and Lokoea (B), Puaʻena Point with its small settlement (C), the fishing hamlet of Kāpaeloa (D), a set of homes belonging to Nāuahi *mā* (Nāuahi folks; *makaʻāinana*) with irrigated taro fields (E), and an area of sweet potato, gourd, and melon cultivation (F) (cited in Sahlins 1992:174)

3.4.4 The Māhele

To try to maintain sovereignty of the land, the Mōī (King) Kauikeaouli (Kamehameha III) in 1846–1848 supervised the Māhele—the division of Hawaiian lands—that transformed the land system in Hawai‘i from collective to private ownership. Modeled after Western concepts, certain lands to be reserved for himself and the royal house were known as Crown Lands, lands claimed by *ali‘i* and their *konohiki* were called Konohiki Lands, and lands set aside to generate revenue for the government were known as Government Lands. In 1850, these three categories of land were subject to the rights of the *maka‘āinana* and other tenants (naturalized foreigners, non-Hawaiians born in the islands, or long-term resident foreigners), who could make claims for their habitation and agricultural plots, known as *kuleana* (Native land rights) parcels (Chinen 1958:8–15).

Under the Kuleana Act of 1850, the *maka‘āinana* were required to file their claims with the Board of Commissioners to Quiet Land Titles (Land Commission) within a specified time period in order to apply for fee-simple title to their lands. The claim could only be filed after the claimant arranged and paid for a survey, and two witnesses testified that they knew the claimant and the boundaries of the land, knew that the claimant had lived on the land since 1939, and knew that no one had challenged the claim. Then, the *maka‘āinana* could present their claims to the Land Commission to receive their Land Commission Award (LCA) (Kame‘eleihiwa 1992).

Not everyone who was eligible to apply for *kuleana* lands did so and not all of those claims were awarded. Some claimants failed to follow through and come before the Land Commission, some did not produce two witnesses, and some did not get their land surveyed. In addition, some *maka‘āinana* may have been reluctant to claim *‘āina* that had been traditionally controlled by their *ali‘i*, some may have not been familiar with the concept of private land ownership, and some may have not known about the Māhele, the process of making claims (which required a survey) or the strict deadline for making claims. Further, the Land Commission was comprised largely of foreign missionaries, so the small number of claimants and awards may reflect only those *maka‘āinana* who were in good standing with the church (Kame‘eleihiwa 1992:296–297). Significantly, the surveying of the land was not standardized.

A total of 14,195 claims were filed and 8,421 awards were approved to about 29 percent of the 29,220 adult Native Hawaiian males living at the time of the Māhele, averaging three acres each (Kame‘eleihiwa 1992:295). Out of the potential 2,500,000 acres of Crown and Government lands, 28,658 acres of land were awarded to the *maka‘āinana*, less than one percent of the total acreage of Hawai‘i (Kame‘eleihiwa 1993:295). The small number of *kuleana* awards and their small size were significant prevented the *maka‘āinana* from maintaining their independent subsistence (Chinen 1958:32), often forcing them to abandon their newly acquired property (Lyons 1875)

Although many Hawaiians did not submit or follow through on claims for their lands, the distribution and written testimonies of LCAs can provide insight into patterns of residence and agriculture. Many of these patterns probably had existed for centuries. By examining the patterns of *kuleana* LCA parcels in the vicinity of the permanent Project footprint, insight can be gained to the likely intensity and nature of Hawaiian activity in the area.

In 1848, the Crown, the Hawaiian government, and the *aliʻi* received their land titles. The majority of Waialua was awarded to Victoria Kamāmalu, sister of Alexander Liholiho (King Kamehameha IV) and Lot Kamehameha (King Kamehameha V). All of western Waialua from Kamananui to Kaʻena Point was ceded to Kauikeaouli (Kamehameha III), which he designated as Government Lands. Kamāmalu retained the two *ahupua'*a of Kawailoa and Paʻalaʻa, excluding the *kuleana* of the residents (LCA 7713, *ʻĀpana* [Lot]33) (Sahlins 1992). Upon Kamāmalu's death in 1866, the lands of Kawailoa were passed to her brother Lot and then to Princess Ruth Keelikōlani in 1872. With her passing in 1883, Kawailoa was transferred to Bernice Pauahi Bishop and became integrated into her estate in 1887. Now, the land is managed by the Land Assets Division of Kamehameha Schools (*Imua* 2005:23).

The *makaʻāinana* received their *kuleana* awards (individual land parcels) in 1850 and thereafter. There were 95 LCA *kuleana* claims filed within Kawailoa Ahupuaʻa, of which 81 were awarded (Waihona ʻAina 2000). Eight *kuleana* parcels are located in or near the vicinity of the *makai* portions of the permanent Project footprint (Figure 21 and Table 3). The claims reveal that Hawaiian households had multiple *ʻāpana* in different geographical locations, involving the cultivation of taro, bananas, bitter gourds, melon, corn, sugarcane, and sweet potatoes, as well as the *pali* (cliffs) exploited for the collection of *wauke* (Waihona ʻAina 2000). Overall, the LCA documentation indicates a wide range of indigenous Hawaiian subsistence activities being practiced in the vicinity of the permanent Project footprint in Kawailoa.

There were 23 LCA claims filed within Kamananui Ahupuaʻa, but no *kuleana* LCAs were awarded. The missionary in residence, John S. Emerson, concluded it was in the interest of the Hawaiians to buy land outright as grants rather than to complete the LCA application process (Emerson 1928:141). The claims that were completed reveal that Hawaiians used the land in the *mauka* portions of Kamananui Ahupuaʻa primarily to cultivate taro and *wauke* (Waihona ʻAina 2000).

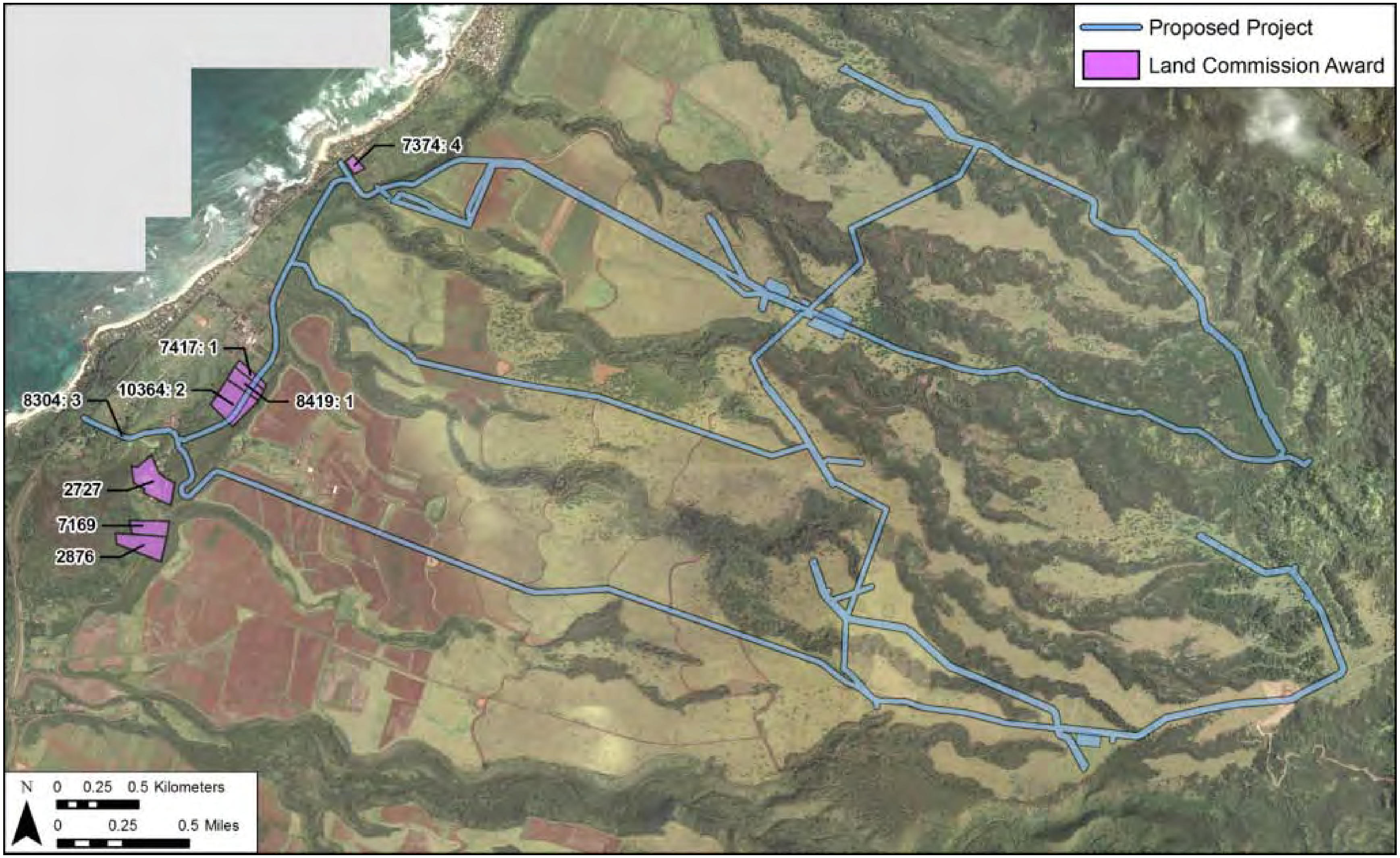

Figure 21. LCAs in the vicinity of the proposed Project (base map, portion of the 1992, 1998, 1999 USGS 7.5-minute series topographic quadrangle)

Table 3. LCAs located in the vicinity of the permanent Project footprint

LCA	Claimant	‘Ili	Land Use	Landscape Feature
2727	Puu	‘Uko‘a, Lahuinoho, and Hakaai	House lot and *lo‘i*	‘Uko‘a pond
2876	Kanepilau	‘Uko‘a, Lokokea, and Kawela	House lot and *lo‘i*	*‘Auwai*/ditch
7169	Koa	‘Uko‘a	House lot and *lo‘i*	*Loko*
7374:4	Kapule	Koheo and Punenui	House lot, bananas, sweet potatoes, bitter melon/gourd, corn, sugarcane, and taro	*Koa* canoe tree
7417:1	Kaukaliu	Lauhulu, Puuaki, Kalokoeli, Pukeamauka, Wailele, and Wailelekai	House lot, *lo‘i*, kula, *wauke*, *noni* (Indian mulberry), sweet potatoes, bananas, bitter melon/gourd, sugar cane, and corn	*‘Auwai*/ditch, wall/fence, and pond
7713:33	Victoria Kamāmalu	(Kawailoa Ahupua‘a)	n/a	n/a
8304:3	Kalamahiai	‘Uko‘a, Waipuolo, Konohikilau, and Kealia	House lot and *lo‘i*	*‘Auwai*/ditch, stream, and *muliwai* (river)
8419:1	Kealainanea	Lauhulu, Kalualeuo, Iliilikea, and Punakai	House lot, *lo‘i*, and sweet potatoes	Road/path, wall/fence, and four small fish ponds bounded by cattle pasture
10364:2	Nanokaeho	Punakai	House lot, *lo‘i*, kula, *wauke*, and sweet potatoes	*Pali*

3.4.5 Shifting Landscape

The landscape of Kawailoa and Kamananui Ahupuaʻa shifted dramatically during the last two decades of the nineteenth century with rice, sugar, and pineapple cultivation, and the infrastructure associated with these agricultural pursuits (plantation camps, railroads, ditches, and reservoirs) can be seen on maps spanning the first half of the twentieth century (Figure 22 to Figure 27). In the 1880s, immigrant Chinese laborers began leasing and buying former taro lands from the Hawaiians of Waialua to convert to rice farming. By 1892, 180 acres of rice were under cultivation in Waialua, including rice fields in the *ahupuaʻa* of Kawailoa and Kamananui (Coulter and Chun 1937:12, 21).

The Oahu Railway and Land (OR&L) Company, organized by Benjamin Dillingham in 1889, connected outlying areas of Oʻahu to Honolulu. During the last decade of the nineteenth century, the railroad would reach from Honolulu to Pearl City in 1890, to Waianae in 1895, to Waialua in 1898, and to Kahuku in 1899 (Kuykendall 1967:100). In 1899, Dillingham, capitalizing on the increasing numbers of visitors to the north shore of Oʻahu, opened the Victorian style, two-story Haleʻiwa Hotel at Waialua Bay in 1899. He named it after a seminary's dormitory for women along Anahulu Stream, which in turn was named from the nest, or house (hale) of the large frigate bird (*ʻiwa*). The hotel's name eventually identified the area above the bay as workers left the sugarcane and pineapple fields to set up stores in the growing town (Jacobs 2006). Today, the town's architecture still resembles the plantation industry in the early 1900s. In 1984, the City and County of Honolulu established Haleʻiwa as a State Historic, Cultural, and Scenic District, mandating preservation rules and new construction constraints for Haleʻiwa Town (Haleiwa Town 2011).

The development of the railroad also spurred the development of large-scale sugar farming in Waialua. Sugarcane had been first cultivated at Waialua earlier in the century by the missionary John Emerson who constructed a small mill to produce sugar and molasses. During subsequent decades, other missionaries and western entrepreneurs continued expanding sugar cultivation in the district, though still on a small-scale. When the OR&L reached Waialua in 1898, Dillingham persuaded Castle & Cook to lease about 600 acres of Waialua land already under sugarcane cultivation, which led to the rise of the Waialua Agricultural Company (Figure 28). Flumes, siphons, and ditches for irrigation were constructed that are still in use today. Later named the Waialua Sugar Company, it expanded during the first decades of the twentieth century to reach more than 12,000 acres, including extensive portions of Kawailoa and Kamananui Ahupuaʻa (*Imua* 2005:20).

The Kawailoa Plantation, situated on the rolling ridges above Haleʻiwa, included 6,000 acres of sugar cultivation. Plantation villages, or camps, allowed workers to walk to work in the fields, including Kawailoa Camp and Kawailoa Camp 8 (see Figure 24 to Figure 26). A Buddhist temple, the Kawailoa Ryusenji Soto Mission, was established in the Kawailoa Camp in 1924 to minister to the needs of the Japanese workers and their families (Clark 2007). The *mauka* Waimea Camp was part of the Hawaiian Pineapple Company (see Figure 24 to Figure 26), which merged with Castle & Cooke in 1961 and changed its name to Dole Food Company, Inc. in 1991. The Waialua Sugar Company closed in 1998, surrendering its lease of agricultural and conservation lands to Kamehameha Schools. In 1999, Kamehameha Schools began managing the Kawailoa Plantation as a diversified farming operation, with 11 tenant farmers cultivating asparagus, wet and dryland taro, papaya, seed and feed corn, tuberose, banana, plumeria, noni, and lettuce on 2,200 acres (*Imua* 2005:15–16).

Prior to the Pacific theater of World War II between 1939 and 1945, modernization of the coastal defenses of the Hawaiian Islands included the Kawailoa Military Reservation in the vicinity of the southern portion of the permanent Project footprint and the Waimea Military Reservation near the northern portion of the permanent Project footprint. Various gun emplacements were constructed, including (in the Kawailoa Military Reservation) Battery Hale‘iwa, Battery Ashley, and Battery Kawailoa, and (in the Waimea Military Reservation) Battery Waimea (Bennett 2002), as well as O‘ahu’s command and fire control cable system that was established as a warning and response system (Bennett 2002).

Numerous structures are located on Mount Ka‘ala, including various military installations, bunkers, radar, and weather stations, much of which dates to the Pacific theater of World War II. Maps from the first half of the century do not indicate any development (Figure 29 to Figure 32), but an aerial photograph indicates the presence of roads that are associated with the weather towers and other equipment (Figure 33). The swamp-filled summit plateau of Mount Ka‘ala and steep gulches and ridges that form its eastern flank are part of the Hawai‘i Natural Reserves System, which was established in 1981 to protect native Hawaiian ecosystems (State of Hawai‘i Department of Land and Natural Resources [DNLR] 2011).

The companion archaeological inventory survey has documented 17 historic sites within the study area that are associated with either former plantation activities or former military operations (Rechtman et al. 2011). Sites associated with World War II infrastructure include concrete pillars (SIHP No. 50-8—04-7155 and -7156) and a metal pole/concrete base (-7158). Sites associated primarily with the irrigation of the sugar and pineapple plantations include a concrete marker (-7157), four ditch complexes (-7159, -7169, -7170, and -7171)), stone abutments (-7160), concrete foundations (-7161), a curbstone alignment (-7162), stone/concrete culverts (-7163, -7165, -7166, -7167), a metal pipeline (-7164), and a concrete bridge (-7168). Rechtman et al. (2011) determined that the three military sites are signifinant under HAR 13§13-284-6 Criteria A (be associated with events that have made an important contribution to the broad patterns of history) and Critera D (have yielded, or is likely to yield, information important for research on prehistory or history), and that the remaining plantation sites are significant under Criteria D. Based on a no historic properties affecting determination, they recommend no further work but suggest that a program of archaeological monitoring be maintained during the Project’s construction activities.

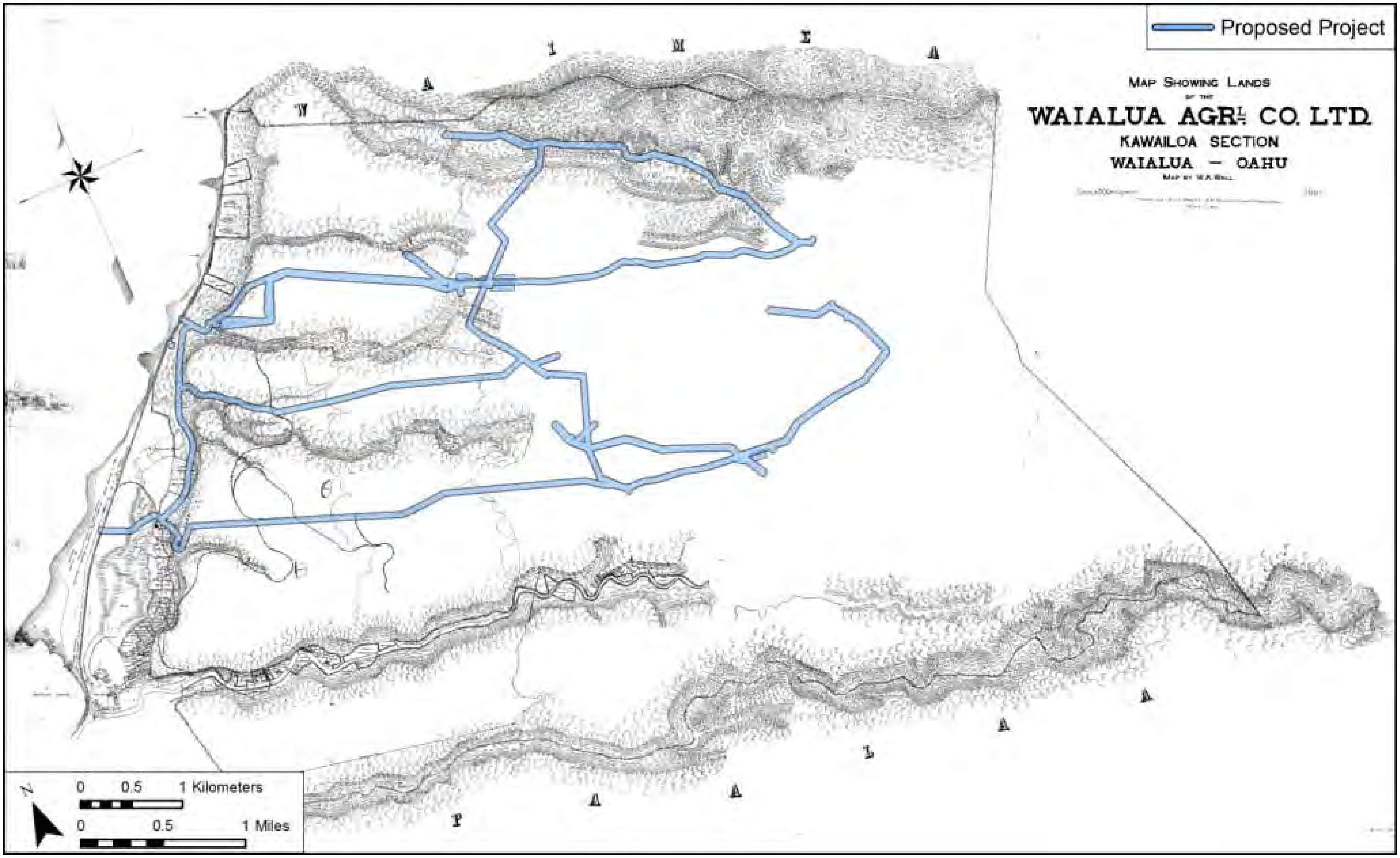

Figure 22. Map of the Waialua Agricultural Company in Kawailoa, showing the proposed Project (Wall 1901)

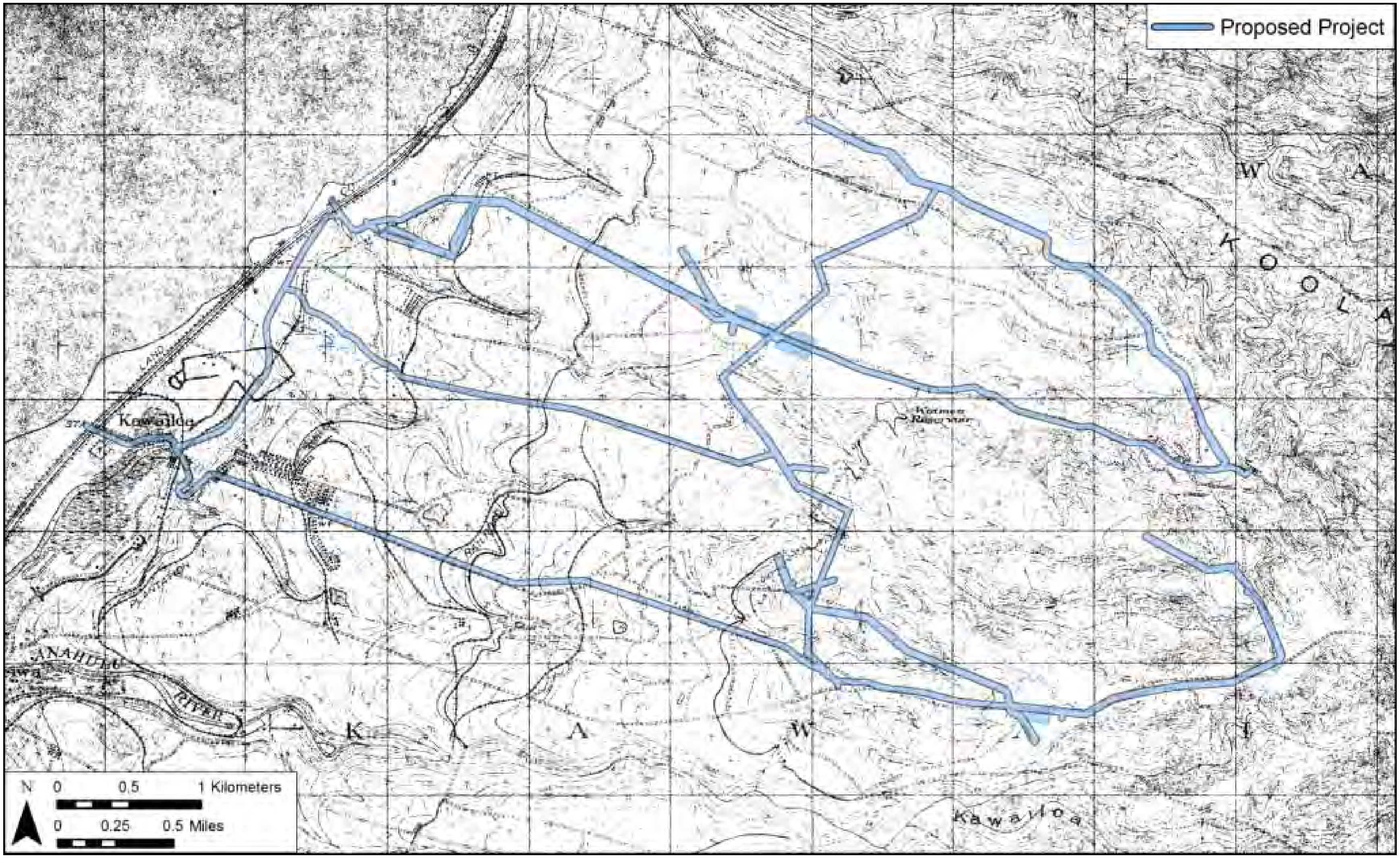

Figure 23. Portion of 1919 U.S. War Department map, Waialua quadrangle, showing the proposed Project

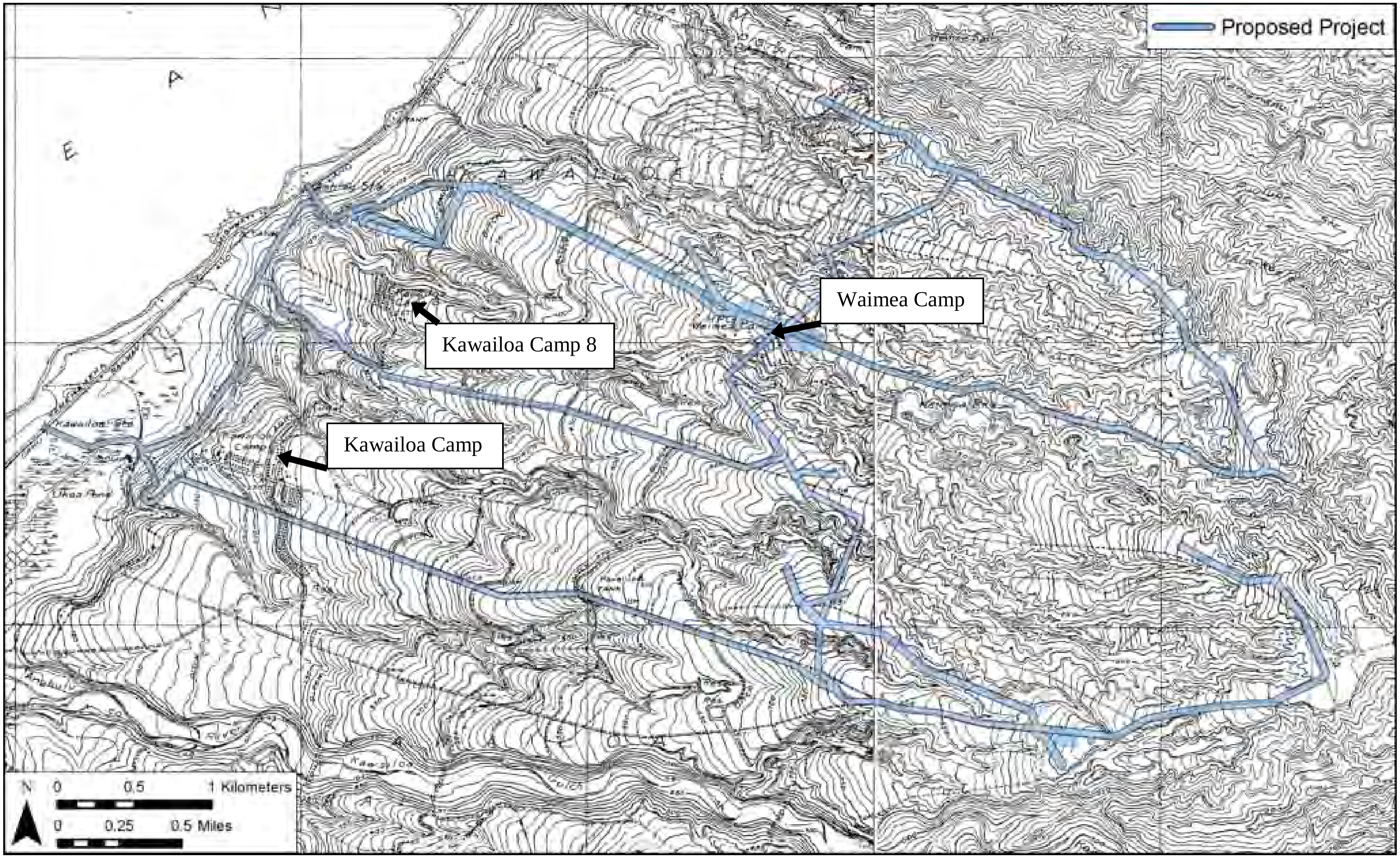

Figure 24. Portion of 1928–1930 USGS 7.5-minute topographic map, Kaipapau quadrangle and 1929 USGS 7.5-minute topographic map, Hale'iwa quadrangle, showing the proposed Project; note Kawailoa Camps and Waimea Camp

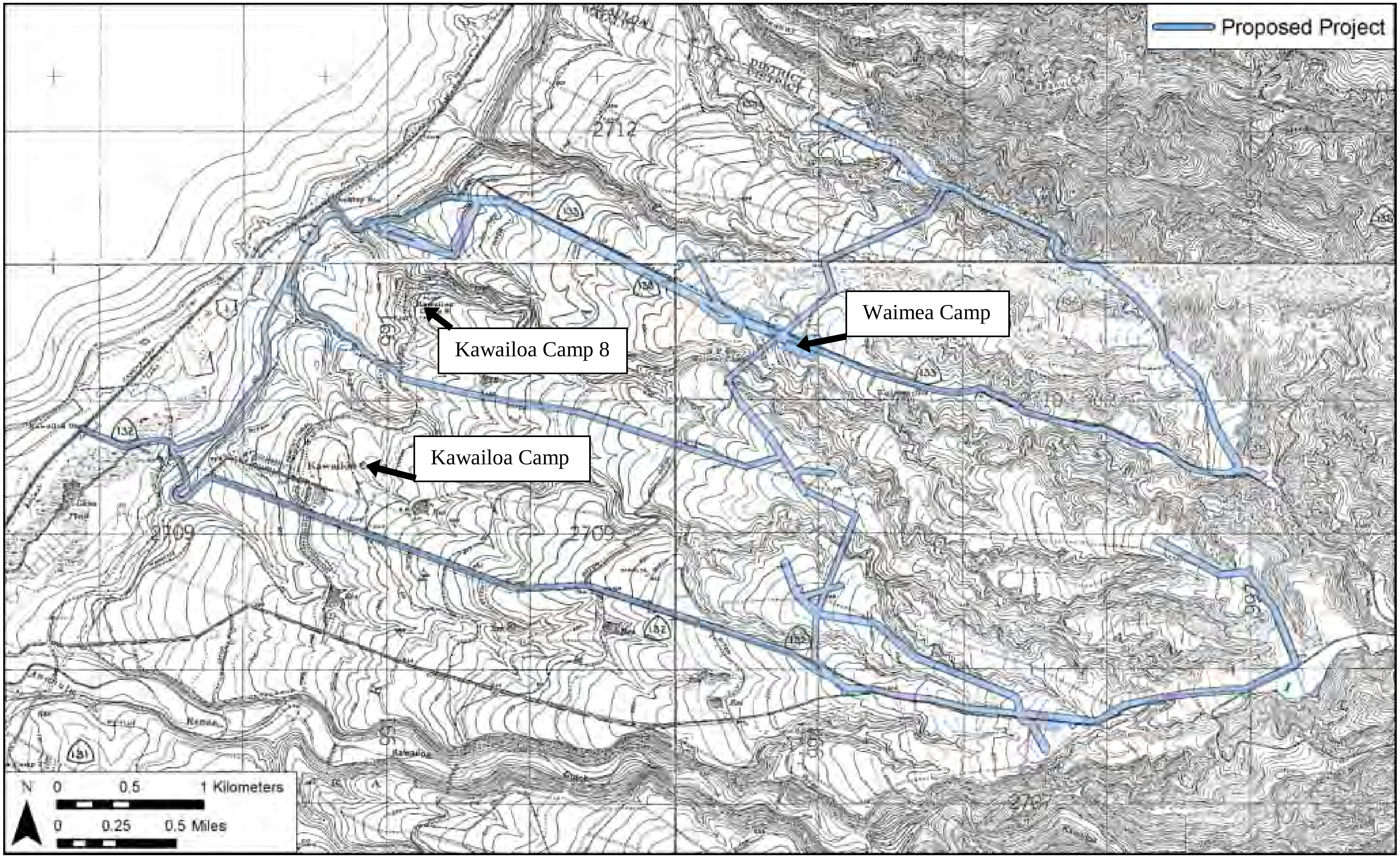

Figure 25. Portion of 1943 U.S. War Department map, Haleʻiwa, Waimea, and Paʻalaʻa quadrangles, showing the proposed Project; note that Kawailoa Camps and Waimea Camp are still present

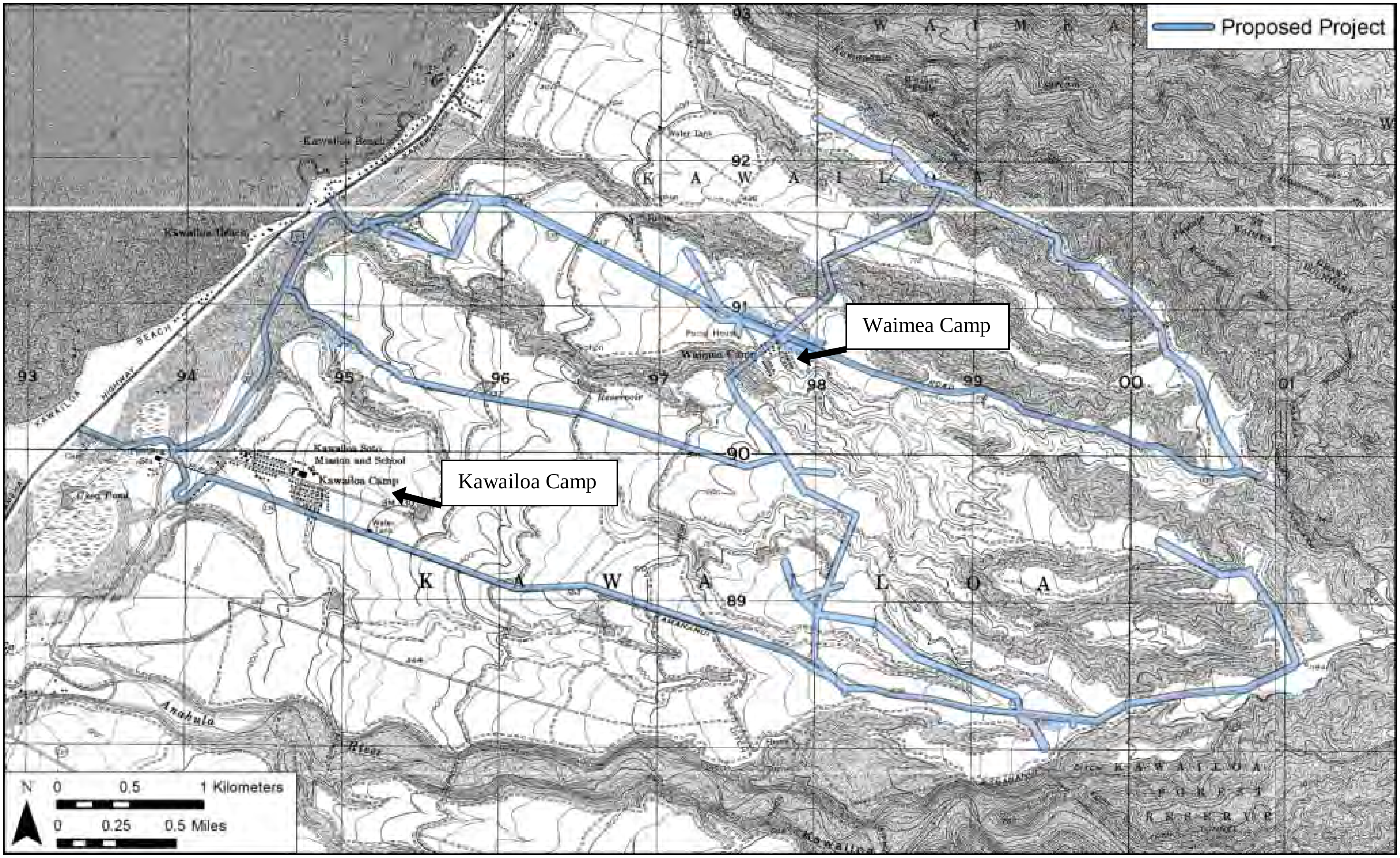

Figure 26. Portion of 1953 U.S. Army Mapping Service (AMS) map, Hale‘iwa and Hau‘ula quadrangles and 1954 AMS map, Waimea and Kahuku quadrangle, showing the proposed Project; note that Kawailoa Camp and Waimea Camp are still present

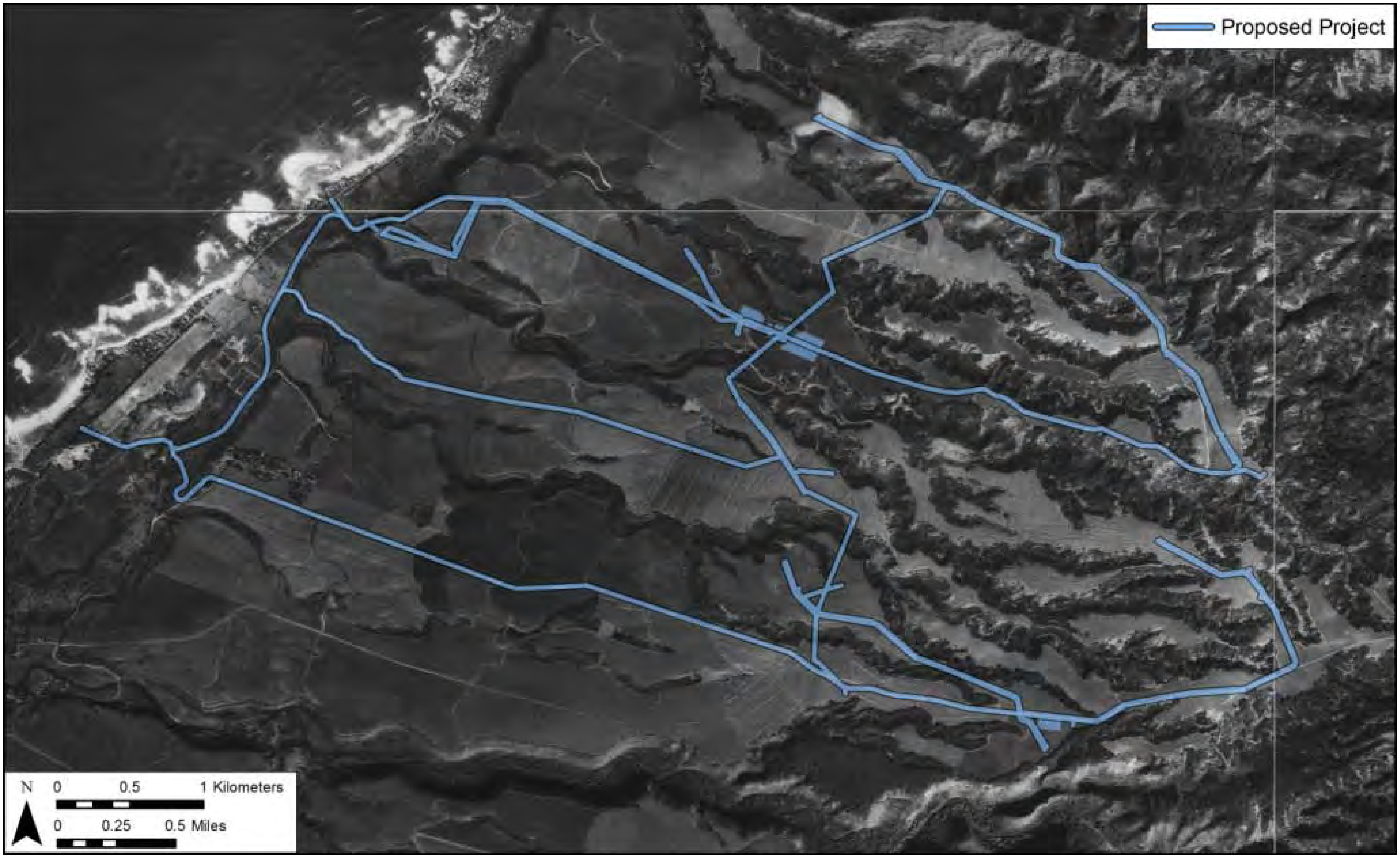

Figure 27. Portion of the orthoimagery of the 1977–1978 USGS 7.5-minute topographic map, Hale‘iwa, Waimea, Kahuku, and Hau‘ula quadrangles, showing the proposed Project

Figure 28. Waialua Agricultural Company railroad in field of sugarcane (Hawaiian Aviation Preservation Society 2011)

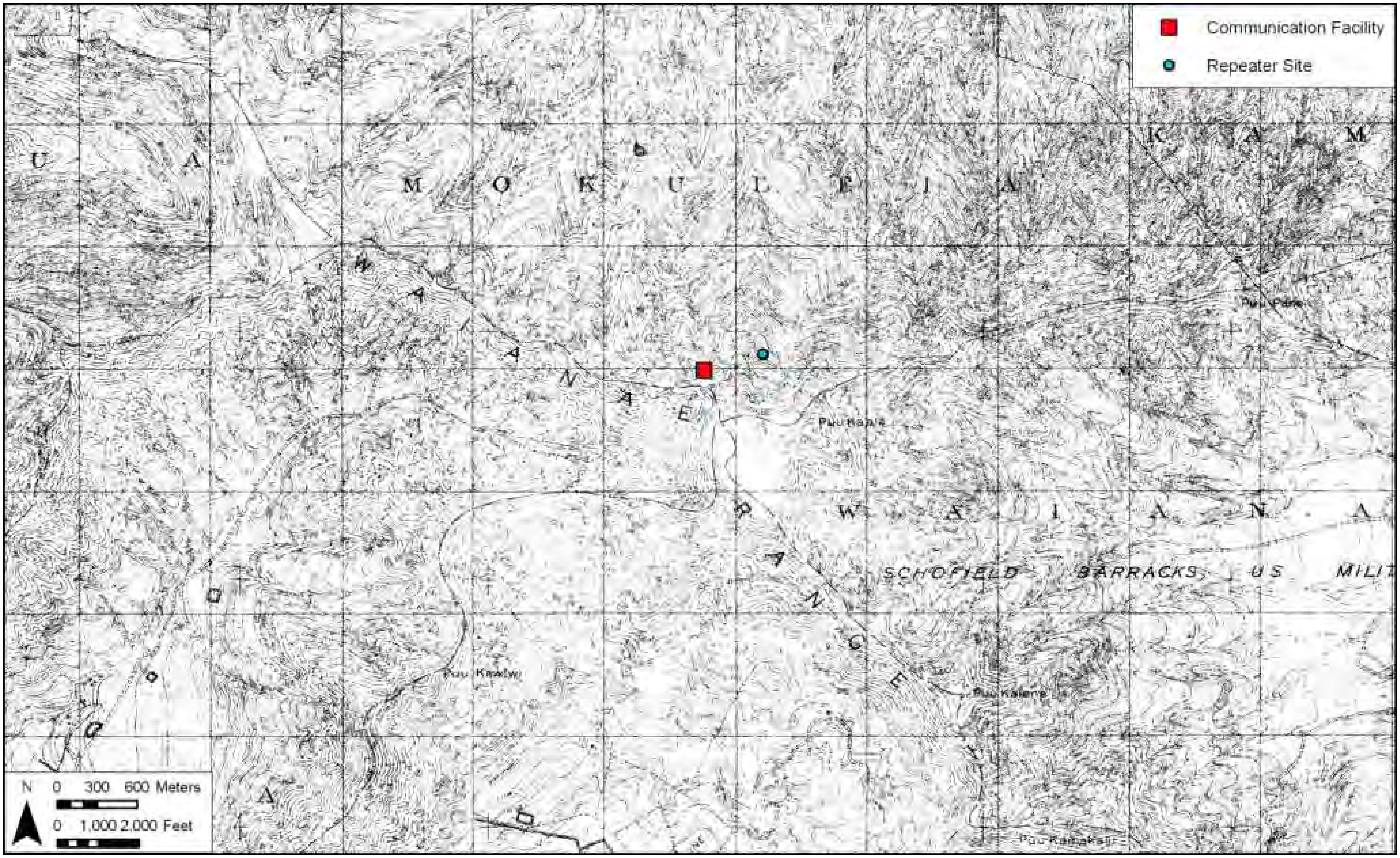

Figure 29. Portion of 1919 U.S. War Department map, Waiʻanae quadrangle, showing the Project area

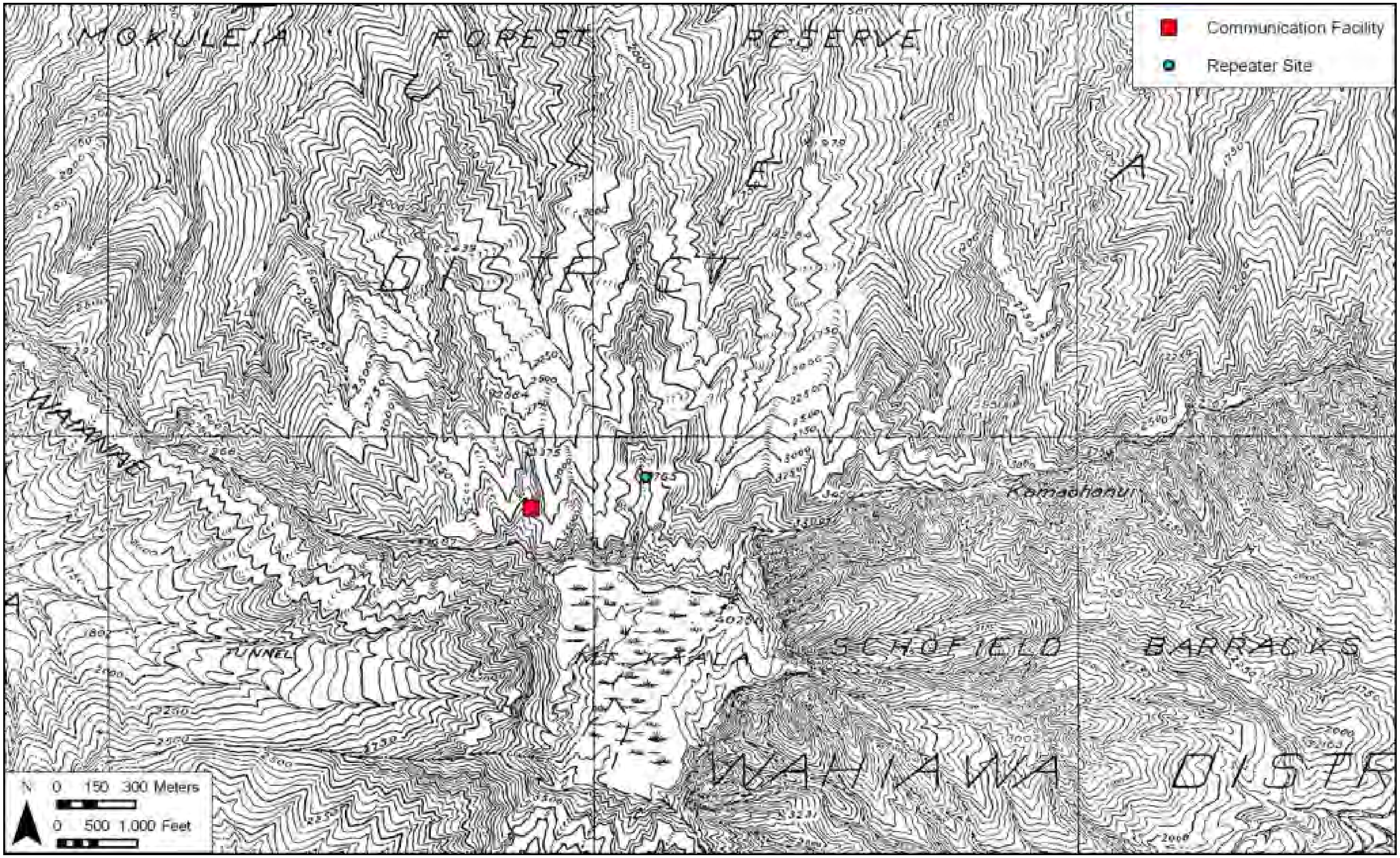

Figure 30. Portion of 1928–1929 USGS 7.5-minute topographic map, Schofield Barracks quadrangle, showing the Project area

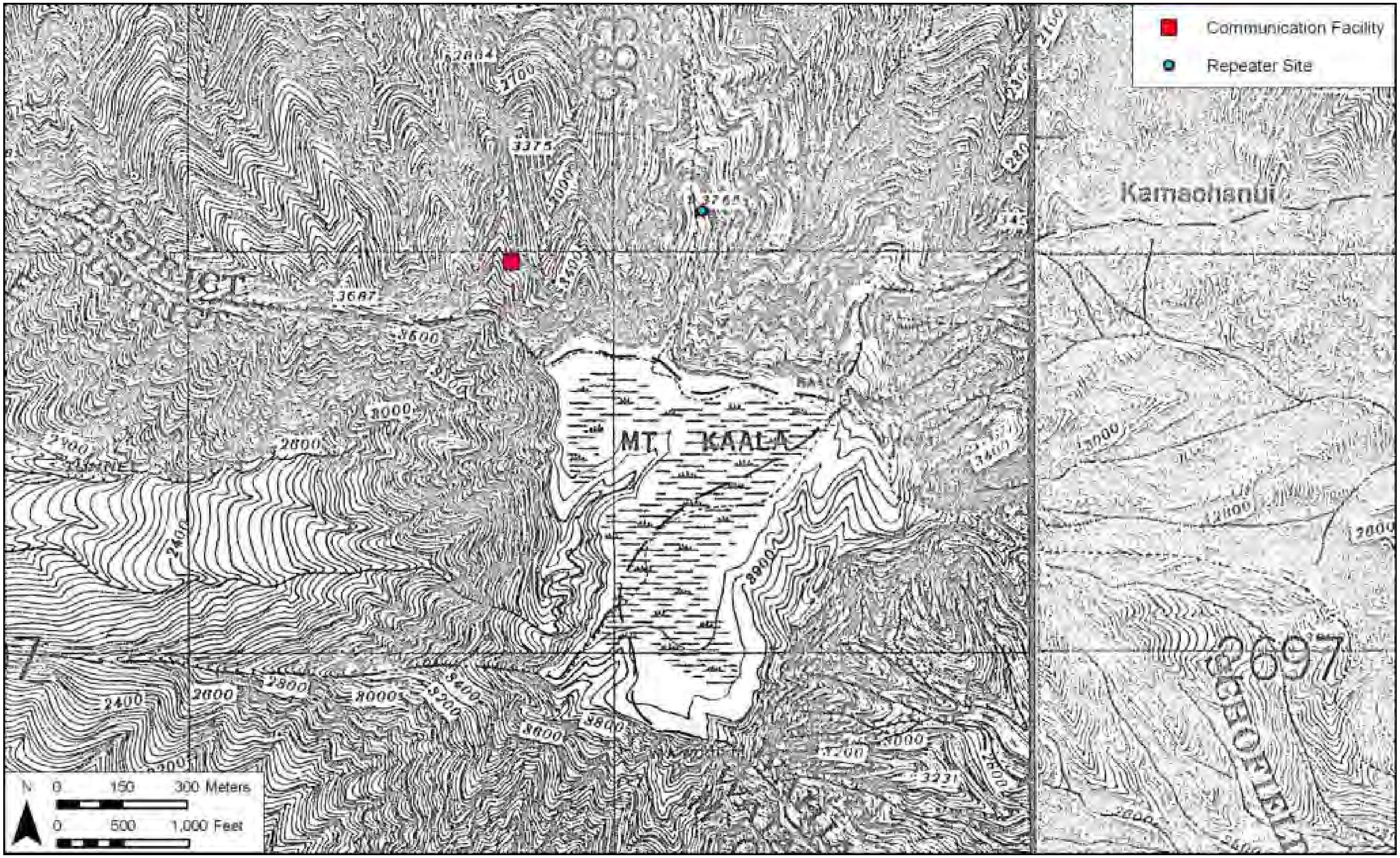

Figure 31. Portion of 1943 U.S. War Department map, Waiʻanae and Schofield Barracks quadrangles, showing the Project area

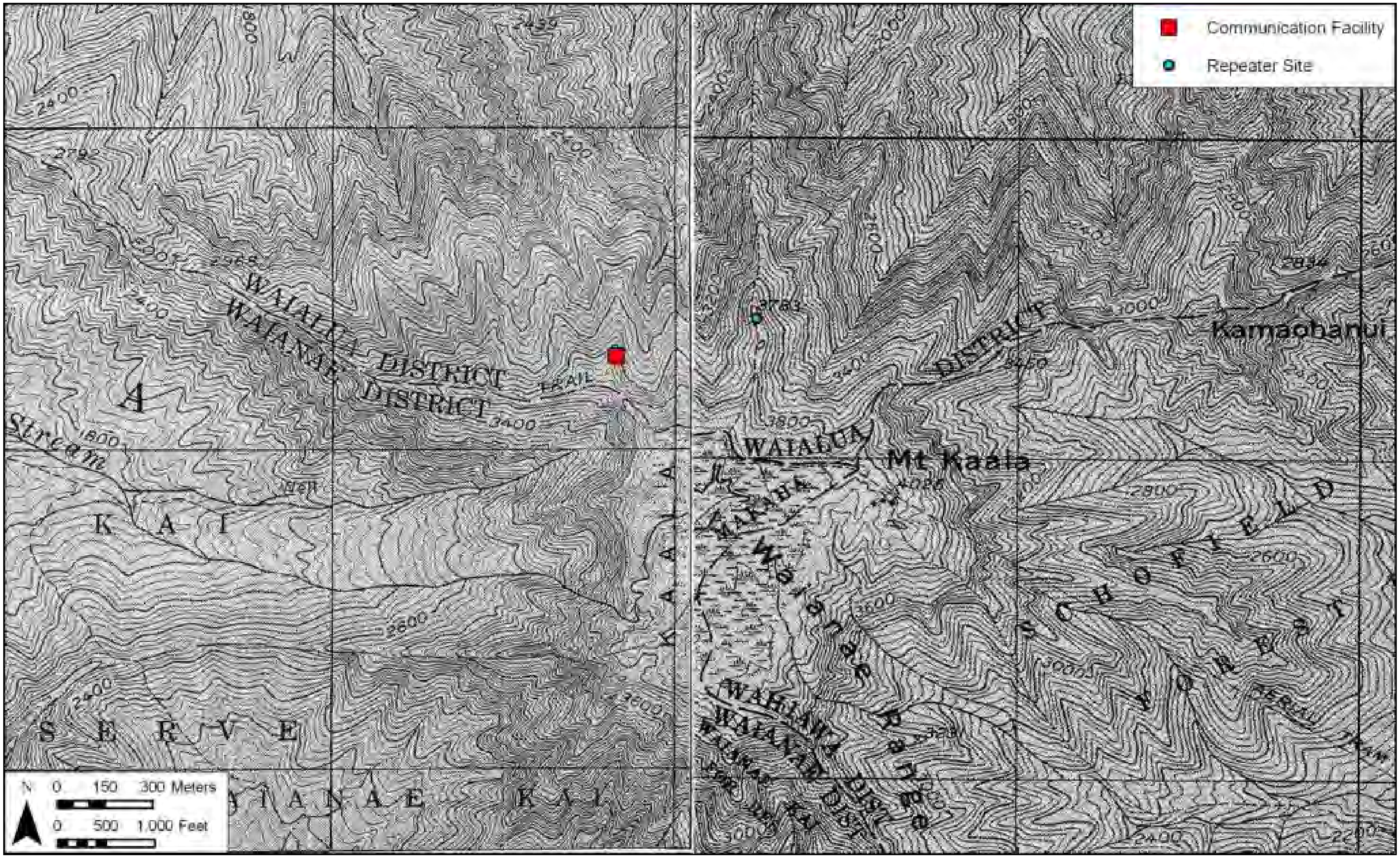

Figure 32. Portion of 1953 U.S. AMS map, Haleʻiwa quadrangle and 1954 AMS map, Kaʻena quadrangle, showing the Project area

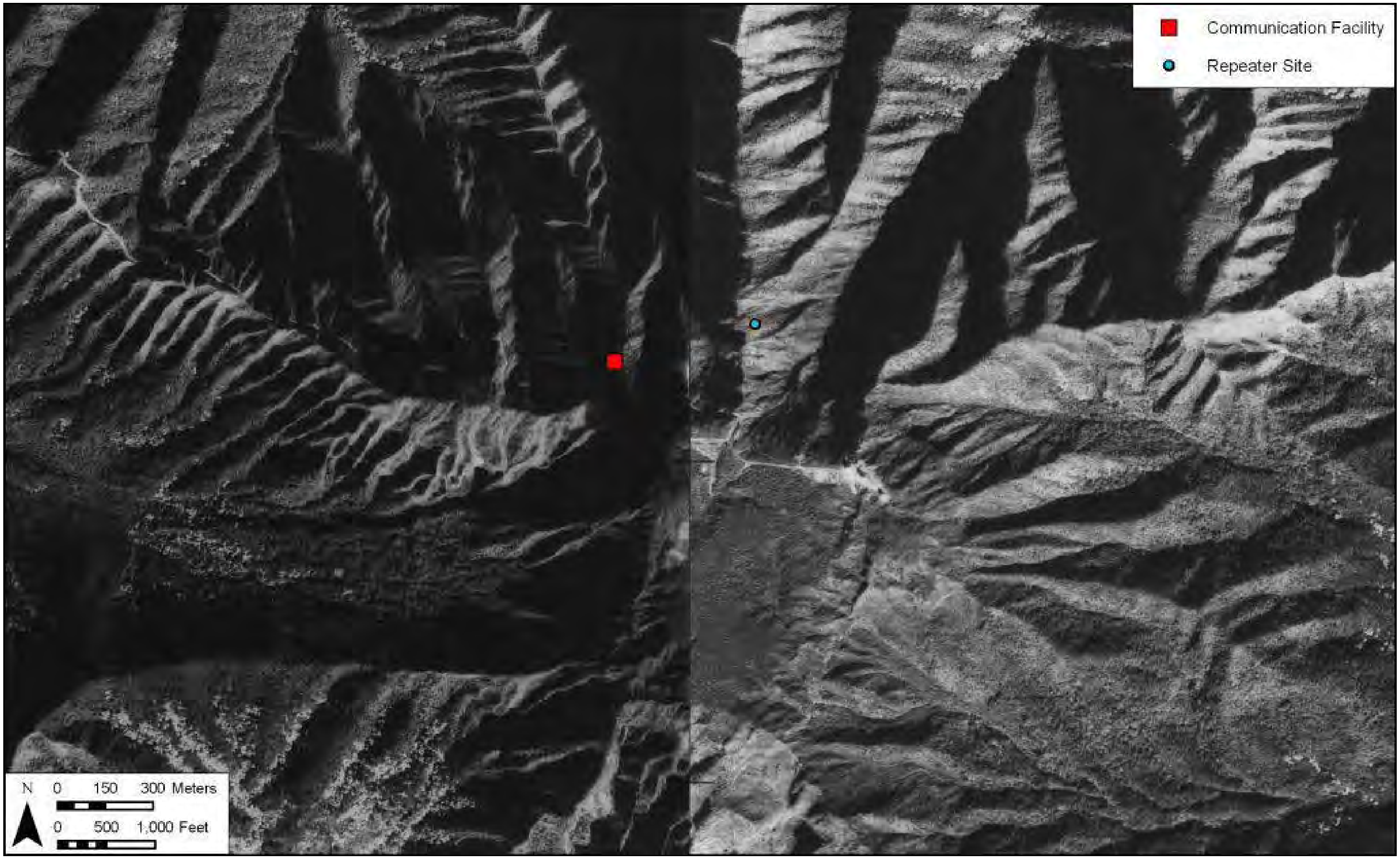

Figure 33. Portion of the orthoimagery of the 1977–1978 USGS 7.5-minute topographic map, Hale‘iwa and Ka‘ena quadrangles, showing the Project area

3.4.6 Previous Oral History Research

This section builds on the previous cultural and historical background by highlighting the voices of Japanese immigrants who worked on the sugar plantations in Waialua, including Philip Ninomiya and Manabu Nonaka (UH 1977). Their *mo‘olelo* from a past generation colors the cultural and historical background with nuanced recollections and add a depth to the information provided by living *kūpuna* and *kama‘āina* who were recently interviewed by CSH (detailed in Section 5).

Philip Ninomiya was born in Hale‘iwa in 1906. His parents came from Japan to work on the Waialua sugar plantation. Manabu Nonaka was born in Honolulu in 1915 after his parents migrate from Japan, and grew up in Waialua. Philip Ninomiya recalls how the Japanese plantation workers caught *aji* (*akule*, big-eyed scad fish), and would tie them together with *akakai* (reeds) that grew along Anahulu Stream (UH 1977:277). The Japanese used *sampan* (a flat-bottomed skiff usually propelled by two short oars) to catch these fish (UH 1977:414). Philip Ninomiya and his childhood friends also constructed *akakai* rafts to go up and down the stream for recreation and for fishing:

> You know, I don’t see *akakai* anymore, but it’s a reed. It just grows straight, and it’s very buoyant. So. You cut them with a sickle, and tie them with a cord, and make a raft. You made your own paddle. You’d go up and down Anahulu Stream. (UH 1977:302)

Manabu Nonaka describes a diet of mostly fish for the Japanese plantation workers and their families. As a teenager, he caught *pāpio* (young stage of *ulua*, crevalle, jack, or pompano), *āholehole* (young stage of *āhole*, Hawaiian flagtail), *moi* (threadfish), *‘oama* (young stage of *weke*, goatfish), and *tako* (Japanese, squid, octopus), and gathered *ogo* (seaweed) (UH 1977:435–437).

Section 4 Community Consultation

Throughout the course of this assessment, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about traditional cultural practices specifically related to the permanent Project footprint. This effort was made by letter, email, telephone and in-person contact. The initial outreach effort was started in January 2011 and completed in April 2011. In the majority of cases, aerial photographs (see Figure 1 and Figure 4), maps (see Figure 2 and Figure 5), and a letter (Appendix D) of the proposed Project were mailed.

In most cases, two to three attempts were made to contact individuals, organizations, and agencies apposite to the CIA for this Project. The results of the community consultation process are presented in Table 4. Written statements are presented in Section 4, and excerpts from interviews are presented in Section 5.

Table 4. Results of Community Consultation

Name	Affiliation, Background	Comments
Agadar, Lavina	Resident of Waialua	February 11, 2011 CSH sent letter by email February 28, 2010 Ms. Agader replied in an email that she and her husband are supportive of the wind farm since “it will be utilizing a good part of our natural resource” February 28, 2011 CSH replied by email with a list of questions March 22, 2011 CSH phoned Ms. Agadar to schedule an interview April 8, 2011 CSH conducted interview (see Section 5.7) April 12, 2011 Ms. Agadar approved interview summary
Aki, Buddy	Resident of Waialua	February 14, 2011 CSH called, but no answer and could not leave a message April 4, 2011 CSH called and at the request of Mr. Buddy, sent letter by mail
Ailā, William	Hui Mālama I Nā Kūpuna ʻO Hawaiʻi Nei	February 11, 2011 CSH sent letter by email

Name	Affiliation, Background	Comments
Alameida, Jeff	Resident of Waialua	February 11, 2011 CSH sent letter by email February 16, 2011 CSH called and Mr. Alameida stated that he is not from Mokulēʻia and is not familiar with Kawailoa, but he referred Aunty Betty Jenkins
Anana, Manu	Resident of Waialua	February 11, 2011 CSH sent letter by email February 16, 2011 CSH called but no answer and could not leave a message April 4, 2011 CSH called but no answer and could not leave a message
Au, Kawika	President, Waialua Hawaiian Civic Club	February 10, 2011 CSH sent letter March 3, 2011 CSH conducted interview (see Section 5.6) and Mr. Au invited CSH to present the Project information at the next monthly meeting of the Waialua Hawaiian Civic Club March 10, 2011 Mr. Au approved interview April 11, 2011 Mr. Au sent email, stating that the Waialua Hawaiian Civic Club will not meet until May
Awai-Lennox, Gladys	*Kupuna*, Resident of Waialua	February 11, 2011 CSH sent letter by email February 16, 2011 CSH conducted a phone interview with Ms. Awai-Lennox, who gave permission to re-use portions of the previously conducted interview (see Section 5.2)
Awai, Kanani	Resident of Waialua	February 14, 2011 CSH called and left message March 24, 2011 CSH called and left message April 4, 2011 CSH called and left message

Name	Affiliation, Background	Comments
Awai, Keith	Resident of Waialua	April 19, 2011 Mr. Awai forwarded email to Hinaleimoana Kalu, stating that he spoke with *kupūna* from the area and they did not know of cultural sites in Kawailoa other than *heiau* in the Waimea area.
Ayau, Halealoha	Hui Mālama I Nā Kūpuna ‘O Hawai‘i Nei	February 11, 2011 CSH sent letter by email
Becket, Jan	Kamehameha Schools	February 11, 2011 CSH sent letter by email February 11, 2011 Mr. Becket invited CSH to meet at the Kamehameha Schools campus February 17, 2011 CSH interviewed Mr. Becket, he gave permission to re-use a previously conducted interview (see Section 5.4), and referred Tom Shirai February 28, 2011 Mr. Becket approved interview summary
Beime, Ululani	Ko‘olauloa Hawaiian Civic Club	February 11, 2011 CSH sent letter by email
Cannon, Dianne	Resident of Waialua	February 14, 2011 CSH called and left message April 4, 2011 CSH called and left message
Causey, Emmaline	Resident of Waialua	February 10, 2011 CSH sent letter February 28, 2011 CSH conducted phone interview with Mrs. Causey, who gave permission to re-use a previously conducted interview (see Section 5.3)
Cayan, Phyllis Coochie	History and Culture Branch Chief, SHPD	February 10, 2011 CSH sent letter March 3, 2011 Ms. Cayan sent response letter, referring Tom Shirai and Leimaile Quiteves (see Section 4.1)

Name	Affiliation, Background	Comments
Chun, Janell	Resident of Waialua	February 11, 2011 CSH sent letter by email February 16, 2011 CSH called but no answer and could not leave a message April 4, 2011 CSH called but no answer and could not leave a message
Cypher, Mahealani	President, O‘ahu Council of the Association of Hawaiian Civic Clubs	February 11, 2011 CSH sent letter by email February 11, 2011 Mrs. Cypher referred Kawika Au of the Waialua Hawaiian Civic Club and Ululani Beime of the Ko‘olauloa Hawaiian Civic Club
Gamiao, Alma	Resident of Waialua	February 11, 2011 CSH sent letter by email March 22, 2011 CSH called and sent letter, questions, release forms via email
Helemano, Butch	Descendant of Hewahewa, Resident of Waialua	April 11, 2011 CSH conducted interview with Mr. Helemano, who gave permission to re-use a previously conducted interview (see Section 5.8) April 12, 2011 Mr. Helemano approved interview summary
Harvest, Dino	Resident of Waialua	February 11, 2011 CSH sent letter by email April 4, 2011 CSH called but no answer and could not leave a message
Hirota, John	Resident of Waialua	February 11, 2011 CSH sent letter by email April 4, 2011 CSH called but no answer and could not leave a message
Hookala, Maile	Resident of Waialua	February 14, 2011 CSH called and left message April 4, 2011 CSH called and left message

Name	Affiliation, Background	Comments
Jenkins, Kawohiokalani	*Kupuna*, Resident of Waialua	February 11, 2011 CSH sent letter by email February 25, 2011 CSH called Ms. Jenkins, who will try to arrange a meeting with other *kūpuna* whose *piko* (birthplace) lies in Kawailoa February 28, 2011 Ms. Jenkins replied by email after arranging a group interview with Kawika Au Moki Labra March 3, 2011 CSH conducted interview with Ms. Jenkins (see Section 5.6) March 10, 2011 Ms. Jenkins approved interview summary
Kaʻala Cultural Learning Center	n/a	March 30, 2011 CSH sent letter by email
Kalu, Hinaleimoana	Vice-President, OIBC	April 11, 2011 CSH sent letter by email April 12, 2011 Ms. Kalu responded by email and forwarded the Project information to her cousin Keith Awai, whose mother is Dorothy Kanani Awai
Kāne, Uncle Shad	OIBC, Nā Koa ʻO Pālehua, Association of Hawaiian Civic Club's Historic Preservation Committee	February 11, 2011 CSH sent letter by email February 16, 2011 Mr. Kāne replied, stating that he is aware of undocumented cultural sites at the Causey property, and that the cultural landscape continues into Kamehameha Schools property
Labra, Moki	Resident of Waialua	March 3, 2011 CSH conducted interview with Mr. Labra (see Section 5.6) April 20, 2011 Mr. Labra approved interview summary

Name	Affiliation, Background	Comments
Lenchanko, Tom	Vice-President, Hawaiian Civic Club of Wahiawā, Spokesperson for ʻAha Kūkaniloko/Koa Mana, Hawaiian National Lineal Descendants	February 11, 2011 CSH sent letter by email February 17, 2011 CSH conducted interview and Mr. Lenchanko gave permission to re-use a previously conducted interview (see Section 5.5)
Lyons, Michael	Chair, North Shore Neighborhood Board	February 11, 2011 CSH sent letter by email March 30, 2011 CSH sent letter by email
McKeague, Kawika	President, OIBC	February 16, 2011 CSH sent letter by email March 30, 2011 CSH sent letter by email April 11, 2011 Mr. McKeague responded, stating that he is now working for Kamehameha Schools, the landowner of the Project, and requests contacting OIBC Vice-President Hinaleimoana Kalu and Waialua Representative Leimaile Quitevis
Nāmuʻo, Clyde	Administrator, OHA	February 10, 2011 CSH sent letter April 11, 2011 Jerome Yasuhara sent the previous draft EIS for specific referrals, including the OIBC, members of the Hewahewa ʻOhana (e.g. Butch Helemano), cultural practitioners and caretakers at such sites as Puʻu o Mahuku and Kūkaniloko (e.g. Tom Lenchanko), Tom Shirai, the North Shore Community Land Trust, Native Hawaiian gathering and subsistence practitioners, management at Waimea Valley Falls Park, and various residents (see Section 4.2)
North Shore Community Land Trust	n/a	April 11, 2011 CSH sent letter by email
Osulivan, Lloyd	Resident of Waialua	February 11, 2011 CSH sent letter by email April 4, 2011 CSH called and left message

Name	Affiliation, Background	Comments
Quitevis, Leimaile	Waialua Representative, OIBC	March 4, 2011 CSH sent letter by email April 11, 2011 CSH sent letter by email
Souza, Aunty	Resident of Waialua	February 11, 2011 CSH sent letter by email April 4, 2011 CSH called and left message
Shirai, Thomas	OHA Native Hawaiian Historic Preservation Council, Past member OIBC, Lineal Descendant, Cultural and Historical Traditions of Waialua	February 11, 2011 CSH sent letter by email February 25, 2011 CSH called but no answer and could not leave a message March 30, 2011 CSH sent letter by email April 4, 2011 CSH called and Mr. Shirai stated that he is supportive of the Project and notes that there will not be any cultural impacts
Waimea Valley Hiʻipaka LLC (formerly Waimea Valley Falls Park)	n/a	April 12, 2011 CSH sent letter

4.1 State Historic Preservation Division

CSH contacted Phyllis "Coochie" Cayan, History and Culture Branch Chief of SHPD, on February 10, 2011, and Ms. Cayan responded to CSH on March 3, 2011 (Figure 34). According to Ms. Cayan, the SHPD states that the proposed Project will have an impact on the area's well documented *moʻolelo*, historic sites, archaeological sites, and burials. She recommends that access and gathering rights should not be prevented, as certain families, practitioners, and groups continue to practice Hawaiian spirituality, traditional burials, and other activities, such as hunting and hiking. Ms. Cayan refers Tom Shirai and Leimaile Quiteves, as well as practitioners who gather resources, hunting associations, stewardship groups (e.g. Kaʻala Cultural Center), senior citizen groups, Hawaiian civic clubs, neighborhood boards, and hiking clubs.

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
INTERIM CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

GUY H. KAULUKUKUI
FIRST DEPUTY

WILLIAM M. TAM
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
HISTORIC PRESERVATION DIVISION
KAHUHIHEWA BUILDING
601 KAMOKILA BLVD, KAPOLEI HI 96706

March 3, 2011

Dr. Hal Hammatt, Ph.D.
Cultural Surveys Hawai'i, Inc.
P.O. Box 1114
Kailua, Hawai'i 96734

Log No.2011.0466
Doc.No.1102pc009

Dear Dr. Hammatt:

SUBJECT: KAWAILOA 8: A Cultural Impact Assessment (CIA) for the proposed Kawailoa Wind Farm Project, Ahupua'as of Kamananui, Kawailoa, Lauhulu, Kuikuiloloa,Punaue, and Kapaeloa, Waialua District, O'ahu Island.
Wind Farm Site TMK (1) 6-1-005:001; 6-1-006:001; 6-1-007:001; 6-2-009:001; 6-2-011:001. Traversed by Existing Onsite Access Roads: TMK (1)6-1-005:003,007,014,015,016, 019; 6-1-005:020, 021,022; 6-1-008:025; 6-2-002:001, 002, 003, 025. Mount Ka'ala Communication Sites: TMK (1) 6-7-003:024.

Thank you for the opportunity to offer some strategic insights to evaluate potential impacts to cultural practices and resources as a result of the aforementioned development in Kamananui Ahupua'a (the microwave communications facilities) and Kawailoa, Lauhulu, Kuikuiloloa, Punaue and Kapaeloa Ahupua'as (the wind power facility).

This is a huge undertaking in multiple ahupua'a that will have an impact on any traditional cultural practices and resources which include the area's well-documented mo'olelo, historic sites, archaeological sites and burials. **A vast project such as this will need full consultation by the immediate communities (and island wide users) on traditional cultural impacts for all of the ahupua'as mentioned above.** As you know, these areas continue to have natural resources and/or have a traditional cultural landscape that are still used by native Hawaiians and the general public. Therefore, access and gathering rights should not be prevented in any of the project's areas. Also, there are some areas in the above various ahupua'a that certain families, practitioners and/or groups continue to practice Hawaiian spirituality, traditional burials and as well as other non-western activities (i.e., hunting, hiking).

Some folks to begin your outreach may include but not limited to the following:

- Tom Shirai, core 'ohana from Waialua nei Phone: 637-4690
- Leimaile Quiteves, OIBC rep for Waialua District Phone: 381-1137

Other groups you may want to dialogue with may include practitioners who gather resources (i.e., wood, flora), hunting associations, stewardship groups (i.e., Ka'ala Cultural Center), senior citizens (kupuna) groups, Hawaiian civic clubs and/or societies, neighborhood boards, hiking clubs and so on not only on in those communities but island-wide to reach potential folks that may have information on the past and present land use of this proposed project area.

Sincerely,

Phyllis Coochie Cayan

Phyllis Coochie Cayan
History and Culture Branch Chief

Figure 34. SHPD response letter

4.2 Office of Hawaiian Affairs

CSH contacted Clyde Nāmuʻo, Administrator of OHA, on February 10, 2011. Jerome K. Yasuhara, Compliance Specialist, forwarded OHA's previous comments on the Kawailoa draft EIS to CSH on April 11, 2011, with particular focus on referrals. This document states that OHA is concerned about known Hawaiian properties and sites in close proximity to the proposed Project, and acknowledges the ancient *aliʻi* and *kahuna* foundations of Waialua. Specific referrals (in footnotes 16 and 18) include the OIBC, members of the Hewahewa ʻOhana (e.g. Butch Helemano), cultural practitioners and caretakers at sites such as Puʻu o Mahuku and Kūkaniloko (e.g. Tom Lenchanko), Tom Shirai, the North Shore Community Land Trust, Native Hawaiian gathering and subsistence practitioners, management at Waimea Valley Falls Park, and various residents.

Section 5 Interviews

Kama‘āina and *kūpuna* with knowledge of the proposed Project and study area participated in semi-structured interviews from January 2011 to April 2011 for this CIA. CSH attempted to contact 37 individuals for this CIA report; of those, 17 responded and nine participated in formal interviews. CSH initiated the interviews with questions from the following five broad categories: *wahi pana* and *mo‘olelo*, agriculture and gathering practices, freshwater and marine resources, cultural and historic properties, and burials. Participants' biographical backgrounds, comments, and concerns about the proposed development and permanent Project footprint are presented below.

5.1 Acknowledgements

The authors and researchers of this report extend our deep appreciation to everyone who took time to speak and share their *mana‘o* (thoughts, opinions) with CSH whether in interviews or brief consultations. We request that if these interviews are used in future documents, the words of contributors are reproduced accurately and not in any way altered, and that if large excerpts from interviews are used, report preparers obtain the express written consent of the interviewee/s.

5.2 Gladys Awai-Lennox

CSH conducted phone interviews with Gladys Awai-Lennox, “Aunty Honey,” on February 16, 2011 and previously on June 23, 2010. In 1929, Mrs. Awai-Lennox was the second of four children born to George Elama Ka’ele’makule Awai and Beatrice Chung-Hoon Awai in Honolulu. Her mother was from the Liliha area at School Street. Her father was a 1910 graduate of Kamehameha Schools and passed away in 1981 when he was 90 years of age. Mrs. Awai-Lennox, now 82 years old, is a retired secondary school principal. Throughout her life, she has lived part time in Hale’iwa, and about ten years ago she returned to her family’s *kuleana* in Hale’iwa where she now resides full-time.

Mrs. Awai-Lennox shared her recollections of the area from Hale’iwa to Kawailoa during the 1930s and 1940s. She recalls Kawailoa as a thriving little plantation town that had a school, swimming pool, and Japanese temple. The Kawailoa area also has deeper cultural and historic significance. She describes that Kamehameha’s warriors stopped at Waimea Bay and used the whole area on the mountain side, from Kawailoa to Waimea, for training centers. She recalls that she found remains of old stone walls that, because of the way they were situated, could have been part of an ancient training center. She describes that Queen Lili‘uokalani had a home near Anahulu Stream, and explains that “We are certain the *ali‘i* enjoyed the balmy weather and abundance of food [in the area].” In addition, her elder family members shared with her that several *heiau* were located in the uplands of Kawailoa, although she cannot specify their exact locations.

Other historical sites in the area she recalls include the OR&L railroad tracks that used to pass right in front of their family house. She explains that the railroad enabled people to come in and visit the area and she fondly remembers riding the trains and seeing them come over the track as she and her siblings swam in Anahulu Stream: “Back then, the water was clean and the men would throw us pineapples from the train and we loved that! I know the waters were clean because the military who were stationed in Kawailoa would throw coins in the stream and we could see them all the way at the bottom, and we'd go dive for them!"

Mrs. Awai-Lennox's family *kuleana* can be found by following Haleʻiwa Road past Aliʻi Beach park and past the Japanese temple and school near where Kamehameha Schools has their preschool. There, a house with a big front lawn is the family house. It has ten bedrooms and was rebuilt in 1930. Mrs. Awai-Lennox lives near the taro in the agricultural lot behind the house and her cousin, Amy Kalili Asano, still lives in the big family home. The land was granted to her father's grandfather at the time of the Māhele and her family has been in the area ever since. Her father told her stories of their ancestors helping the early missionaries travel (circa 1830) because, "in those days, they knew about the currents, so they could get them to and from North Shore to Kauaiʻi." Since her father worked in Honolulu, their family's time was divided between town and Haleʻiwa, yet her father ensured they religiously went back every weekend to return to the *ʻāina* (land) and tend their taro.

She explains that they had their taro lands, breadfruit, and bananas, which still exist to some extent but their supplies have diminished. She points out that although they still have many coconuts, little taro is available. Tending and eating taro was central to their life. "We never bought *poi* [pounded taro] for over fifty years!" she reminisces. They always harvested their own taro and prepared *paʻiʻai* (hard, pounded but undiluted taro). They would line the bowl with a *tī* leaf and, as needed, mix it with water to make *poi*, which was their staple. When her family needed a large quantity for a *pāʻina (*party with dinner), her father would take their taro to Mr. Matson's mill behind Kawaihaʻo church in Honolulu to prepare the *poi*.

Important influences during her development included her family, the Congregational church they attended, education, Hawaiian language and culture, living off the land, and living off the ocean. Her mother was a teacher at Kawailoa elementary school and her uncle, James Awai, was a principal there, too. Her father worked for the Land Office and he was bilingual, fluent in his native Hawaiian and in English. One of his strengths was translating documents such as deeds, which were all in Hawaiian. Although she did not grow up speaking Hawaiian, her father was fluent and he created Hawaiian lessons for Mrs. Awai-Lennox and her siblings. They began with single words, then phrases, and then sentences. Music was another very important way they learned Hawaiian. Her father played music at the Haleʻiwa Hotel with his brother and sister and they also were involved in music through their church. Memorizing Bible verses in Hawaiian also contributed to Mrs. Awai-Lennox's Hawaiian language development. "When I think back now, he was wanting us to retain our culture, not lose it. Mother was very supportive, too, you know, typical school teacher." Mrs. Awai-Lennox reflects that this was important for developing their self-esteem.

"Even though we weren't considered poor, we lived off the uplands and oceans. This was before [talk about] sustainability," she remarks. Fishing has been a significant activity. It was a group effort and a family activity that provided sustenance for everyday eating and for special occasions. She recalls that her grandmother who went to a seminary near Anahulu Stream was also a great fisher. "We fished from Haleʻiwa up to Kawailoa and beyond, depending on the availability and the need," Mrs. Awai-Lennox explains. She recalls being woken up when it was still dark by her father and there were no questions asked about why he woke her, or where they were going. She knew they were going fishing. They practiced a method called *pa'i pa'i* (to slap). Her father and uncle would take nets out and surround the area and when the fish were near, they would signal the kids to *pa'i pa'i* the water to scare the fish into the nets. They used old *tī* leaves and *haole koa* sticks to swap or slap the water, reef, or sand. Another method they practiced was the *hukilau* (to fish with a seine, literally meaning pulling ropes) and refers to a large group of people surrounding the fish with a net and pulling the net tied with dried *tī* leaves closer and closer together to trap the fish. She explains that this method was especially used for *akule* fishing, and it was practiced less frequently because it required a large group of people.

In addition to fishing, her family also gathered *wana* (spiny urchins). She also recalls using goggles made from cross-sections of bamboo to look for them underwater, exclaiming "I still have one pair!" They prepared the *wana* by shaking them in the bag or basket to loosen their spines, then they would crack the shells, and take the tongues out. While in San Francisco years later, Mrs. Awai-Lennox was surprised to "see Italians eating *wana* like a caviar!" She recalls that Kawailoa and Waimea were excellent for *wana* harvesting because "the rough water meant they were more plentiful." They also gathered many *pipipi* (pearl oysters) and *ha'uki'uki* (shingle urchins), which are round, stubby, and fat. Their juice was used for embellishing food. Now, she notes that these are all scarce around the Hale'iwa area. She also recalls eating special fish, like raw *nenue* (chub fish) and *kala* (surgeon fish), remarking that the *kala* from Hale'iwa area waters were particularly tasty. Her memory of eating *kala* from Manaloa Bay (Hawai'i Kai) was not as pleasant because "there the *kala* ate too much seaweed, so all you could taste was seaweed." Her family cooked *kala* in a fish stew. "My dad and family members knew how to clean the intestines really well, so some of the goodies were added to the flavor of the soup," she reminisces. For special holidays such as New Year's and birthdays it was her family's tradition to prepare squid *luau* (a stew made from squid, coconut milk, and luau or taro leaves). She also recalls stringing and drying all the *'oama* which she says were very abundant.

Mrs. Awai-Lennox's family gathered *limu* including: *wāwae'iole*, also called rat feet; *ogo*, a Japanese term for a kind of *limu*; *limu 'ele'ele,* which was found where fresh water came down from mountains in Kawailoa Ahupua'a in the area around Chun's reef, and *limu kohu*. She remembers these used to be plentiful and that even the old Hale'iwa IGA and Fujioka's grocery stores used to sell *limu kohu*. She adds that eventually they disappeared because they have become so scarce.

These days, "surfing has gobbled up all the attention" and fishing, especially family fishing, has fallen out of popularity, she says. She knows that some younger fishermen still visit Kawailoa area. They work individually and are often free diving for lobsters, which she has heard are becoming scarce, along with *limu*.

In addition to growing *taro* and other vegetables, her family also cultivated breadfruit, banana, and coconut trees. For special holidays such as New Year's and birthdays it was her family's tradition to prepare *kūlolo* (coconut pudding made of baked or steamed grated taro and coconut cream), *haupia* (pudding made of arrowroot, or *pia*, and coconut cream). Mrs. Awai-Lennox and her siblings also utilized the uplands for fruit. She recalls gathering guava and passion fruit which they used to make juice. Some would be stored in freezers for later use.

Another plant they collected was *kiawe* (Algaroba tree). Mrs. Awai-Lennox and her siblings collected the seed pods or beans as one of their chores. *Kiawe* was used for fodder for the cattle and pigs kept by her father's youngest sister who lived above Waimea Bay. Other plants her family valued for their aesthetic qualities including gingers (especially white but also red and yellow) and *hala* (pandanus). Their *hala* tree, which sadly died later, was particularly loved by Mrs. Awai-Lennox as she recounts how her father would make *hala* leis on special occasions for family members. The red *hala* lei (made from the pandanus fruit parts or phalanges) was very special, she recalls. She recently spoke with a *kupuna* from Kahuku, Roy Benim, who is in his late 80s, and he told her of the saying "you never leave Kahuku without a *hala* lei." The sentiment rings true for her and she adds, "same for us. We would make a red *hala* and it was very special." For celebrations they gathered other special flowers such as the *kukuna-o-ka-lā* for lei (which literally means ray of the sun and refers to how the stiff yellow to red calyxes, or outer parts of the flower, resemble the sun's rays [Pukui and Elbert1986:178]).

Mrs. Awai-Lennox relayed examples of how birds have been important in the area. The first is about the plover. Her father told stories about retrieving plover for Prince Kūhio, who was fond of hunting them. The second is about Peacock Flats. As a young girl, she asked her father about the lights on Mount Ka‘ala at night and her father told her they were lights from people hunting for wild turkeys. Peacocks and wild turkeys are abundant there. The third bird reference she relays is about the *‘alae ‘ula* (Common Hawaiian Moorhen). It was present when she grew up and, to a lesser extent, she still sees them in the wetlands near their home. When it flew close to their family home and cried, they believed it meant that someone would pass away. Her cousin who is about 90 years old also remembers that. Her younger son who was a dedicated practitioner of *lua* did research on their genealogy, and learned that Ke‘u, a family name, is an onomonopia for the call of the *‘alae ‘ula*. Their family feels connected to the bird. "We still have them here in the area," she added.

Mrs. Awai-Lennox supports the Project overall and does not have any concerns or recommendations.

5.3 Emmaline Causey

CSH interviewed Mrs. Emmaline Causey on the phone on February 28, 2011 and previously in her home at Diamond C. Ranch, LLC in Hale‘iwa. Mrs. Causey was born in 1943 in Hale‘iwa to Juliet (maiden name Souza) and Henry K. Plemer. Both of her parents came from large families who have lived in Hale‘iwa for a long time and are well known as her family has been in Hale‘iwa for generations. Her maternal grandfather, Mr. Souza, came from Madero, Portugal to Hale‘iwa. He used to lease land where Jameson's By the Sea Restaurant now stands in Hale‘iwa town up to Kawailoa Road nearby where she now lives. Mr. Souza was a chauffeur for the manager of Waialua Sugar. He was also a horse jockey. Mrs. Causey's maternal grandmother, Ms. Edith Achiu, was Hawaiian-Chinese and taught at what was then called Waialua Elementary. Mrs. Causey's paternal great-grandfather, Mr. Henry Plemer, was a judge at the Waialua Court House in Hale‘iwa.

Mrs. Causey's mother, one of twelve children, was born in a house that is still standing outside of Hale‘iwa town, past Thomson's corner at an area that was formerly known as Souza Corner, because of her family's presence in the area. Mrs. Causey's father had about half an acre off Lokoea in Hale‘iwa town between Kamehameha Highway and Hale‘iwa Road behind what is now Jameson’s By the Sea. He had a piggery there and now Mrs. Causey’s brother has the property. Mrs. Causey remembers that her father worked as a mechanic for Waialua Sugar for 43 years before he retired. He also worked at a gas station to supplement his income and continued working there after his retirement to supplement his pension. In the 1950s and 1960s, her mother worked as a baker, chef, and school bus driver to help support their family. Because Mrs. Causey is the first born, she was delegated considerable responsibility for helping to raise her six younger siblings. Her father passed away in 1992 and her mother continued working as a butcher at the supermarket in Hale‘iwa until she died in 2006 from leukemia.

Mrs. Causey’s mother and her mother’s youngest sister were brought by their father on a little boat from the water near Jameson’s By the Sea to the marshy area near the old pump station at the ranch where she lives now. (The marsh is fed by artesian springs.) She reminisced that, “it used to be all clean and nice.” They would fish and have a nice time. In particular she recalls they caught plenty of *āholehole* something that is no longer possible as the marsh is now managed by the DLNR and no one is allowed in it. Furthermore it is choked with reeds and the water is not passable by boat now, she adds.

The property used to be leased by Mr. Vasconsalles and then by Mr. George Q. Canon and Mr. James Causey (Mrs. Causey’s husband, now deceased). Mr. Causey used to help Mr. Cannon with the ranch and in 1965 the ranch was turned over to her husband. They used to have 240 acres that went all the way to the Hale‘iwa Beach Park but she now has only 120 acres. Mrs. Causey also leases 11 acres from Dole near the marsh. She has been on the property for 25 years and still keeps some cattle. The land *mauka* of her property is being used by Kamehameha Schools for diversified farming. Corn seed (from Monsanto), tuber rose, and papaya are a few of the crops grown there.

Her property contains a number of archaeological features of interest that are checked annually by Mr. Jan Becket of Kamehameha Schools. The old railroad track that used to transport sugar cane runs just behind her property. Sometime before 1961, the year Mrs. Causey graduated from high school, she recalls how Waialua Sugar stopped transporting their sugar cane on the railroad and began transporting it with large cane haulers on the road. They had no need for the railroad any longer, and she recalls how she and her other neighbors got to ride the rail on its last trip.

The property where she lives is located adjacent to the southwestern access roads of the permanent Project footprint. Two Japanese graveyards are located just *makai* and *mauka* of her property very close to Old Cane Haul Road and Kawailoa Road. Having previously noticed how the transport of wind turbines required the entire width of a two-lane road, she is concerned that the transport of wind turbines along Old Cane Haul Road and Kawailoa Road may disturb these two graveyards, which are only maintained twice a year and may thus be at times obstructed from view.

Mrs. Causey previously took CSH to an area to point out a lot that used to contain the beach house where her mother’s family congregated throughout her childhood and continued to gather until about twenty or so years ago. At one time, Mrs. Causey had 39 cousins and they all used to meet at that beach house and spend time together, especially during the summer. She has fond memories of swimming all day and eating her grandmother's yellow cake with watermelon. There was a big rock just off shore where she and her cousins learned to swim. No one surfed right there because it is too rocky and not good for surfing, she says, although she added that nearby is a surf spot known as Alligators. She and her cousins enjoyed snacking on sea grapes that grew along the coast. They also gathered *limu* including *ogo* and another thick kind of *limu* that was called *pokpokalo* (by the Filipinos), *wāwaeʻiole* (in Hawaiian), and rabbit's foot. They prepared it by mixing it with tomato, onion, and vinegar. Mrs. Causey's uncles and older cousins would fish from this property and catch *akule*, *kūmū* (goatfish), *ʻāweoweo* (bigeye), *manini* (convict tang), and *āholehole*. She and her cousins also gathered *limu, ʻōpihi*, and *pipipi*. Her grandmother would boil the *pipipi* and give them a needle to scoop out the flesh to eat. They also gathered there for special occasions. For example, she recalls an Easter Egg hunt when she and her cousins found money hidden by her Grandmother's brother. They also had many *lūʻau* (feasts) there. When Mrs. Causey was growing up, the property was owned by Kamehameha Schools. After her family gave up the lease it was taken over by her uncle, and then by a woman who worked for Kamehameha Schools who eventually gave it up because the property taxes became so high. Mrs. Causey's cousin, Ms. Diane Canon, still has a month-to-month lease on the house next door to where the family beach house stood.

The Waialua Sugar Plantation Camp was located about a ten minute walk from where she now lives. "It used to be the most beautiful plantation camp you saw," Mrs. Causey recalls. They had a gym, pool, store, and gas station. She has fond memories of climbing mango trees and roller skating with her friends and classmates who lived there. Hawaiian, Japanese, Filipino, and Portuguese families lived there. They also used to walk on old cans of Carnation evaporated milk by using the sticky Ganduli Bean sap to make them adhere to their feet for homemade stilts. She recalls the place as nice, safe, no problems and seems to contrast this with today's problems in the area like squatters and homelessness. In 1995, Waialua Sugar went out of business and the entire camp was bulldozed.

Puaʻena Point used to be an airfield. As a child, she rode go-carts there. She also recalls that people gathered seaweed there. Mrs. Causey notes how these days people do not cut seaweed as they should—they uproot and destroy it completely so it cannot continue to grow.

5.4 Jan Becket

Jan Becket lives in and grew up in Mānoa, and teaches photography at Kamehameha Schools. About 15 years ago, he began checking Kamehameha Schools' properties for archaeological structures, and it is then that he began visiting Mrs. Causey's property. He has co-written a book, *Pana Oʻahu* (Becket and Singer 1999) that features interesting archaeological sites on Oʻahu, including two sites on the Causey property. Several *kūpuna* have also shared information on many other cultural sites along the coast of Kawailoa. Mr. Becket showed CSH the locations of some of these sites, provided GPS coordinates for others, and also estimated some of their positions on maps (Figure 35).

Mr. Becket documented a buttressed platform on a rock outcrop (Becket and Singer 1999:98) (Figure 36). He describes it as having a "pre-Contact" look and estimates it may be a house site or a *heiau*. This is located close to the pond on the Kaʻena side of Mrs. Causey's home. About five years ago, Mr. Becket happened to meet a relative of Mrs. Causey while he was visiting. He recalled that there was a respected elder Hawaiian man who used to live near the structure and that there used to be a large stone platform there, although it was not present at the time of their discussion. Mr. Becket also documented a large enclosure (Becket and Singer 1999:103) (Figure 37). On the *makai* side, adjacent to the ʻUkoʻa pond is a huge upright stone, built into the enclosure. ʻUkoʻa Pond, he explains, is associated with ceremonies to attract lightning according to one small reference in *Sites of Oahu* (Sterling and Summers 1978).

Mr. Becket and CSH previously visited Mrs. Causey's property in order to view some of the structures on that property and on the neighboring property (on the Haleʻiwa side). At the time CSH toured the area with Mr. Becket, it was part of a 16-acre parcel being offered for sale by the George H. Holt estate, through Sterman Reality. Beyond that parcel lies a parcel that Mr. Dino Ventura is acquiring from Dole Corporation. Stretching from the Causey property through Mr. Ventura's land lies an extensive complex, with what appear to be *ahu* (shrine) (Figure 38 and Figure 39), walls (Figure 40), platforms (Figure 41), enclosures, and bell stones (a stone with a thin ledge and strike marks at one spot that rings when struck) (Figure 42 and Figure 43). Although there are no fences to mark property boundaries, it appears that an especially high concentration of sites lies on the Holt estate.

Mr. Andy Anderson (now deceased) knew a lot about the Kawailoa area and told Ms. Marian Kelly (emeritus faculty at UH from Cultural Studies), who, in turn, told Mr. Becket that one local tradition places Kapukapuākea Heiau *mauka* of ʻUkoʻa Pond and in the vicinity of Mrs. Causey's property. (Mr. Becket explains that many other references place Kapukapuākea Heiau at Kaiaka Bay.) Later Mr. Becket visited the adjoining Holt property with Mr. Thomas Shirai and they viewed the sites together. The counterpart to that *heiau* is Taputapuākea Heiau, located in Tahiti and built circa the twelfth century. These related *heiau* are said to demonstrate the contact between Hawaiʻi and Tahiti through voyaging. (Kapukapuākea is described as "destroyed" by Sterling and Summers [1978], but clearly some well respected community members believe this part of Kawailoa includes very important cultural sites).

Mr. Becket also learned about numerous cultural sites in Kawailoa from *kupuna* Rudy Mitchell, a cultural historian of Waimea Valley. Mr. Becket identifies, describes, locates, and references the following cultural sites based on site visits with and *moʻolelo* from Rudy Mitchell:

1. Fish stones on either side of Waimea Bay, where people used to watch for fish: Kū (below Puʻu o Mahuku Heiau) is an upright standing stone where people go to watch surf; and Ahuena (on the Haleʻiwa side). Rudy Mitchell showed Mr. Becket these two stones. Other names for these stones are Kalaku and Kalakoi, respectively. They are referenced in Sterling and Summers (1978:131).
2. A pool next to Ahuena. This marks an area where taxes were paid and also marked the *ahupuaʻa* boundary. It is still there in the bushes and is located between Waimea Bay and a recent housing development (at Iliohu Street). It is referenced in Sterling and Summers (1978:129).
3. Keahuohāpuʻu, a fish *heiau* accessible through private development off Iliohu Street.

4. Pōhaku Hoʻohanau, which means "self birthing stones." It is located off Pohakuloa Way and according to Joe Kennedy (former SHPD archaeologist) , it is still there. It is referenced in Sterling and Summers (1978:123).
5. Pele's Followers, natural features of rocks and coral heads offshore near Pohaku Loa Way.
6. Kūpōpolo Heiau, located on Kamehameha Schools land (see Figure 15).
7. A cave behind Kūpōpolo, which is connected with a famous upright stone (Kaneaukai, referenced in Sterling and Summers (1978:125) and petroglyphs located on Kamehameha Schools land.
8. An unmarked and unrecognized structure consisting of a wall, an even enclosure, and a platform (possibly a *heiau*) near Kamehameha Road on Meadow Gold property across from Laniakea. The City has expressed interest in turning that site into a parking lot or in realigning the present road to move all parking *makai* of the road.
9. ʻIliʻilikea Heiau. Mr. Mitchell showed this site to Mr. Becket. This *heiau* in Haleʻiwa is also on the Meadow Gold property. Portions of it have deteriorated. Sterling and Summers describe it as "destroyed" (1978: 120). (The mapped location of ʻIliʻilikea Heiau, as demonstrated by Mr. Mitchell, is closer to the coast than the location identified by Sterling and Summers, which is on the Project's *makai* access roads; compare Figure 9 and Figure 35).
10. Puʻu o Mahuka Heiau (see Figure 17).
11. A *heiau* for Lono in Waimea Falls park (now called Waimea Valley), where Rudy Mitchell reconstructed an original *hale* of the *heiau* (see Figure 16).
12. A low enclosure next to ʻIliʻilikea Heiau, located toward Waimea Bay on Meadow Gold property.
13. Burials on Kamehameha Schools property in a swampy area.
14. A big wall and other structures in tall grass (unless it has been bulldozed since Mr. Becket was last there) located *mauka* of the Kawailoa transfer station.
15. An altar for Laniwahine, the Moʻo of ʻUkoʻa Pond. According to McAllister (1933) it is said to be "near pump #4" and Mr. Becket says this pump #4 is on the driveway leading up to the Causey property and it is also mentioned in Sterling and Summers (1978). Mr. Becket clarifies that "near" may even mean that it is on Causey's property, noting McAllister's use of the word "near" is subjective. Kamehameha Schools filled in the pond at Pump #4 connected with Laniwahine, according to Mrs. Causey. He has looked for but not seen the feature itself.
16. Kahōkūwelowelo Heiau, located across Cane Road and *mauka* of ʻIliʻilikea Heiau. It is on property owned by Kamehameha Schools and is referenced in McAllister (1933). It has a platform and large upright stone. Mr. Becket says the condition of the site has been significantly altered by the U.S. Army (see Figure 18).

17. Kahōkūwelowelo Hale is a site that may be where *kāhuna* lived or may be a women's *heiau* (*hale o papa*). It consists of an enclosure and other features that are in good condition. It is located on property owned by Kamehameha Schools.
18. A quarry site near pump #4 at a closed gate off Kawailoa Road has remnants of a pattern carved into stones. Mr. Becket calls the pattern the "*niho*" (tooth) pattern because it is made up of triangular notches alternating with straight line. He suggests that carving the pattern may have been a technique for splitting stone, but he is not sure.
19. Within the Causey and Holt properties there is a complex of features that seem to be related. These are on Kamehameha Schools and Dole land and consists of a long wall along ‘Uko‘a Pond, a platform (about 12 by 18 feet) on an outcrop, a rough enclosure (about 40 by 60 feet) with a prominent stone facing the pond, an *ahu* at the edge of an amorphous alignment, and an area with well organized walls.
20. Rudy Mitchell knew the locations of hundreds of burials in the cliff faces along the *makai* coastal strip of Kawailoa. These may have been from earlier epidemics. Rudy Mitchell also discovered *iwi* in caves in Waimea Valley and prevented their removal.
21. Mr. Becket describes a fishing shrine on the southern side of Waimea Bay and a *heiau* or *ali‘i* residence and an upright stone farther back in the valley.

Mr. Becket also draws attention to intensive archaeological investigations in the upper Anahulu Valley (Kirch and Sahlins 1992) and suggests that parallel groupings of upper valley settlements may be located in the gulches in the northern *mauka* sections of Kawailoa, including the permanent Project footprint.

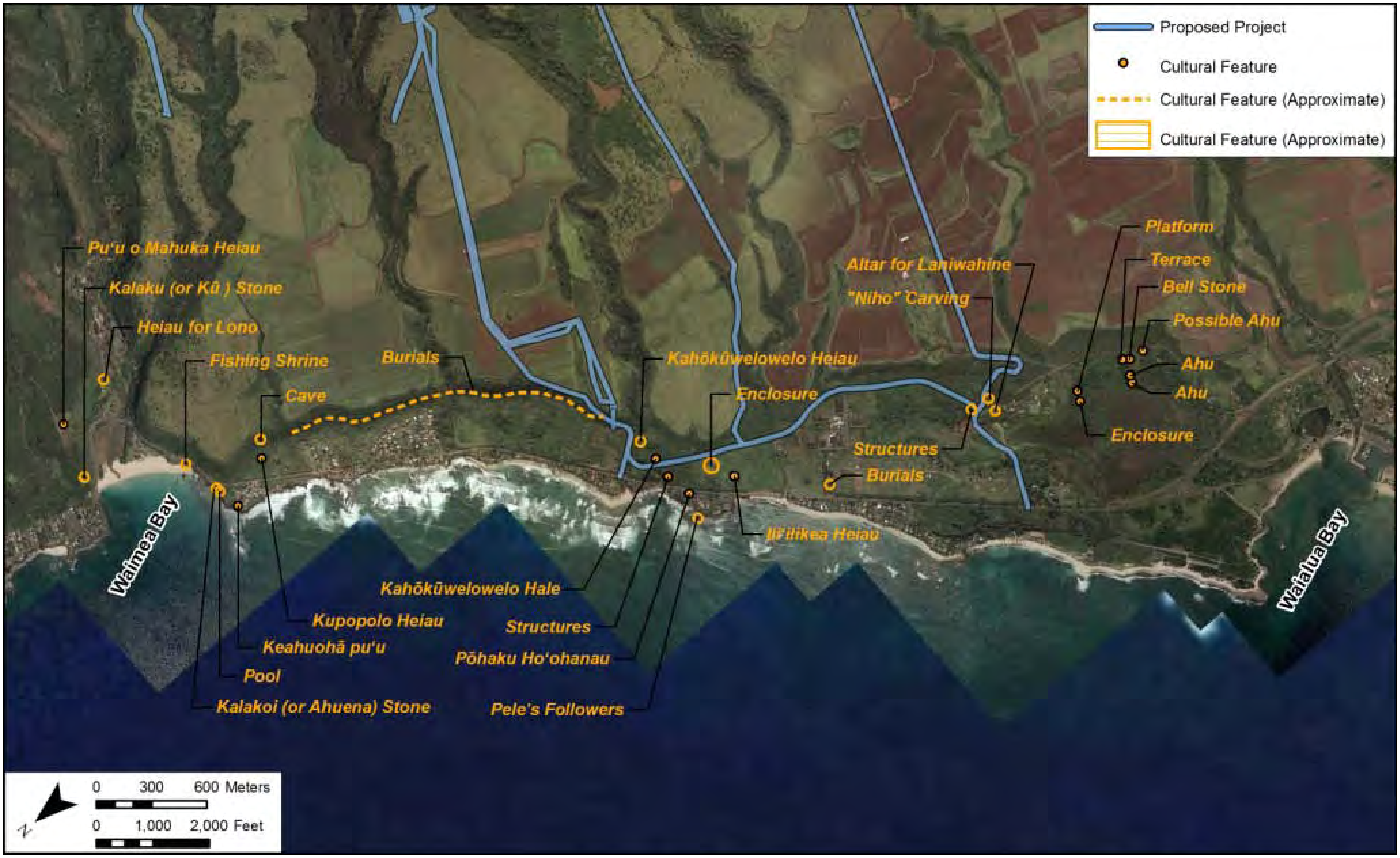

Figure 35. Cultural features in Kawailoa identified and estimated by Jan Becket

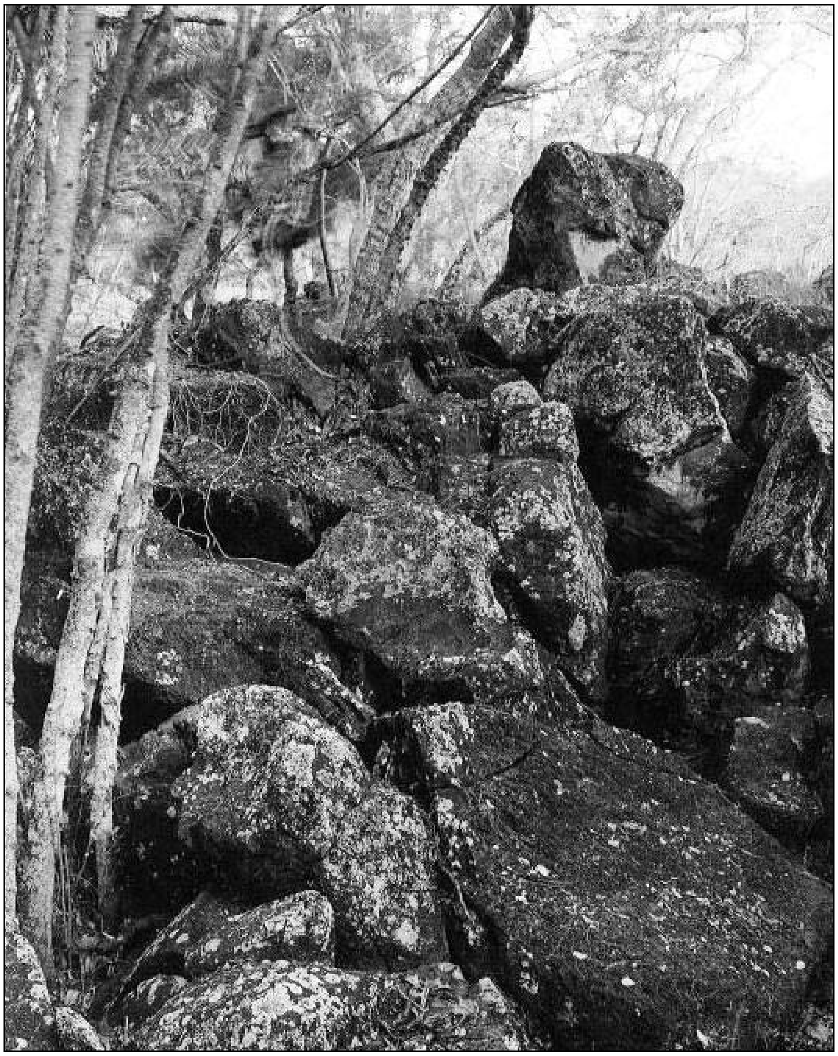

Figure 36. Rock-faced terrace with upright stone on the Causey property (Becket and Singer 1999:99)

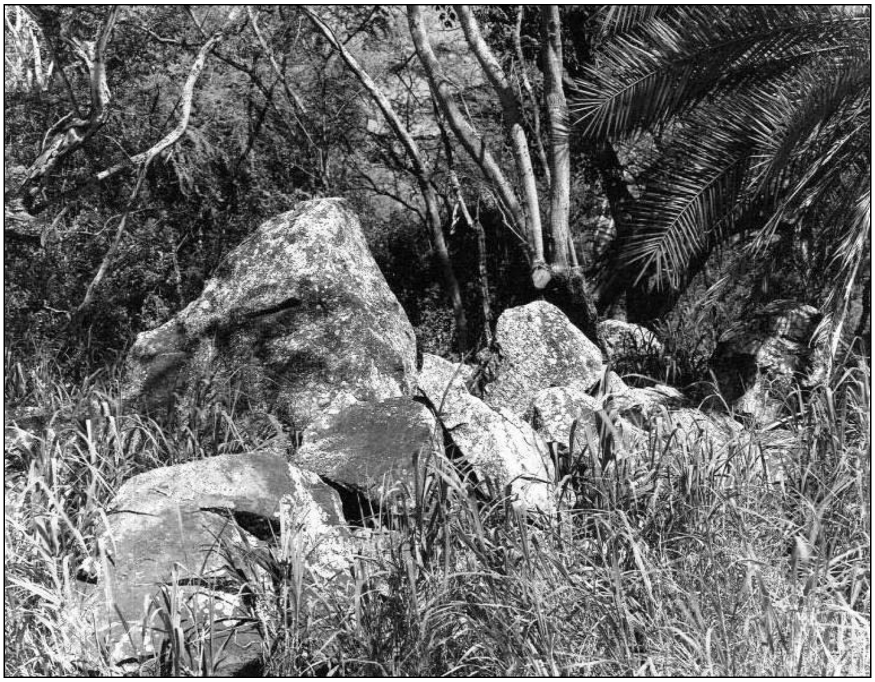

Figure 37. Upright stone built into platform facing ‘Uko‘a Fishpond on the Causey property (Becket and Singer 1999:101)

Figure 38. Mr. Becket photographs a cultural feature, possibly an *ahu*, on the Causey property (CSH July 20, 2010)

Figure 39. Possible *ahu* on Dean Ventura's property (CSH July 21, 2010)

Figure 40. Section of long wall on the Causey property (CSH July 20, 2010)

Figure 41. Platform on the Causey property (CSH July 20, 2010)

Figure 42. Possible Bell Stone on the Causey property (CSH July 20, 2010)

Figure 43. Mr. Becket testing the sound of another possible bell stone on the Causey property (CSH July 20, 2010)

5.5 Thomas Lenchanko[1]

Thomas Joseph Lenchanko, Spokesperson for ʻAha Kūkaniloko/Koa Mana, Hawaiian National Lineal Descendants, met with CSH on January 17, 2011 at the *kaʻananiʻau* (boundary markers that distinguish a beautiful period of time) O'ahu nui, ka lua a'a hu, Waikakalaua Stream, also known as Launani Valley, in Wahiawā, and on February 17, 2011 at Kūkaniloko to share his traditional comprehension, *moʻolelo*, and *manaʻo* of the enduring cosmological, spiritual, and cultural significance of Kūkaniloko, since time eternal, time immemorial, the creation of the island of Oʻahu, and the descent of the first people from the gods. Traditionally, Kūkaniloko extends geographically to encompass the island of Oʻahu within (*iloko*) and without (*iwaho*) a network of kaʻananiʻau that are superimposed upon the six territorial *moku* land divisions of Kona, Ewa, Waiʻanae, Waialua, Koʻolauloa and Koʻolaupoko.

"According to traditional practice and learning from our *kūpuna mā* (those we choose to follow), Kūkaniloko is the most sacred site on Oʻahu; however, it is much larger in total land mass and traditional significance than the current State of Hawaiʻi five-acre park site noted to be Kūkaniloko Birthstones State Monument." Mr. Lenchanko shares a *moʻolelo* of the genesis of the island of Oʻahu: "Two islands, Waiʻanae, the *wahine* (woman), and Koʻolau, the *kāne* (man),

[1] Mr. Lenchanko intentionally deviates from the use of diacritical markings for some Hawaiian terms and the capitalization of some place names to highlight their antiquity, intentionally does not translate some Hawaiian terms because such translation would only be a superficial gloss of the layers of hidden meanings [*kaona*], and provides his own translations that sometimes differ from Pukui et al. (1974). While this interview was not audio-recorded, the summary is mostly Mr. Lenchanko's words after several revisions.

spiritually united, connecting and centering their issue at Kūkaniloko, the *piko* of our Nation, Ko Hawaii Pae Aina.”

The land of O‘ahu is divided by a concentric alignment of *ka‘ānani‘au* that demarcates the area of Kūkaniloko. Mr. Lenchanko describes that these series of rock pilings conservatively demarcates an area of 36,000 acres known to be Lihue, Wahiawā, Halemano... that somewhat resembles the constellation Orion. Through land navigation and the confirmation of their continued existence, the *ka‘ānani‘au* include, but are not limit to: O‘ahu nui, Paupalai, Halawa, Hawea, Kou, Maunauna, Ku‘ua, Kulihemo, Kānewai, Halahape, ‘Ō‘io, Halemano... “*Kūpuna mā* taught us that these lands are those of the Lo-Ali’i, whom were like gods, unseen, resembling men; for they lived here continually, guarded their *kapu* (sacredness, special privileges) and from whom a guaranteed *ali‘i* (managers of people, land, and resources) could be obtained (*loa‘a*).”

The *ka‘ānani‘au* O‘ahu nui, located on the hill Wahiawā side of Waikakalaua Stream, is composed of several *ahu*, or rock pilings, totaling three thousand stones. Two large *pōhaku*, noted to be O‘ahu nui and an associate named O‘ahu iki are sill located within the stream and upon the bank Honolulu side of Waikakalaua stream (close to a Pele rock formation). *Mo‘olelo* teach that O‘ahu nui and O‘ahu iki were brother and sister who once ruled in common. *Ali‘i* who viewed upon the *ka‘ānani‘au* Oahu nui are said to have managed all of O‘ahu. According to Mr. Lenchanko, the Kumulipo, a Hawaiian creation chant, describes how the people of O‘ahu are originally descended from the gods at ka lua a’a hu, “the pit from where we descend.” He elaborates the meaning of O‘a-hu: *O‘a* is the intertwining and interweaving of the blood lines of La‘ila‘i, the woman who stood down from the heavens, and Ki‘i, which issued forth those people known to be the hu. Mr. Lenchanko shared photographs with CSH of O‘ahu nui in a narrow section of the stream, O‘ahu iki in a broad area overlooking the stream, and a rock formation resembling La‘ila‘i within the streambed. To Mr. Lenchanko, these stone features confirm the enduring validity of who we are. In fact, “someone attempted to air-drill the *pōhaku* O‘ahu nui to destroy our Hawaiian National Treasure, our visual and spiritual connection and traditional comprehension to our epochal Kumulipo.” Small holes can be seen in the photograph of *pōhaku* O‘ahu nui, adversely impacted and broken, yet maintaining its *mana*... Noting testimony from *kūpuna mā*:

> ...a little pool somewhere up in Wahiawā, called ka lua a‘a hu. If you bath in that pool you have seen O‘ahu...” From the Kumulipo, ka wā ewalu (The Eighth Epoch), The Dawn of Day: “Born were men by the hundreds, Born was man for the narrow stream, Born was woman for the broad stream.

Mr. Lenchanko describes *ali‘i* as managers of the people. The *ali‘i* had divine status (*ikū pau*) and the highest genealogy (*hoa ali‘i*), as they were descendant of “Kāne, *akua* (gods, spirits), *ali‘i*, *ho‘āno* (peacefulness, sacredness), *kapu*, *wela* (heat), *moe*, *ahi* (fire)...” Those special privileges were issued at the birth for those of divine descent whom are known to be Lo-Ali‘i:

> Kūkaniloko since time immemorial, time eternal, begins with ka lua a‘a hu at *ka‘ānani‘au* O‘ahu nui, then to be found within kapa ahu (unapproachable, child only one of whose parents are *ali‘i*) at *ka‘ānani‘au* Halemano and to the contemporary site kapa ahu awa (prescribed birth rite, unapproachable, child only of whose parents are *ali‘i*) Kūkaniloko, also known as Kūkaniloko Birthstones

> State Monument. It is taught that A.D.1060, *aliʻi kapu* Nanakaoko, *kāne*, and *ali'i kapu* Kahihiokalani, *wahine*, made kapa ahu awa Kūkaniloko for the birth of their son, Kapawa. This hallowed place remained in ceremonial rite until the liloe kapu birth of Kakuhihewa, the last such practiced at Kūkaniloko. Keopuolani and Kamehameha I were hopeful for the birth of his heir, Liloliho (Kamehameha II), at Kūkaniloko; however, a fate that some attribute to Kamehameha's practice of human sacrifice disallowed this distinguished birth rite to continue within the Kamehameha lineage.

The birth rite was one of a multiple of disciplines attributed to the region of Kūkaniloko. It is also the first learning center established within and beyond the *kaʻananiʻau* that is maintained by its *kāhuna*. According to Mr. Lenchanko, John Papa ʻĪʻī was the agent for the Department of Instruction under Kauikeaouli (Kamehameha III) and managed these Kingdom properties as traditional school lands.

To highlight the connectivity among cultural sites within the broad region of Kūkaniloko, Mr. Lenchanko describes how a trail runs from a site of several *pōhaku* close to the northern edge of Schofield Barracks across the plain toward a pool within Kaukonahua Stream, and ku uwaki uha keanianiulaokalani. From these *pōhaku*, one can view several peaks, including, in descending order from north to south, Kaʻala, Kalena, and Makaliʻi. The latter contains a corridor and view plane to sight the constellation Makaliʻi (Pleiades). An astronomical alignment between the *pōhaku* on the plain and Pu'u Makali'i illuminates the setting of the cluster of seven stars, of which are etched upon one *pōhaku*. Traditionally the land areas of Kamananui and Halemano were known to be the general locations for the *pahu heiau* ʻOpuku and *pahu heiau* Hawea, respectively, sounded at the birth and during the purification ceremonial rites within the *waihau heiau* Hoʻolonopahu, associate *heiau* of Kūkaniloko.

Mr. Lenchanko's expansive view of Kūkaniloko integrates the creation of land and people with land divisions, ceremonial practices, and instruction of *aliʻi*. He summarily states that "Oʻahu is the temple, Kūkaniloko its *mana*, and we are all connected to it." For Mr. Lenchanko, the *ʻāina* itself is the *heiau*, and every component of the land is contiguous to itself. From this perspective, every proposed development project will create an adverse impact, footprint, upon the land, and since the land is contiguous, the entire island of Oʻahu is adversely impacted. Of critical note is that the *mana* of a traditional cultural site remains despite the removal of its physical features and structures:

> The *mana* within our land justifies the reason it was chosen to be Oʻahu. They cleared our Hawaiian National Treasures from the land for affrontive industrialized farming, to buffer the military and affording the State of Hawaiʻi to minimize the land area of Kūkaniloko to five acres (Kūkaniloko Birthstones State Monument). How does the footprint of a development project adversely impact or disjoint Kūkaniloko from the temple of Oʻahu? The land of Kūkaniloko, which is our inheritance, contains our family's *iwiawaloa*, ancestral burial places, its learning center, and its traditional comprehension. Any disturbance to the land will disrupt the perpetuation of our inheritance.

Mr. Lenchanko's greater concern with the proposed wind farm Project and all programmed developments are their "deliberate trespass upon our family's inheritance." He notes *Ke Au ʻOkoʻa*, Kaʻaona 13, 1869:

> In old days the inheritance of the family burial place, the caves and secret burial places of our ancestors was handed down from these to their descendants without the intrusion of a single stranger unless by consent of the descendant, so that whenever a death occurred the body was conveyed to its inheritance. These immovable barriers belonged to burial rights for all time. The rule of kings and chiefs and their land agents might change, but the burial rights of the families survived on their lands...

Mr. Lenchanko asserts his belief that the massive wind turbines will forever impact the traditional cultural properties of the *mauka* sections of Kuokala, Kawaihapai, Waialua, Kawailoa, and Ka'ala. "These wind turbines and transmitters will not only impede our vision of our traditional natural landscape, but they will interfere with the view plane of those who are buried in our land, *he lani i luna* (heaven above) and *he honua i lalo* (earth below), who have secured a beautiful period of time, *ka'anani'au*."

The cosmological, spiritual, and cultural worldview articulated by Mr. Lenchanko derives from the erudition of the Hawaiian creation chant. From such a deep ancestral connection to the genesis of the land, Mr. Lenchanko questions how developers today claim land ownership. He politely queries whether the United States Federal Government, the State of Hawaiʻi, its agents and public citizens (i.e. First Wind) can demonstrate and prove their clear unbroken chain of land ownership and/or "exclusive territorial jurisdiction" for all land in Hawaiʻi. He summarily states "So it is, this is known, there it is... he pule hoolaa alii, nothing is older than Kūkaniloko and those whom are buried in our land, Ko Hawaii Pae Aina."

ʻaʻe ku

ua ʻaʻe lako i luna o kahi laʻa

hoʻohewahewa mauliauhonua malama oʻpa ʻoe

aloha pua pele pau mano

ʻoia ua ʻike a ʻaia la

5.6 Kawohiokalani Jenkins, Kawika Au, and Moki Labra

CSH interviewed "Aunty Betty" Kawohiokalani Jenkins, Kawika Au, and Moki Labra at the Waimea Valley Center's Wahi Kupuna on March 3, 2011. Aunty Betty, a *kupuna*, has lived in the Kawailoa area for fifty years but the area is not her *piko*. She thus engaged Mr. Au, president of the Waialua Hawaiian Civic Club, and Mr. Labra, a *kamaʻāina* of Waimea and Kawailoa, to offer their *manaʻo* on the proposed wind farm Project. Mr. Au is not from the area, but he knows the families who are. Mr. Labra's *ʻohana* is from Waimea Valley, and as a child, Mr. Labra roamed throughout Kawailoa, from the coast to the mountains of Halemano.

Based on two previous excursions with archaeologists (not associated with this Project) on Kamehameha Schools land, Mr. Au is aware of numerous cultural sites in the *mauka* portions of

Kawailoa, including three heiau, several former habitation sites, and walls. Mr. Labra describes how the families that once lived in those *mauka* regions gave birth there, as opposed to traveling to a particular birthing site. Thus, the land was theirs to *mālama* (take care of) both physically and spiritually.

Aunty Betty, Mr. Au, and Mr. Labra concur that the proposed Project, which is massive in scale, must be done *pono* (in the right way). They agree that change, especially alternative forms of renewable energy are good, but only up to a point. For Mr. Au, this means ensuring that the wind-generated energy goes to local Hawaiian people. For Mr. Labra, this means re-assessing the cultural significance of the *makani* and *ʻāina*.

Mr. Labra is particularly concerned about the *makani*. He stresses that "Kawailoa" is not the name of the wind that blows through the *ahupua'a* and questions the company name, Kawailoa Wind. He notes that other places on Oʻahu have much stronger winds, and questions why the Project is not proposed in those locations. He is knowledgeable of the wind that blows strongly through Kawailoa, but does not wish to reveal its name. For Mr. Labra, one of the consequences of not conducting this Project *pono* is that "the winds might not listen and could stop blowing altogether," a sure indication that the 30 wind turbines were not intended to be built in this area.

Mr. Labra elaborates that the ancestors used the winds for their journeys across the ocean, while this Project is something artificial imposed upon the landscape. As more development Projects impose upon the land, he and others can't use the land. When asked specifically about ongoing cultural practices in the area, Mr. Labra responded that "the land is alive, the land is *kūpuna*, there is always something going on." He elaborates that the land is continually used in the spiritual realm, from the mountains to the ocean, but that now the deceased are being disconnected from the land. He feels that "parts of the *ahupuaʻa* need to be rested" and that the *ʻāina* needs to "get balance." He translates a Hawaiian *ʻōlelo noʻeau* as "Be careful of your step, lest you fall."

Mr. Au adds a proverb from Ghandi to Mr. Labra's *manaʻo*, paraphrased as "The Earth can create enough for people's need, but not enough for their greed." He summarily states that "if the wind farm Project can benefit local Hawaiian people, as opposed to increasing people's wealth, the Project area lands can be sacrificed." He reinforces Mr. Labra's concern by stating that "if not *pono*, no winds will come." He would rather "live by candlelight than sacrifice culture."

Mr. Au warns that more people will likely oppose this Project as the building stage gets closer. He recommends consulting the families that used to live in the *mauka* portions of Kawailoa. Regarding the proposed communication facility on Mount Kaʻala, Mr. Au recommends that the new structure be connected to existing structures as much as possible.

5.7 Lavina Agadar

CSH interviewed Lavina Mary Silva Agader, affectionately called "Aunty Maile or Maile Lauliʻiliʻi (lei of small *maile* [native shrub] leaves)," at the Hawaiki Tower in Honolulu on April 8, 2011. Born on March 15, 1950, Aunty Maile grew up in the plantation lifestyle in Waialua. In addition to her recollections as a child, she shares stories of her parents' involvement in the Waialua Sugar Company's plantation "camps," or settlements. Her mother, of Japanese descent, was a nurse at the plantation hospital and her father, of Hawaiian, Portuguese, and English ancestry, was a hauler of sugarcane. Her husband was also the irrigation superintendent for Waialua Sugar. In addition to her in-depth knowledge of the Waialua Sugar Company's plantation system, Aunty Maile is currently mentoring under *kūpuna* Aunty Betty (Ms. Jenkins) and Aunty Honey (Ms. Awai-Lennox) for Native Hawaiian cultural understanding.

Aunty Maile recalls that several immigrant groups worked in the sugar plantation, forming distinctive Japanese, Korean, Filipino, and Chinese camps. The various ethnic groups interacted cohesively with each other. For example, Aunty Maile never knew the real names of many people, but had nicknames for them, such as "Thunder" and "Nine Toes." The most active and cohesive of these settlements was Kawailoa Camp (near the southern access roads of the permanent Project footprint). There were numerous activities and the camp contained a swimming pool, a Catholic church, and a Buddhist temple. The Japanese community, including her family, continued to maintain their traditions and culture, such as performing bon dances and pounding *mochi* (Japanese sweet rice).

While a certain cohesiveness pervaded the sugar plantation and connected the various camps, the plantation was also like a caste system, according to Aunty Maile. She describes how the *haole* (Caucasian, foreigner) held supervisory positions; the Portuguese were the *luna*, or bosses; and the rest of the groups labored. In her youth, Aunty Maile attended St. Michael's Elementary School. Even there, she felt a certain racial prejudice from the *haole* nuns. Now, Aunty Maile lives in a plantation house in the former Haole Camp.

When Aunty Maile's father was a child, the entire landscape of Waialua was covered in sugarcane. Aunty Maile's father took her and her two siblings to the more *mauka* regions of Kawailoa to show them dryland sugarcane. Aunty Maile remembers that at those higher elevations—the same as the proposed sites for the Project's wind turbines—the non-irrigated sugarcane produced low yields. The camps closed down over ten years ago with the termination of the Waialua Sugar Company, and the land has since been neglected and turned fallow. Within the last five years, Kamehameha Schools has planted some *koa* trees. Overall, Aunty Maile asserts that these *mauka* lands are not preferred agricultural lands. In fact, her husband has developed a very successful business under the name of Twin Bridge Farms with diversified agriculture in lands near the coast. In these highly productive and irrigated lands, her family cultivates asparagus on 40 acres of Kamehameha Schools land and other agricultural products on 210 acres, including sweet onions, potatoes, vine-ripened tomatoes, sunflowers, corn, and asparagus. She believes that if those *mauka* lands had the potential for similar diversified agriculture, it would have already happened. Because the lands are not being used, she is supportive of the wind farm Project.

Aunty Maile is currently learning about Native Hawaiian practices and cultural sites in Waialua, but she does not recall seeing Hawaiian practitioners or tangible structures, such as *heiau*, in her youth. She qualifies this observation, however, with the knowledge that such cultural practices would have been private affairs conducted within Hawaiian families. As her family oriented towards her Japanese ancestry, she would not have been privy to this Hawaiian cultural information. However, one of the original residents of the Kawailoa Camp, a Filipino man, recently told Aunty Maile about three burials near Kawailoa Camp. She asserts that if *iwi* are discovered during the Project, they should remain in place and not be relocated. This belief is based on a story about her grandmother and one of her daughters (Aunty Maile's mother's sister). Her grandmother lost a child when she lived in Kahuku Camp prior to moving to Waialua. When her grandmother passed away in 1971, her burial was planned to take place in Nu‘uanu. The family unearthed her daughter in Kahuku to reunite them, but when the family unearthed the grave, her bones were mixed with others due to a previous tidal wave. The family decided to leave the bones but take the grave marker to Nu‘uanu, but they almost got into an accident. Aunty Maile shares this story to highlight that the *iwi* did not want to be taken, and to reiterate that any discovered bones be left in place.

5.8 Butch Helemano

CSH interviewed Butch Kauihimalaihi Helemano by phone on April 11, 2011 and previously at the Ka Papa ‘Oihana (Traditional Knowledge Project) held in Waimea Valley on the North Shore of O‘ahu on July 19, 2010. Mr. Helemano was born on O‘ahu in 1950 to Ellamae Pua‘ala and Kupau Kauihimalaihi. He grew up in Kalihi, lived on the North Shore for years, and currently resides in Mililani Mauka. Mr. Helemano is the *kahu pule* (caretaker or guardian) of Pu‘u o Mahuku Heiau (that overlooks Pūpūkea), and he is also a Kumu a’o (teacher, organizer) for the Ka Papa ‘Oihana held in Waimea Valley, among many other teaching and community involvements.

Mr. Helemano’s ties to the Waimea area run deep as he is a descendant of Hewahewa, the last *kahuna nui* (spiritual leader) in Waimea valley. From his *kūpuna*, Mr. Helemano was taught about Hawaiian history, culture, and practices including Hawaiian language, carving, weaponry, and the gathering of healing plants and *kino lau* (forms taken by a supernatural body) that exist in the area, especially in the ocean and along the shoreline.

He sees Waimea Valley as a critical feature with respect to Kawailoa: “Anything that went on out there [in Kawailoa] had something to do with Waimea Valley. There were traditional relationships between the valley and the *makai* areas.” Mr. Helemano explains that the area was important for fishing and *kāhuna* practices. Several ancient *wahi pana* are also located in Kawailoa. The following *wahi pana* are located in the *makai* region of Kāpaeloa: Ke Ahu Hapu‘u Heiau, a shark *heiau* that references the black sea bass or *hāpu‘u* [Hawaiian black grouper, is another translation]; Kūpōpōlo Heiau; several ancient *honu ki‘i pōhaku* (sea turtle petroglyphs) located on the *pali* above the site called ‘*pali poli*’; other cultural features which are thought to be *‘awa* (kawa) pits, *‘uala* pits or some other type of stone lined pits used by *kāhuna* in the area; and a famous *ilina* located below *pali poli* (now secured by a gate).

In terms of natural resources along the coast, Mr. Helemano explains that in ancient times the whole area “was well known for the abundance (*lē’ia*) of fish” and that today it is still valued for marine resources such as *wana* and *‘uke‘uke* (armored sea urchin), which he notes are still abundant in the area. People have also gathered certain *limu* for use in cleansing and *kuni* (sorcery) rituals. He notes that although terrestrial healing plants were likely gathered in the area in the past, most of them have been destroyed.

Mr. Helemano recounts the history of sacred people and things in the Waimea area beginning in A.D. 1090. “All the *kahuna nui* lived in Waimea valley all the way up until the time of Hewahewa. So, for well over 1000 years, the *kahuna nui* of this island resided here in this valley or at least had potential control, as *konohiki*, over the island.” Well known figures in the area from this time include Ka‘opulupulu, the officiating *kahuna* at Kūpōpolo, and his son Kahulupe.

Kaʻopulupulu built Puʻu o Mahuku Heiau and later Kūpōpolo Heiau. Mr. Helemano explains that although many famous chiefs are associated with Waimea Valley after the time of Kahulupe, they came during the takeover of Kahekili and they weren't really *kamaʻāina* of Oʻahu—although they were uncles and nephews and cousins of *kamaʻāina*. "The sovereignty aspect is difficult to discuss because even though one came from Molokaʻi and one came from Maui, and captured the others in 1895, they were uncles and aunts and sisters and brothers," he elaborates.

Mr. Helemano is well-versed about this storied landscape. He explained that Pu'u o Mahuku literally means "hill of escape" and was built about A.D. 1600 on the old site of a *heiau* that was previously built about A.D. 1400. From this point, he says that it is possible to see across the ocean toward Kauaʻi. He explains that Kūpōpolo, which means "to see with eyes and mind" did not serve the purpose as a place where Kaʻopulupulu could have visions. Off shore from Kūpōpolo Heiau, in front of Ke ʻAhu o Hapuʻu is the small yet famous *moku* (island), Wānanapaoa, which means "unsuccessful prophecy" and refers to the "vision discarded." Across from this *moku* is Kāpaeloa, which means "to put aside, or cast out, as with rotten food" and refers to Kaopulupulu's visions that were not read correctly at Kūpōpolo Heiau. Mr. Helemano stressed that an important *moʻolelo* about the area is that of Kāneʻaukai, a shark god and *ʻaumakua* (deified ancestor) who is related to the goddess Pele. Mr. Helemano says there are actually two *moʻolelo* about it, and the accepted concept is that the image of Kāneʻaukai was set up in the *heiau* by the two *kāhuna* that lived there.

Mr. Helemano is aware of several *heiau* located in the more *mauka* lands of Kawailoa, and is concerned that the Project may impact them. In addition to these tangible aspects of Hawaiian culture that may be impacted by the Project, Mr. Helemano is opposed to the massive scale of development and the impact on the *ʻāina* from a cultural and spiritual perspective. In an email written on April 11, 2011, Mr. Helemano articulates his *manaʻo*:

> As per our conversation today I still am amazed that a project of this magnitude is planned for the North Shore.
>
> As a native Hawaiian Minster and practitioner who has *ʻohana* who not only lived in the region but have many generations of ancestors who dwelled in Waimea and Hau'ula, I find the project insulting and an abomination.
>
> The cultural impacts and scenic impacts our not only selfish but this project is not proven to be of any real asset to the power grid, only a deficit.
>
> I do not support this monstrosity. If Princess Puahi was alive today she would *uwē* [wail] and weep to see what her 'land stewards' (of her land and trust) are attempting to do on our sacred lands and fragile natural resources.
>
> Our people have to sit by and watch as the rich get richer and the developers continue to develop our ancestral lands as we watch the Western civilization desecrate our *kulāiwi* [native land].
>
> As far as cultural impacts and cultural practices, these things took place "everywhere" in the *paeʻāina* [these islands] of Hawaiʻi.

In closing I cannot find anything positive to say about this project (this is my opinion based on the upbringing that I had as a native and *kama‘āina*). No where can I see in this proposal an alternative choice such as solar even being looked at.

eia au he kanaka ‘oiwi, na‘u Kahu, Butch Kauihimalaihi Helemano

Kahuna Pule, Hale o Lono Heiau Waimea nei

Section 6 Cultural Landscape

Discussions of specific aspects of traditional Hawaiian culture as they may relate to the permanent Project footprint are presented below. This section integrates information from Sections 3–5 in order to examine cultural resources and practices identified within or in proximity to the permanent Project footprint in the broader context of the encompassing landscape of Kawailoa (and Lauhulu, Kuikuiloloa, Punanue, Kāpaeloa) and Kamananui Ahupua‘a.

6.1 Cosmological and Religious Significance

A network of trails once traversed O‘ahu, connecting the *moku* of Waialua, Wai‘anae, ‘Ewa, and Kona (‘Ī‘ī 1959:99). These paths intersected at Kūkaniloko, a sacred ceremonial birthing place for the highest ranking chiefs, in the modern *ahupua‘a* of Wahiawā (formerly part of Kamananui) in an area that Mr. Lenchanko considers the *piko* of O‘ahu. Drawing from the Kumulipo, a cosmological creation chant, and teachings from *kūpuna*, Mr. Lenchanko articulates a view of Kūkaniloko that expands beyond the current State of Hawai‘i five-acre Kūkaniloko Birthstones State Monument. Mr. Lenchanko explains that Kūkaniloko extends back in time to the creation of the island of O‘ahu and the descent of the first people from the gods, and expands geographically to encompass at least 36,000 acres of land within a network of *ka’anani’au* that pre-dates the *moku* and *ahupua‘a* territorial system. Thus, according to Mr. Lenchanko, the permanent Project footprint is part of Kūkaniloko, the most sacred site on O‘ahu. According to Maly (1999:27), the core of Hawaiian spirituality is cultural attachment to the landscape. For Hawaiians, maintaining a sense of place and identity is fundamentally about keeping the integrity of this cultural landscape: “Thus, what we do on one part of the landscape has an affect on the rest of it” (Maly 2001:2). According to Mr. Lenchanko, the proposed wind turbines will alter not only the view of the cultural landscape, but the view plane of those ancestors buried in the land.

6.2 Settlement and Habitation

The earliest settlements along the northern coastal areas of O‘ahu have yet to be recovered archaeologically, but a settlement complex in Anahulu Valley, which was most likely a peripheral extension of the core Waialua production lands, dates to A.D. 1300. Located near the southern portion of the permanent Project footprint in Kawailoa, rock shelters were used by coastal residents as intermittent camps for the extraction of mountain resources. Between A.D. 1600–1700, shifting cultivation and forest-product extraction supported several permanent household groups living in these rock shelters. With Kamehameha’s conquest in 1795, he encouraged the expansion and intensification of agricultural production to sustain his invading forces when they returned to O‘ahu in 1804, including the peripheral lands of the upper Anahulu Valley. The rock shelters were abandoned, and descendants of Kamehameha’s conquering forces constructed a series of open house sites in association with intensive pond field irrigation of taro on the alluvial terraces at the bends of the main stream and adjacent *kula* lands, as well as made clearings in the smaller forested valleys and ravines (Kirch 1992).

Previous archaeological surveys and research, recent cultural resource management work, and community interviews indicate numerous cultural features and artifacts along the coastal strip of

Kawailoa Ahupuaʻa that are indicative of former habitation (Athens and Shun 1982; Borthwick et al. 2002; Borthwick et al. 1998; Cluff 1968; Hammatt and Shideler 2006; Moore et al. 1993; Welch 1981). Some of these sites are located near the *makai* boundary of the access road for the permanent Project footprint, including stacked basalt boulder walls (and a more recent historic bridge and segment of the OR&L track) (Masterson et al. 1995), ʻIliʻilikea Heiau (McAllister 1933:142), and a complex of partially enclosed terraces, platforms, and walls called Kahōkūwelowelo that has been variously described as a priestly dwelling, monastery, and *heiau* (*Advertiser* 1933; McAllister 1933:143; Thrum 1906). In addition, Mr. Becket maps the locations of Kahōkūwelowelo Heiau, Kahōkūwelowelo Hale, an enclosure, a wall and other rock structures, a rock carving, and an altar near the Project's *makai* access roads. Mr. Au, Mr. Helemano, and Ms. Awai-Lennox describe several *heiau* in the uplands of Kawailoa, and Mr. Helemano describes *heiau* near the coast of Kāpaeloa. The accompanying AIS has not identified any *heiau* or other cultural sites in the permanent Project footprint (Rechtman et al. 2011).

The *ahupuaʻa* system of territorial land units was established in approximately A.D. 1400 by Māʻilikūkahi, an *aliʻi kapu* who was born at Kūkaniloko in the uplands of Waialua, and whose chiefly title was consecrated at the *heiau* of Kapukapuākea (Kirch 2010:84–90). Mr. Helemano recounts that for well over 1000 years, the *kahuna nui* of this island resided in Waimea Valley or at least had potential control, as *konohiki*, over the island. Kamananui Ahupuaʻa was the political and ritual center of Waialua until the 1820s, when the ruling chief re-drew the *ahupuaʻa* boundaries with his shift in residence to Kawailoa Ahupuaʻa and when the Kawailoa-based Protestant mission of Waialua "usurped the ritual hegemony from the temples of human sacrifice [*poʻokanaka*] that not long before had sanctified the landscape of Kamananui" (Sahlins 1992:21).

6.3 Cultivation, Fishing, and Gathering

The fertile coastal plains of Kamananui and Kawailoa Ahupuaʻa were watered from the streams flowing from the Koʻolau mountains, and dense settlements and large complexes of irrigated taro fields were located on the floodplains of these streams near the coast (Sahlins 1992:20). Other settlements along Anahulu Stream cultivated taro and extracted *wauke*, and later, after Kamehameha's conquest and occupation, expanded to cultivate bananas, yams, sweet potatoes, and dryland taro (Kirch 1992:57–59). In the high, level saddle region between the two mountain ranges of Oʻahu in the former lands of Kamananui (now Wahiawā), extensive cultivation of taro, sweet potatoes, and yams took place (Handy and Handy 1972:464–465). The circular plateau of Mount Kaʻala is bounded by precipices 1,000–2,000 feet high. Small streams from the swampy plateau cascade as waterfalls into the lower valleys. *Moʻolelo* and *mele* suggest that the summit swamp was formerly a freshwater fishpond called Luakini that contained *hīnālea*, *wuwoa*, and freshwater crabs (Forndander 1916–1920, Vol. 4:390; McAllister 1933:133).

Claims for LCAs reveal that prior to 1850 Hawaiian households had multiple *ʻāpana* in different geographical locations, involving the cultivation of taro, bananas, bitter gourds, melon, corn, sugarcane, and sweet potatoes, and *pali* were exploited for the collection of *wauke* (Waihona ʻAina 2000). Rice cultivation, extension of the railroad system toward Waialua, and the development of commercial sugarcane cultivation led to the rise of the Waialua Agricultural

Company (later named the Waialua Sugar Company), which dramatically altered the landscape of Kawailoa and Kamananui Ahupuaʻa during the last two decades of the nineteenth century. Mrs. Agader relates that the entire landscape of Waialua was covered in sugarcane during the first half of the twentieth century. She remembers that at the higher elevations—the same as the proposed sites for the Project's wind turbines—the non-irrigated sugarcane produced low yields. Philip Ninomiya and Manabu Nonaka, descendants of Japanese immigrants, describe in previously recorded oral histories a diet of mostly fish for the Japanese plantation workers and their families, including *aji*, *pāpio*, *āholehole*, *moi*, *ʻoama*, and *tako*, as well as *ogo*. They also detail how they constructed rafts out of *akakai* that grew along Anahulu Stream (UH 1977).

Along the coast at Kāpaeloa, Mrs. Causey and her family used to gather *ʻōpihi*, *pipipi*, and *limu*, including *ogo* and *wāwaeʻiole*, and catch *akule*, *kūmū*, *ʻāweoweo*, *manini*, and *āholehole*. Mr. Helemano recalls gathering *wana* and *ʻukeʻuke* along the coast at Kāpaeloa. Near Hale'iwa, Ms. Gladys Awai-Lennox and her family used to cultivate taro, breadfruit, and bananas. Her family also fished extensively along the coast, catching *nenue*, *kala*, *ʻoama*, and gathered *wana*, *ha'uki'uki, pipipi*, and several kinds of *limu* including *wāwaeʻiole*, *ogo*, *ʻeleʻele*, and *kohu*. Her family also collected the seed pods of *kiawe* for cattle and pig fodder, and made leis from the red *hala* fruit. In addition, she also describes the importance to her family of the *ʻalae ʻula*.

Most recently, 2,200 acres of land in Kawailoa have been managed by Kamehameha Schools for diversified farming of asparagus, wet and dryland taro, papaya, seed and feed corn, tuberose, banana, plumeria, *noni*, and lettuce (*Imua* 2005:15–16). Mrs. Agader also notes that within the last five years, Kamehameha Schools has planted some *koa* trees in the *mauka* lands of Kawailoa.

Overall, the historic research and community consultation suggests that a variety of cultivars were once grown in the *makai* portion of Kawailoa and numerous marine resources caught or gathered, but that the *mauka* lands of Kawailoa, including the permanent Project footprint (wind turbines and facilities), were mostly covered in sugarcane. Since those fields were left fallow after the termination of the Waialua Sugar Company in 1998, there does not appear to have been any recent use of the land for cultivation or gathering.

6.4 Storied Landscape

The Wind Gourd of Laʻamaomao tells the story of how Pākaʻa and his son Kuāpākaʻa, descendants of the wind goddess Laʻamaomao, control the winds of Hawaiʻi through a gourd that contains the winds and could be called forth by chanting their names (Nakuina 1992). Pākaʻa's chant traces the winds of Oʻahu and the *moku* of Waialua, including the wind that blows at Mount Kaʻala, called Puʻu-ka-ʻala. The chant does not name the specific wind that blows through Kawailoa, but Mr. Labra knows its name (although he does not intend to reveal it at this time). Other *mo'olelo* connect the gourd of Laʻamaomao to the god Lono, a cosmic gourd from whence came the winds, clouds, and rain (Handy and Handy 1972:220; *Ka Naʻi Aupuni* 1906). A cultural connection can be made between the *moʻolelo* of the wind goddess Laʻamaomao and modern wind farms: Wind farms, just like the descendants of Laʻamaomao, involve the capturing and harnessing of wind energy.

The summit of Kaʻala, the highest point on Oʻahu, is considered a sacred place (Wai'anae Ecological Characterization 2011). Kāhuna described the summit plateau as being "clothed in the golden cloak of Kane," a resting place for spirits of the dead (McGrath et al. 1973:11). It is possible that this resting place was for souls heading down the spine of the Wai‘anae mountains toward Ka‘ena Point, a *leina ‘uhane* (leap of the soul), or place where the souls of the dead leaped into the next world (McAllister 1933:125–126). Other *mo‘olelo* relate the significance of the Ka‘ala summit for weather forecasting and making prophecies (Kalākaua 1890:155–173; 455–480).

Mr. Helemano shares several other *mo‘olelo* of *wahi pana* in Kawailoa that provide a broader perspective of the cultural traditions surrounding the permanent Project footprint. He explains that Kūpōpolo, which means "to see with eyes and mind" did not serve the purpose as a place where Ka‘opulupulu could have visions, and Kāpaeloa, which means "to put aside, or cast out, as with rotten food," refers to Kaopulupulu's visions that were not read correctly at Kūpōpolo Heiau. Mr. Helemano stressed that an important *mo‘olelo* about the area is that of Kāne‘aukai, a shark god and *‘aumakua* who is related to the goddess Pele.

6.5 Burials

Community consultation, historic documentation, previous archaeological research, and the accompanying AIS (Rechtman et al. 2011) have not identified any burials within the permanent Project footprint. However, numerous documented burials are located in the *ahupua'a* of Kamananui and Kawailoa, several of which are located in proximity to the permanent Project footprint.

Two burial caves are located about three miles north of the microwave communication facility Project area at the cliffs of Kaumoku Gulch beneath Pu‘u Kaupakuhale in Kamananui Ahupua‘a (Sites 198 and 200, McAllister 1933:130–131). Skeletal remains have also been discovered near the coastal area of Pu‘uiki (Site 202, McAllister 1933:132). Hawaiians have also been recently buried in an area near an *akua* stone (Site 205) in the central *makai* portion of the *ahupua‘a* (McAllister 133:105). Farther *mauka* about two miles northwest of the microwave communication facility Project area, two caves with skeletal remains are located along Kaukonahua Gulch (Sites 210 and 211, McAllister 1933:133).

In the southern coastal section of Kawailoa Ahupua‘a, the point of Pua‘ena was a place where the body of an *ali‘i* named Elani was placed, and corpses of commoners were also placed on the rocks, such that "the fluids from the decaying body would seep into the sea and attract sharks, which the people killed" (Site 234, McAllister 1933:141–142). Two burial sites were discovered in this coastal area (SIHP No. 50-80-01-4670, Avery and Kennedy 1993; SIHP No. 50-80-01-5495, Borthwick et al. 1998). In the southern mountainous section of Kawailoa Ahupua‘a, burials are located within and near the settlements in the upper Anahulu Valley, including stone burial crypts, a cliff burial, and a walled burial cave (Kirch 1992:88, 94,104, 112). Along the northern coastal strip of Kawailoa, the SHPD reported findings of human remains (SIHP No. 50-80-01-3724) on the inland side of Kamehameha Highway (Bath 1988). In addition, community participant Mr. Becket maps the location of burial caves in the Project's *makai* access roads, and Mrs. Causey describes the locations of two Japanese graveyards just *makai* and *mauka* of her property very close to Old Cane Haul Road and Kawailoa Road.

The estimated locations of the cliff burials mapped by Mr. Becket, which are based on teachings from *kupuna* Rudy Mitchell, are closest in proximity to the permanent Project footprint. This cliff section of Kawailoa is just *makai* of Ashley Road. Since Ashley Road (and other access roads for the transport of the wind turbines) are not being widened, it is unlikely that any burials would be uncovered. Although unlikely, there is the possibility that the transport or the construction of the wind turbines could result in the inadvertent discovery of burials.

Section 7 Summary and Recommendations

CSH undertook this CIA at the request of CH2M HILL. The cultural survey broadly included the entire *ahupuaʻa* of Kawailoa (and Lauhulu, Kuikuiloloa, Punanue, Kāpaeloa) and Kamananui including the following specific parcels:

- Wind Farm Site: TMK [1] 6-1-005:001; 6-1-006:001; 6-1-007:001; 6-2-011:001
- Traversed by Existing Onsite Access Roads: TMK [1] 6-1-005:003, 007, 014, 015, 016, 019, 020, 021, 022; 6-1-008:025; 6-2-002:001, 002, 025; 6-2-009:001
- Mount Ka'ala Communication Sites: TMK [1] 6-7-003:024

7.1 Results of Background Research

Background research for this Project yielded the following results (presented in approximate chronological order):

1. The *moku* (district) of Waialua contained a set of centrally located productive lands and peripheral areas that were ecologically marginal but that had access to abundant ocean resources. The fertile center consisted of the area surrounding Kaiaka and Waialua Bays located in the *makai* (seaward) regions of the *ahupuaʻa* of Kamananui, Paʻalaʻa, and Kawailoa. This core productive region likely supported the majority of the Waialua population. In marked contrast, small fishing communities were located on marginal lands at the edges of Waialua, including Kāpaeloa.
2. The earliest settlements along the northern coastal areas of Oʻahu have yet to be recovered archaeologically, but a settlement complex in Anahulu Valley, which was most likely a peripheral extension of the core Waialua production lands, dates to A.D. 1300. This complex, located next to the southern section of the Kawailoa permanent Project footprint, includes numerous habitation sites, rock shelters, irrigation systems, and dryland agricultural remains (Kirch 1992).
3. *Moʻolelo* (oral traditions) chronicle the rise of divine kingship in the uplands of Waialua. Located near what some people consider the *piko* (navel or center) of Oʻahu, the site of Kūkaniloko was a birthing place of *aliʻi kapu* (sacred chiefs), who were the *akua* (gods) of the land (Kamakau 1964:12). The *ahupuaʻa* system of territorial land units was established in approximately A.D. 1400 by Māʻilikūkahi, an *aliʻi kapu* who was born at Kūkaniloko in the uplands of Waialua, and whose chiefly title was consecrated at the *heiau* (sacred place of worship, temple) of Kapukapuākea (Kirch 2010:84–90)
4. *The Wind Gourd of Laʻamaomao* tells the story of how Pākaʻa and his son Kuāpākaʻa, descendants of the wind god Laʻamaomao, controlled the winds of Hawaiʻi through a gourd that contained the winds and could be called forth by chanting their names (Nakuina 1992). Pākaʻa's chant traces the winds of Oʻahu and the *moku* of Waialua, including the wind that blows at Mount Kaʻala, called Puʻu-ka‘ala. Other *mo'olelo* connect the gourd of Laʻamaomao to the god Lono, a cosmic gourd from whence came the winds, clouds, and rain (Handy and Handy 1972:220; *Ka Naʻi Aupuni* 1906). A cultural connection can be made between the *moʻolelo* of the wind goddess Laʻamaomao

and modern wind farms: Wind farms (such as First Wind), just like the descendants of Laʻamaomao, involve the capturing and harnessing of wind energy.

5. The summit of Kaʻala, the highest point on Oʻahu, is considered a sacred place (Waiʻanae Ecological Characterization 2011). *Kāhuna* (priests) described the summit plateau as being "clothed in the golden cloak of Kane," a resting place for spirits of the dead (McGrath et al. 1973:11). It is possible that this resting place was for souls heading down the spine of the Waiʻanae mountains toward Kaʻena Point, a *leina ʻuhane* (leap of the soul), or place where the souls of the dead leaped into the next world (McAllister 1933:125–126). Other *moʻolelo* relate the significance of the Kaʻala summit for weather forecasting and making prophecies (Kalākaua 1890:155–173; 455–480).
6. The distant lands of the proposed Project, from the southwest mountainous peak of Kaʻala to the northeast coastal region of Kāpaeloa, were once connected culturally and politically prior to the introduction of private property with the Māhele of 1848. The proposed microwave communications facility Project area near the summit of Mount Kaʻala is part of Kamananui Ahupuaʻa, formerly the political and ritual center of Waialua. The *konohiki* (stewards) of Kamananui also managed detached, outlying lands, including the fishing community of Kāpaeloa at the eastern border of Waialua. Then, in the 1820s, the ruling chief of Kamananui Ahupuaʻa moved to Anahulu Valley in the *ahupuaʻa* of Kawailoa, which resulted in a redrawing of *ahupuaʻa* boundaries. Kāpaeloa and other outlying sections of Kamananui were thus subsumed into the land of Kawailoa (Sahlins 1992:20–21). The proposed wind power facility permanent Project footprint is located in this expanded region of Kawailoa.
7. Previous archaeological research and recent cultural resource management work indicate that the *ahupuaʻa* of Kawailoa and Kamananui contain numerous cultural sites and *wahi pana* (storied places) indicative of ancient settlement patterns. *Moʻolelo* suggest that the summit swamp of Mount Kaʻala near the microwave communication facility Project area was formerly a freshwater fishpond called Luakini. McAllister (1933) documented two sites in the vicinity of the *makai* access roads of the Kawailoa permanent Project footprint—a *heiau* called ʻIliʻilikea (Site 237), which was destroyed in 1916 by W. Harpham for the Waialua Agricultural Company (but according to Mr. Jan Becket, part of it is still standing, although not in the permanent Project footprint; see Results of Community Consultation), and a complex of partially enclosed terraces, platforms, and walls called Kahōkūwelowelo (Site 240) that has been variously described as a priestly dwelling, monastery, and *heiau* (*Honolulu Advertiser* 1933; McAllister 1933:143; Thrum 1906). The accompanying Archaeological Inventory Survey (AIS) (Rechtman et al. 2011) confirmed that there are not any *heiau* or other Native Hawaiian cultural sites in the permanent Project footprint.
8. Previous archaeological research and recent cultural resource management work indicate numerous burials in Kawailoa and Kamananui. In proximity to the Kawailoa permanent Project footprint are burials within and near the early settlements in the upper Anahulu Valley (Kirch 1992:88, 94,104, 112) and along the coastal strip of Kawailoa on the inland side of Kamehameha Highway (State Inventory of Historic Properties [SIHP] No. 50-80-

01-3724, Bath 1988; SIHP No. 50-80-01-4670, Avery and Kennedy 1993; SIHP No. 50-80-01-5495, Borthwick et al. 1998).

9. Land Commission Award documentation of the Māhele indicates a wide range of indigenous Hawaiian subsistence practices in the vicinity of the permanent Project footprint in Kawailoa prior to 1850. The land claims reveal that Hawaiian households had multiple *‘āpana* (lots) in different geographical locations, involving the cultivation of taro, bananas, bitter gourds, melon, corn, sugarcane, and sweet potatoes, and *pali* (cliffs) were exploited for the collection of *wauke* (paper mulberry) (Waihona ‘Aina 2000).

10. The landscape of Kawailoa and Kamananui Ahupua‘a shifted dramatically during the last two decades of the nineteenth century with rice, sugar, and pineapple cultivation. The development of the Oahu Railway and Land Company (OR&L) led to the rise of the Waialua Agricultural Company, later named the Waialua Sugar Company. The Kawailoa Plantation, situated on the rolling ridges above Hale‘iwa, included 6,000 acres of sugar cultivation. After the Waialua Sugar Company closed in 1998, Kamehameha Schools began managing the Kawailoa Plantation as a diversified farming operation (*Imua* 2005:15–16). The accompanying AIS (Rechtman et al. 2011) did identify 17 historic sites associated with the former plantation (and military) activities in the permanent Project footprint.

11. Philip Ninomiya and Manabu Nonaka, descendants of Japanese immigrants in Waialua, describe in previously recorded oral histories a diet of mostly fish for the Japanese plantation workers and their families, including *aji* (*akule*, big-eyed scad fish), *pāpio* (young stage of *ulua*, crevalle, jack, or pompano), *āholehole* (young stage of *āhole*, Hawaiian flagtail), *moi* (threadfish), *‘oama* (young stage of *weke*, goatfish), and *tako* ([Japanese] squid, octopus), as well as *ogo* ([Japanese] seaweed). They also constructed rafts out of *akakai* (reeds) that grew along Anahulu Stream (UH 1977).

7.2 Results of Community Consultation

CSH attempted to contact 37 community members and government agency and community organization representatives. Of the 17 people that responded, nine *kūpuna* (elders) and/or *kama‘āina* (Native-born) participated in formal interviews for more in-depth contributions to the CIA. This community consultation indicates:

1. Community participants share a range of *mana‘o* (thoughts, opinions) and views on the proposed wind farm. Four participants support the Project. Mr. Thomas Shirai states that the Project will not have any cultural impacts, Ms. Gladys Awai-Lennox does not have any cultural concerns, Mrs. Lavina Agader believes that the wind farms will be a good use of the land since it is no longer supporting agriculture, and Mr. Kawika Au is supportive if the Project is done *pono* (in the correct way). Other participants articulated their *mana‘o* as to how the Project may impact cultural sites, beliefs, and practices:

2. Community participants describe and map the locations of numerous cultural sites in the *makai* section of Kawailoa, several of which are located near the Project’s access roads. Based on the teaching of *kupuna* Rudy Mitchell, Mr. Jan Becket maps the locations of the following cultural sites in the vicinity of the permanent Project footprint:

Kahōkūwelowelo Heiau, Kahōkūwelowelo Hale, burials, an enclosure, a wall, a rock carving, an altar, and other rock structures (see Figure 35). Mrs. Emmaline Causey describes the locations of two Japanese graveyards just *makai* and *mauka* of her property very close to Old Cane Haul Road and Kawailoa Road, and Mrs. Agader describes three burials at the former Kawailoa Camp. Having previously noticed how the transport of wind turbines required the entire width of a two-lane road, she is concerned that the transport of wind turbines along Old Cane Haul Road and Kawailoa Road may disturb these two graveyards, which are only maintained twice a year and may thus be at times obstructed from view. In addition, Ms. Coochie Cayan, the History and Culture Branch Chief of the SHPD, states that the proposed Project will have an impact on the area's well documented *mo‘olelo*, historic sites, archaeological sites, and burials.

The accompanying AIS (Rechtman et al. 2011) has not identified any cultural sites in the permanent Project footprint; however, 17 historic sites associated with the former plantation activities or former military operations have been identified within the permanent Project footprint and archaeological monitoring is recommended.

3. Mr. Becket draws attention to intensive archaeological investigations in the upper Anahulu Valley (Kirch and Sahlins 1992) and suggests that parallel groupings of upper valley settlements may be located in the gulches in the northern *mauka* sections of Kawailoa, including the permanent Project footprint. Ms. Awai-Lennox and Mr. Butch Helemano also describe, in general terms, several *heiau* in the *mauka* lands of Kawailoa, and Mr. Au is aware of numerous cultural sites in the *mauka* portions of Kawailoa, including *three* heiau, several former habitation sites, and walls, although he does not specify their location.

   The accompanying AIS (Rechtman et al. 2011) has not identified any *heiau* or other cultural sites in the permanent Project footprint, and is avoiding the gulches and steep slopes where burials could be found.

4. The entire landscape of Waialua was covered in sugarcane during the first half of the twentieth century, according to Mrs. Agader. Immigrants settled in various "camps," including Japanese, Chinese, Korean, and Filipino laborers and their families at Kawailoa Camp near the southern access roads of the Project.

5. The *makai* and *mauka* lands of Kawailoa contain abundant ocean and forest resources. Along the coast at Kāpaeloa, Mrs. Causey and her family used to gather *‘ōpihi* (limpet), *pipipi* (pearl oyster), and *limu* (seaweed), including *ogo* and *wāwae‘iole*, and catch *akule*, *kūmū* (goatfish), *‘āweoweo* (big eye), *manini* (convict tang), and *āholehole*. Near Hale‘iwa, Ms. Gladys Awai-Lennox and her family used to cultivate taro, breadfruit, and bananas. Her family also fished extensively along the coast, catching *nenue* (chub fish), *kala* (surgeon fish), *‘oama*, and gathered *wana* (spiny urchins), *ha‘uki‘uki* (shingle urchins), *pipipi*, and several kinds of *limu* including *wāwae‘iole*, *ogo*, *‘ele‘ele*, and *kohu*. Her family also collected the seed pods of *kiawe* (mesquite) for cattle and pig fodder, and made leis from the red *hala* (pandanus) fruit. In addition, she also describes the importance to her family of the *‘alae ‘ula* (Common Hawaiian Moorhen). Mrs. Agader also relates that Kamehameha Schools recently planted *koa* in the *mauka* portions of

Kawailoa. Ms. Cayan, as the History and Culture Branch Chief of the SHPD, recommends that access and gathering rights should not be prevented, as certain families, practitioners, and groups continue to practice Hawaiian spirituality, traditional burials, and other activities, such as hunting and hiking.

Although community members have not identified such cultural practices, First Wind will work with Kamehameha Schools to facilitate access in the wind farm permanent Project footprint and the *mauka* Kawailoa property for hiking, hunting, gathering, and cultural practices.

6. Drawing from the Kumulipo, a cosmological creation chant, and *kūpuna*, Mr. Tom Lenchanko articulates an expansive view of Kūkaniloko (the current State of Hawai'i five-acre park site noted to be Kūkaniloko Birthstones State Monument, a sacred site for the birth of *ali'i* [chiefs]) that extends geographically to encompass 36,000 acres of land within a network of *ka'anani'au* (boundary markers). This area, which has *mana* (divine power), includes the *mauka* portions of Kawailoa and Kamananui. Mr. Lenchanko is concerned that the proposed Project will trespass upon his family's *'āina* (land) and *iwiawaloa* (ancestral burial places). He also asserts his belief that the wind turbines will forever impact the traditional cultural properties of the *mauka* sections of Kawailoa and Mount Ka'ala—they will impede the vision of the traditional natural landscape and interfere with the view plane of those who are buried in the land.

   The accompanying AIS (Rechtman et al. 2011) has not identified any burial features in the permanent Project footprint. According to First Wind, the wind farm Project will not make a permanent change to the landscape—the wind turbine equipment will either be replaced or removed after 20 years.

7. Mr. Moki Labra and Mr. Helemano are concerned about the massive scale of development (30 wind turbines) in Kawailoa: Mr. Labra states that "parts of the *ahupua'a* need to be rested" and that the *'āina* (land) needs to "get balance," and Mr. Helemano criticizes land stewardship that enables the desecration of "our sacred lands and fragile natural resources." Mr. Au and Ms. Betty Jenkins concur with Mr. Labra that if the Project is not done in the correct way (*pono*), the "winds might not listen and could stop blowing altogether." Mr. Labra questions the company name, 'Kawailo Wind,' and the location of the Project—'Kawailoa' is not the name of the wind that blows through the *ahupua'a* and other places on O'ahu have much stronger winds. Mr. Au summarily states that he could support the Project if it benefits local Hawaiian people and is not only to make outsiders rich.

   According to First Wind, the company will work with the Waialua community to seek input about the Project and how the wind farm should support community priorities in the area in order to create a balance to any perceived.

7.3 Impacts and Recommendation

Based on the information gathered for the cultural and historic background and community consultation detailed in this CIA report, the proposed Project may potentially impact Native

Hawaiian burials and cultural beliefs. CSH identifies these potential impacts and makes the following recommendations:

1. The accompanying AIS has not documented any burial features in the permanent Project footprint (Rechtman et al. 2011), and it is unlikely that burials will be encountered due to previous disturbance from former plantation activities and military operations. However, community participants Mr. Becket and Mrs. Causey express concerns of the proximity of the Project’s *makai* access roads to cliff burials and Japanese graveyards, and Ms. Cayan, as the History and Culture Branch Chief of the SHPD, states that the Project will impact burials.

   Since land-disturbing activities may uncover presently undetected burials, personnel involved in the construction activities of the permanent Project footprint should be informed of the possibility of inadvertent cultural finds, including human remains. The accompanying AIS (Rechtman et al. 2011) recommends archaeological monitoring as appropriate mitigation to address (in part) the possibility of presently unidentified burials. Should burials (or other cultural finds) be identified during ground disturbance, the construction contractor should immediately cease all work and the appropriate agencies notified pursuant to applicable law.

2. Community participants Mr. Lenchanko, Mr. Labra, and Mr. Helemano express that the wind turbines will impact the visual landscape and the integrity of the cultural landscape of Kawailoa. Although these community participants did not describe visual impacts from any specific cultural sites, First Wind notes that some of the wind turbines will be visible from cultural sites, such as Pu‘u o Mahuka Heiau, and culturally significant locations, including Waimea Valley, which was nominated as a Traditional Cultural Property (Monahan 2008), and Hale‘iwa, which is a State Historic, Cultural, and Scenic District. Other community members, such as Mr. Shirai, Ms. Awai-Lennox, Mrs. Agader, and Mr. Au, are supportive of the Project for a variety of reasons if it is conducted *pono*.

   According to First Wind, although the Project cannot be implemented in a way that entirely avoids all potential cultural impacts, particularly those related to visual impacts, First Wind’s goal is to develop and operate the Project in a way that is respectful to Hawai‘i’s unique cultural and natural resources while also contributing to the local community where the Project is located, so as to balance any perceived negative effects. The intent of these measures is to balance the beliefs and traditions of the past with the need for clean, renewable energy to sustain future generations. For other wind farm projects, First Wind has sought community input about the Project and how the wind farm should support community priorities so as balance the perceived negative impacts. For this Project, First Wind has already engaged the Waialua community and intends to form a long-term partnership with Waimea Valley to support their efforts to promote Hawaiian culture. First Wind should continue to brief and consult with community members and organizations as the Project design and construction progresses in order to inform the community of any changes that could result in unanticipated adverse cultural impacts and to better understand and incorporate the Hawaiian cultural worldview.

7.4 Mitigation and Outreach

At each of its wind projects in Hawai‘i, First Wind works to study and understand the important environmental and cultural resources in and around the permanent Project footprint. First Wind’s goal is to develop and operate wind energy projects in a way that is respectful to Hawai‘i’s unique cultural and natural resources while also contributing to the local communities where its wind farms are located. First Wind has conducted the following previous cultural and environmental mitigation and community outreach, and is planning on conducting the following mitigation and outreach for the Kawailoa wind farm:

- **Archaeological Surveys & Project Layout –** First Wind has designed the layout of each of its projects in order to avoid impacts to environmental and cultural resources. After on-site archaeological surveys, if any significant features are identified, the location of wind turbines, buildings, substations, utility poles and roads can be modified so that no resources are affected. Prior to clearing the land for the Kahuku and Maui projects, First Wind fenced off sensitive cultural areas so they would not be disturbed during construction. First Wind is applying these same practices on the Kawailoa wind farm Project.
- **Habitat Conservation Plan –**First Wind is developing a Habitat Conservation Plan (HCP) that provides a net benefit to the native species that may be impacted. As part of the HCP for the Kawailoa project, First Wind will be working with Kamehameha Schools to protect and restore Uko‘a Pond, improving it as a habitat for native species.
- **Replanting Native Plants –** At First Wind’s Kaheawa project, they have engaged with community groups and others to replant native plants in areas that were cleared during construction. Several species native to the dryland forest *mauka* of the project were propagated at a local plant nursery, and since 2006, First Wind staff and volunteers have replanted seedlings of thousands of native plants, including *pukiawe*, *a‘ali‘i* and *‘ohia lehua*. For the Kawailoa Project, First Wind will replant areas with native plants.
- **Erosion Control Measures –**First Wind will install silt fencing and other temporary means to minimize erosion of areas that are cleared. After construction, First Wind will plant grass on the graded areas of turbine pads and along the sides of new project roads so that the new growth will establish a root system and prevent future soil runoff. In addition, First Wind will develop drainage measures to manage storm water flow along and across roadways which minimizes erosion during heavy rains through the life of the project.
- **Community Input –** Throughout the development of its projects, First Wind meets with community residents and organizations to share information about the project and seek input. In its Kahuku project, the community asked First Wind to site the project as much as possible to minimize the possibility of hearing sound from the project in Kahuku town, and First Wind adjusted the project accordingly. Residents in Mokulē‘ia were concerned about a planned communications tower being built in their neighborhood, and First Wind found an alternate location for the communication antennas on an existing facility at Mount Ka‘ala. In both cases, community feedback helped to improve the final project. First Wind also seeks residents’ input about community priorities and what efforts the wind farm should support in the area. In preparing for the Kahuku project, First Wind

talked to hundreds of Kahuku residents who identified education, flood mitigation, and agriculture as the most important priorities for the local community. First Wind is working with schools, community associations, and local ranchers to contribute to these priorities over the life of the Kahuku project. For the Kawailoa Project, First Wind has consulted with the community and intends to continue the process of sharing information, seeking input, and making appropriate adjustments.

- **Support for Native Hawaiian Organizations** – Since beginning operations in Hawai‘i, First Wind has been a strong supporter of Native Hawaiian organizations and cultural events, including ‘Aha Punana Leo, Maui Cultural Lands, Hawaiian Homestead Associations on Moloka‘i, Na Pua No‘eau, Waimea Valley Music Festival, Waimea Valley Makahiki Festival, and the Council for Native Hawaiian Advancement’s annual convention. For the Kawailoa project, First Wind intends to form a long-term partnership with Waimea Valley to support their efforts to promote Hawaiian culture and environmental awareness.
- **Access for Traditional Activities** – Kamehameha Schools is planning to expand its access opportunities to allow for safe, legal, and controlled access to and around the *mauka* Kawailoa property for hiking, hunting, gathering, and cultural practices. First Wind will work with Kamehameha Schools to facilitate safe access in and around the wind farm site for cultural practitioners.
- **Productive Use of Land** – The wind farm allows the land to be maintained in agriculture. By producing wind energy on the *mauka* section of Kawailoa, Kamehameha Schools will be able to use generated lease revenues to improve the access roads and water irrigation system which would directly benefit local farmers. Not unlike the traditional concept of the *ahupua‘a*, this arrangement will make the most productive, sustainable use of the land while not depleting any resources. Wind energy does not require water nor does it have give off any harmful emissions into our atmosphere. The wind Project also will not make a permanent change to the landscape: Wind turbine equipment has a useful life of about 20 years, after which they would either be replaced with new turbines or removed.

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Appendix A Glossary

To highlight the various and complex meanings of Hawaiian words, the complete translations from Pukui and Elbert (1986) are used unless otherwise noted. In some cases, alternate translations may resonate stronger with Hawaiians today; these are placed prior to the Pukui and Elbert (1986) translations and marked with “(common).”

Diacritical markings used in the Hawaiian words are the *‘okina* and the *kahakō*. The *‘okina*, or glottal stop, is only found between two vowels or at the beginning of a word that starts with a vowel. A break in speech is created between the sounds of the two vowels. The pronunciation of the *‘okina* is similar to saying “oh-oh.” The *‘okina* is written as a backwards apostrophe. The *kahakō* is only found above a vowel. It stresses or elongates a vowel sound from one beat to two beats. The *kahakō* is written as a line above a vowel.

Hawaiian Word	English Translation
ahupua‘a	Land division usually extending from the uplands to the sea, so called because the boundary was marked by a heap (*ahu*) of stones surmounted by an image of a pig (*pua‘a*), or because a pig or other tribute was laid on the altar as tax to the chief.
āholehole	Young stage of *āhole*, Hawaiian flagtail.
ahu	Heap, pile, collection, mound, mass; altar, shrine, cairn.
‘āina	Land, earth.
akakai (Japanese)	Reeds (UH 1977).
ao	Light, day, daylight, dawn; to dawn, grow light; enlightened; to regain consciousness.
‘āpana	Piece, slice, portion, fragment, section, segment, installment, part, land parcel, lot, district, sector, ward, precinct.
aji (Japanese)	*Akule*, big-eyed scad fish (UH 1977).
akua	God, goddess, spirit, ghost, devil, image, idol, corpse.
akule	Big-eyed scad.
‘alae ‘ula	Common Hawaiian Moorhen.

Hawaiian Word	English Translation
ala hele	Pathway, route, road, way to go, itinerary, trail, highway, means of transportation.
ali‘i	Chief, chiefess, officer, ruler, monarch, peer, headman, noble, aristocrat, king, queen, commander.
ali‘i kapu	Sacred chief (common).
‘aumakua	Deified ancestor.
‘auwai	Ditch, canal.
‘āweoweo	Bigeye.
hala	Pandanus.
hale	House, building, institution, lodge, station, hall.
haole	Caucasian, foreigner.
ha‘uki‘uki	Shingle urchins.
heiau	Pre-Christian place of worship, shrine; some *heiau* were elaborately constructed stone platforms, others simple earth terraces. Many are preserved today.
hīnālea	Wrasses.
‘ili	Land section, next in importance to an ahupua‘a and usually a subdivision of an *ahupua‘a*.
ilina	Grave, tomb, sepulcher, cemetery, mausoleum, plot in a cemetery.
iwi kūpuna	Ancestral bone remains (common).
ka‘anani‘au	Boundary markers (Tom Lenchanko)
kahuna	Priest, sorcerer, magician, wizard, minister, expert in any profession. *Kāhuna*—plural of *kahuna*.
kahuna nui	Supreme spiritual leader (common). High priest and councilor to a high chief.

Hawaiian Word	English Translation
kala	Surgeon fish.
kama‘āina	Native-born, one born in a place, host; native plant; acquainted, familiar, Lit., land child.
kāne	Man.
kaona	Hidden meaning, as in Hawaiian poetry; concealed reference, as to a person, thing, or place; words with double meanings that might bring good or bad fortune.
kapu	Taboo, prohibition; special privilege or exemption from ordinary taboo; sacredness; prohibited, forbidden; sacred, holy, consecrated; no trespassing, keep out.
kiawe	Algaroba tree.
konohiki	Headman of an *ahupua‘a* land division under the chief.
kula	Dryland agriculture (common). Plain, field, open country, pasture.
kuleana	Native Hawaiian land rights (common). Right, privilege, concern, responsibility, title, business, property, estate, portion, jurisdiction, authority, liability, interest, claim, ownership, tenure, affair, province.
kūmū	Goatfish.
kupuna	Elders (common). Grandparent, ancestor, relative or close friend of the grandparent's generation, grandaunt, granduncle. *Kūpuna*—plural of *kupuna*.
lehua	The flower of the *‘ōhi‘a* tree.
limu	Seaweed.
lo‘i	Irrigated terrace, especially for taro, but also for rice; paddy.
loko	Pond, lake, pool.
loko i‘a	Fishpond (common).

Hawaiian Word	English Translation
lua	A type of dangerous hand-to-hand fighting in which the, fighters broke bones, dislocated bones at the joints, and inflicted severe pain by pressing on nerve centers.
makaʻāinana	Commoners.
makai	Seaward.
makani	Wind, breeze.
mana	Supernatural or divine power.
manaʻo	Thought, idea, belief, opinion, theory, thesis, intention, meaning, suggestion, mind, desire, want; to think, estimate, anticipate, expect, suppose, mediate, deem, consider.
manini	Convict tang.
mauka	Inland.
mele	Song, anthem, or chant of any kind.
moi	Threadfish.
mōʻī	King, sovereign, monarch, majesty, ruler, queen.
moku	District, island, islet, section.
moʻolelo	Story, tale, myth, history, tradition, literature, legend, journal, log, yarn, fable, essay, chronicle, record, article; minutes, as of a meeting. (From *moʻo ʻōlelo*, succession of talk; all stories were oral, not written).
nenue	Chub fish.
noni	Indian mulberry.
ʻoama	Young stage of *weke*, goatfish.
ogo (Japanese)	Seaweed.
ʻohana	Family.

Hawaiian Word	English Translation
ʻōlelo noʻeau	Proverb, wise saying, traditional saying.
oli	Chant that was not danced to, especially with prolonged phrases chanted in one breath, often with a trill at the end of each phrase; to chant thus.
ʻōpihi	Limpet.
pahu	Drums.
paʻi paʻi	To slap.
pali	Cliff, precipice, steep hill or slope.
pāpio	Young stage of *ulua* (crevalle, jack, or pompano).
piko	Naval, center, birthplace.
pipipi	Pearl oyster.
pō	Night, darkness, obscurity; the realm of the gods; pertaining to or of the gods, chaos, or hell; dark, obscure, benighted; formerly the period of 24 hours beginning with nightfall (the Hawaiian "day" began at nightfall.
pōhaku	Rock, stone, mineral, tablet.
poi	Pounded taro.
pono	Goodness, uprightness, morality, moral qualities, correct or proper procedure, excellence, well-being, prosperity, welfare, benefit, behalf, equity, sake, true condition or nature, duty.
poʻokanaka	Class of *heiau* for human sacrifice (common).
pūnāwai	Fresh-water springs.
tako (Japanese)	Squid, octopus (UH 1977).
tī (kī)	A woody plant in the lily family.
ʻuala	Sweet potatoe.

Hawaiian Word	English Translation
‘uke‘uke	Armored sea urchin.
‘ulu maika	Ball for bowling game.
wā	epoch, time period.
wana	Spiny urchins.
wauke	Paper mulberry.
wahine	Woman.
wahi pana	Storied place (common). Legendary place.
wuwoa	A kind of mullet.

Appendix B Common and Scientific Names for Plants and Animals Mentioned by Community Participants

Common Names		Possible Scientific Names		Source
Hawaiian	**Other**	**Genus**	**Species**	
āholehole	juvenile *āhole* (Hawaiian flagtail)	*Kuhlia*	*xenura*	Hoover 2003
akule	big-eyed scad	*Selar*	*crumenophthalmus*	Hoover 2003
ʻalaeʻula	Hawaiian common moorhen	*Gallinula*	*chloropus*	Pukui and Elbert 1986
ʻawa	kava	*Piper*	*methysticum*	Wagner et al. 1999
ʻāweoweo	bigeye	*Heteropriacanthus*	*cruentatus*	Hoover 2003
hala	pandanus	*Pandanus*	spp.*	Wagner et al. 1999
haole koa	(none)	*Leucaena*	spp.*	Wagner et al. 1999
hāpuʻu	Hawaiian black grouper	*Epinephelus*	*quernus*	Randall 1996
kala	surgeon fish	*Naso*	spp.*	Randall 1996
kiawe	Algaroba tree	*Prosopis*	*pallida*	Wagner et al. 1999
koa	(none)	*Acaia*	*koa*	Wagner et al. 1999

kūmū	goatfish	*Parupeneus*	*porphyreus*	Hoover 1993
limu ‘ele‘ele	seaweed, algae	*Entermorpha*	*prolifera*	Abbott and Williamson 1974
limu kohu	seaweed, algae	*Asparagopsis*	*taxiformis*	Abbott and Williamson 1974
limu wāwae‘iole **	seaweed, algae	*Codium*	*edule*	Titcomb 1972
manini	convict tang	*Acanthurus*	*triostegus*	Hoover 2003
nenue	chub fish	*Kyphosus*	spp.*	Hoover 2003
‘oama	goatfish under 7 inches long	*Mulloidichthys*	spp.*	Hoover 1993
ogo (Japanese)	seaweed	*Gracil*	*parvispora*	Guiry and Guiry 2010
‘opihi	limpet	*Cellana*	spp.*	Pukui and Elbert 1986
pipi (or *pipipi*)	pearl oysters	*Pinctada*	*radiata* and other spp. from family Pteriidae	Pukui and Elbert 1986
tī (or *kī*)	(none)	*Cordyline*	*fruticosa*	Wagner et al. 1999
‘uala	sweet potato	*Ipomoea*	*batatas*	Wagner et al. 1999
‘uke‘uke (or *hā‘uke‘uke*)	armored sea urchin	*Colobocentrotus*	*atratus*	Pukui and Elbert 1986
wana	spiny sea urchin	*Echinothrix*	*diadema*	Pukui and Elbert 1986

*spp. = multiple species

** Corrected Hawaiian spelling by Pukui and Elbert 1986

Appendix C Authorization and Release Form

Cultural Surveys Hawai‘i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawai‘i 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: KAWAILOA 8 jgenz@culturalsurveys.com www.culturalsurveys.com

AUTHORIZATION AND RELEASE FORM

Cultural Surveys Hawai‘i appreciates the generosity of the *kūpuna* and *kama‘āina* who are sharing their knowledge of cultural and historic properties, and experiences of past and present cultural practices for the Cultural Impact Assessment for the *ahupua‘a* of Kamananui.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our study. Here are the procedures we promise to follow:

1. You will have the opportunity to review the written transcript of our interview with you. At that time you may make any additions, deletions or corrections you wish.
2. You will be given a copy of the interview notes for your records.
3. You will be given a copy of this release form for your records.

For your protection, we need your written confirmation that:

1. You consent to the use of the complete transcript and/or interview quotes for reports on cultural sites and practices, historic documentation, and/or academic purposes.
2. You agree that the interview shall be made available to the public.

I, ______________________________, agree to the procedures outlined above and, by my
(Please print your name here)
signature, give my consent and release for this interview to be used as specified.

____
(Signature)

____
(Date)

Appendix D Community Consultation Letter

Cultural Surveys Hawai‘i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 Kailua, Hawai‘i 96734 Ph: (808) 262-9972 Fax: (808) 262-4950

Job code: KAWAILOA 8 jgenz@culturalsurveys.com www.culturalsurveys.com

February 10, 2011

Aloha e Kāua,

At the request of CH2M HILL, Cultural Surveys Hawai‘i, Inc. is conducting a Cultural Impact Assessment (CIA) for the proposed Kawailoa Wind Farm Project, Multiple Ahupua‘a, Waialua District, O‘ahu Island and includes the following parcels:

- Wind Farm Site: TMK [1] 6-1-005:001; 6-1-006:001; 6-1-007:001; 6-2-009:001; 6-2-011:001
- Traversed by Existing Onsite Access Roads: TMK [1] 6-1-005:003, 007, 014, 015, 016, 019; 6-1-005:020, 021, 022; 6-1-008:025; 6-2-002:001, 002, 003, 025
- Mount Ka’ala Communication Sites: TMK [1] 6-7-003:024

This CIA focuses on the Project area (see aerial images and USGS maps) as well as the entire *ahupua‘a* of Kamananui, Kawailoa, Lauhulu, Kuikuiloloa, Punaue, and Kāpaeloa.

Kawailoa Wind, LLC (Kawailoa Wind) was formed by First Wind, LLC (First Wind), a Boston-based wind energy company, for the express purpose of developing a wind power facility at the former Kawailoa Plantation on the North Shore of O‘ahu in order to supply clean, renewable energy for the State of Hawai‘i. First Wind is currently operating Kaheawa Wind Power I on Maui (Hawai‘i’s largest wind farm) and has begun construction of Kaheawa Wind Power II. First Wind’s Kahuku Wind Power on O‘ahu was recently constructed and is in the process of being commissioned for connection into the electrical grid of Hawaiian Electric Company (HECO).

Kawailoa Wind is proposing to construct, operate, and maintain a wind farm with a generating capacity of up to 70 megawatts on Kamehameha Schools (KS) property located on the North Shore of O‘ahu. The proposed wind farm facilities would be located on KS land at the former Kawailoa Plantation (Kawailoa, Lauhulu, Kuikuiloloa, Punaue, and Kāpaeloa Ahupua‘a). Lands owned by other entities are included as existing onsite access roads traverse these properties. KS currently has reciprocal agreements with these landowners for access through their properties; it is anticipated that these rights would be extended to Kawailoa Wind for construction and operation of the project. Microwave communication facilities for the Project will be installed at existing communication sites on State-owned land, leased to Hawaiian Telcom, on Mount Ka‘ala (Kamananui Ahupua‘a) .

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Specific Project components would include 30 wind turbine generators (turbines), underground and overhead electrical collector lines to carry the electrical power from each wind turbine generator to an electrical substation, a battery energy storage system, electrical switching station facilities and sub-transmission lines, an operations and maintenance building, HECO control buildings, a communication tower with microwave dishes, meteorological monitoring equipment, and onsite roads to facilitate access to each of these facilities. The Project would also include installation of additional communication equipment on Mount Kaʻala in order to provide a dedicated communication link between the wind farm and existing HECO substations in Waialua and Wahiawā.

The purpose of this CIA is to evaluate potential impacts to cultural practices and resources as a result of the proposed development in Kamananui Ahupuaʻa (the microwave communications facilities) and Kawailoa, Lauhulu, Kuikuiloloa, Punaue, and Kāpaeloa Ahupuaʻa (the wind power facility). We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- **General history and present and past land use of the Project area.**
- **Knowledge of cultural sites which may be impacted by future development of the Project area - for example, historic sites, archaeological sites, and burials.**
- **Knowledge of traditional gathering practices in the Project area both past and ongoing.**
- **Cultural associations of the Project area, such as *moʻolelo* and traditional uses.**
- **Referrals of *kūpuna* and *kamaʻāina* who might be willing to share their cultural knowledge of the Project area and the surrounding *ahupuaʻa* lands.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the Project area.**

I invite you to contact me, Joe Genz, at 262-9972 or send me an email at jgenz@culturalsurveys.com if you have any information you would like to share.

Mahalo nui,

Joe Genz, Ph.D.
Cultural Specialist

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APPENDIX B: Environmental Noise Assessment Report for Kawailoa Wind Farm

D. L. ADAMS ASSOCIATES, LTD.
Consultants in Acoustics and Performing Arts Technologies

Environmental Noise Assessment Report
Kawailoa Wind Farm
Haleiwa, Oahu, Hawaii

June 2011

DLAA Project No. 09-39A

Prepared for:
CH2M Hill / First Wind Energy, LLC
Honolulu, Hawaii

970 N. KALAHEO AVE. • SUITE A311 • KAILUA, HAWAII 96734
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1.0 EXECUTIVE SUMMARY

1.1 The proposed Kawailoa Wind Farm project is located between Haleiwa and Waimea Bay on the north shore of Oahu, Hawaii. Thirty wind turbines are planned, along with other key components such as electrical substations, operations and maintenance buildings, communications and meteorological towers, and communication facilities. The wind turbines selected for use at the proposed Kawailoa Wind Farm project are the Siemens SWT-2.3-101, which have 332 foot (101 meter) diameter three-blade rotors and a hub height of 326 feet (99.5 meters).

1.2 The proposed project site is located on the Kawailoa Plantation lands, and is zoned primarily as an agricultural district (AG-1), with a small area zoned as preservation (P-1). As such, there are no residential dwellings within 4,000 feet (1220 meters) from the project site or noise sensitive land uses within 1,000 feet (300 meters) from the project site. Sound from the wind turbines must comply with the State Department of Health (HDOH) maximum permissible sound levels for any location at or beyond the First Wind project area. These sound limits may be enforced at nearby residences or along the boundary of the project site. Therefore, project noise must comply with the limits specified for all HDOH zoning districts (Residential, Preservation, Commercial, and Agriculture).

1.3 Ambient noise level measurements and wind speed data was collected to assess the existing acoustical environment in the community surrounding the project site and on the proposed Kawailoa Wind Farm project site. The range of equivalent sound levels, L_{eq}, during the day (7:00 a.m. to 10:00 p.m.) and during the night (10:00 p.m. to 7:00 a.m.) and average calculated day-night level, L_{dn}, were reported for 13 locations. The average calculated L_{dn} ranged from 43 to 69 dBA on the project site and 42 to 63 dBA in the surrounding community. Contributing noise sources included environmental noise sources such as wind and birds, vehicular traffic, community noises, landscaping or grading equipment, and aircraft flyovers.

1.4 A sound propagation model of the proposed Kawailoa Wind Farm project was developed to predict wind turbine sound in the areas surrounding the project site. To assess potential sound impacts and compliance with associated regulations, the results of the sound propagation model were compared to the State of Hawaii Department of Health Community Noise Rule's maximum permissible noise limits. To assess community reaction to project noise, the results were compared to the ambient sound levels that were measured in the community surrounding the project site.

1.5 Based on the results of the sound propagation model and comparisons to the measured ambient sound levels, wind turbine sound is expected to increase the ambient noise environment by less than 3 dB, an insignificant amount, at the closest noise sensitive receptor (Waimea Valley). This means that during the day, turbine sounds will be fully masked by ambient noise sources such as birds and wind. At night, turbine sounds will just barely be perceptible. The other nearby residential communities are located at a sufficient distance from the Kawailoa Wind Farm project site that wind turbine sounds are predicted to be lower than the existing ambient noise environment. This means that wind turbine noise will not be audible at these residences. Therefore, the Kawailoa Wind Farm project noise would be unlikely to create a disturbance to sensitive noise receptors or generate complaints from the surrounding residences.

1.6 The predicted wind turbine sound levels from the Kawailoa Wind Farm project are not expected to exceed the HDOH maximum permissible noise limit in the areas to the west of the project site that are zoned for agriculture. However, sounds from the wind turbines are expected to exceed the HDOH nighttime maximum permissible noise limit where the project borders preservation land. Although the property line locations are not easily accessible or commonly occupied locations, any requirements for a noise variance should be confirmed with the HDOH.

1.7 Sounds from the wind turbines are also not expected to exceed the HDOH maximum permissible noise limit at the residential communities or commercial properties closest to the project site. Since the project noise complies with the HDOH Community Noise Rule, a noise impact is not expected at these nearby residences and businesses.

2.0 PROJECT DESCRIPTION

The proposed Kawailoa Wind Farm project is located between Haleiwa and Waimea Bay on the north shore of Oahu, Hawaii. The project site is located on the Kawailoa Plantation lands, and is zoned primarily as an Agricultural District (AG-1), with a small area zoned as Preservation (P-1). As such, there are no residential dwellings within 4,000 feet (1220 meters) from the project site or noise sensitive land uses within 1,000 feet (300 meters) from the project site.

Thirty wind turbines are planned, along with other key components such as electrical substations, operations and maintenance buildings, communications and meteorological towers, and communication facilities. The wind turbines selected for use at the proposed Kawailoa Wind Farm project are the Siemens SWT-2.3-101, which have 332 foot (101 meter) diameter three-blade rotors and a hub height of 326 feet (99.5 meters). The turbines will be located at varying elevations, primarily in the north-eastern portion of the Kawailoa Plantation lands where the wind profile is favorable. The turbines are generally activated when wind speeds reach approximately 8 miles per hour (mph) or 4 meters per second (mps) and shut down when winds exceed 55 mph (25 mps), as high wind speeds can damage the equipment. The wind turbines are expected to have a nominal output of 2.3 MW each.

The environmental noise assessment consists of two phases: a survey of the existing ambient noise environment and an analysis of future wind turbine sound levels with computer modeling software. Long-term ambient sound level measurements were conducted to monitor existing sound levels at the project site and in the surrounding areas. A sound propagation model of the site and the surrounding areas was developed in order to assess the potential sound impacts of the selected wind turbines. The results of the sound propagation model and the measurements will confirm whether sound from the wind turbines will be audible over the existing ambient environment.

3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. It is our understanding that the only local noise regulation that applies to the proposed project is the State of Hawaii Community Noise Control Rule. However, other guidelines may be used to assess the community response to the proposed project as it relates to noise. A brief description of common acoustic terminology used in the regulation and in this report is presented in Appendix A.

3.1 State of Hawaii Department of Health, Community Noise Control

The State of Hawaii Community Noise Control Rule [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* sound sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, it does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary. The proposed wind turbines are considered stationary sound sources and would be subject to the Community Noise Control Rule.

The maximum permissible sound levels are enforced by the State Department of Health (HDOH) for any location at or beyond the First Wind project area and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 1. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. For enforcement purposes, sound levels are typically measured at the property line or on the property of the complainant, and the maximum permissible sound level corresponds with the zoning of the complainant's property.

While the HDOH Community Noise Rule is generally enforced at the property line boundary between two adjoining lands, the maximum permissible noise levels can apply to any excessive noise source "emanating at any point at or beyond the property line." Therefore, wind turbine sound levels must also meet the HDOH maximum permissible noise limit at all zoning districts outside of the First Wind project area, including residential or commercial zones.

3.2 U.S. Environmental Protection Agency (EPA)

The U.S. EPA has identified a range of yearly day-night equivalent sound levels, L_{dn}, sufficient to protect public health and welfare from the effects of environmental noise [Reference 2]. The EPA has established a goal to reduce exterior environmental noise to an L_{dn} not exceeding 65 dBA and a future goal to further reduce exterior environmental noise to an L_{dn} not exceeding 55 dBA. Additionally, the EPA states that these goals are not intended as regulations as it has no authority to regulate noise levels, but rather they are intended to be viewed as levels below which the general population will not be at risk from any of the identified effects of noise.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

4.1 Noise Measurement Procedure

Ambient noise level measurements and wind speed data was collected to assess the existing acoustical environment in two areas which will be referred to as "Community" and "Project Site". Noise monitoring stations were set up in seven locations in the community surrounding the project site. The project site measurements were conducted at six locations in the vicinity of the proposed Kawailoa Wind Farm project area. The locations of the noise monitoring stations are shown in Figures 2 and 3 and described below.

The data collection took place during the months of January, February and March 2011. Continuous, one-hour, statistical sound levels were recorded for approximately two weeks at each location. Calibration was checked before and after the measurements. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period. The microphone was mounted on a tripod, generally about 5 feet above grade, and covered by a windscreen. The sound level meter was secured in a weather resistant case.

Simultaneous weather data (wind speed, direction, temperature, etc.) was also collected in 15 minute intervals. The anemometer was mounted on a tripod near the sound level meter, generally about 6 feet above grade. A handheld Garmin GPS was used to adjust the wind vane to accurately measure wind direction. The wind speed measurements were validated using a handheld Kestrel 3000 Pocket Weather Meter. The Weather Console and Weatherlink were secured in a weather resistant case.

The measurement equipment is described in Table 1 below. Photographs of the various measurement equipment setups can be seen in Appendix B.

Table 1. Noise Monitoring Station Equipment List

Equipment Type	Manufacturer, Model
Type 1 Sound Level Meter	Larson Davis Model 820
	Larson Davis Model 831
Type 1 Microphone	Gras Model 40AQ
	PCB Model 377B20
Calibrator	Larson Davis CAL200
Windscreen	Larson Davis 001
	Larson Davis EPS2106
Weather Station	Davis Instruments Weather Wizard III, Product 7425
	Davis Instruments, Vantage VUE Integrated Sensor Suite Model 6357, Console Model 6351
	Larson Davis Model 831, Weather Module
WeatherLink	Davis Instruments WeatherLink, Model 7866
	Davis Instruments WeatherLink, Model 6510USB
Anemometer	Davis Instruments Model 7911

4.2 Community Noise Measurement Locations and Results

Ambient noise measurements were conducted at seven locations between the communities of Whitmore Village and Pupukea, as shown in Figure 2. The existing conditions and ambient noise environment for each location are described below. The results from these long-term noise measurements are graphically presented in Figures 4 through 10, which show the measured equivalent sound level, L_{eq}, in A-weighted decibels (dBA) and the measured wind speed as a function of the measurement date and time. The results are also summarized for each location in Table 2 below.

Table 2. Community Noise Measurement Results

ID	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]
C3	Pu'u O Mahuka Heiau	41 - 47 dBA	36 - 51 dBA	44 - 56 dBA
C4	Pupukea	38 - 48 dBA	35 - 51 dBA	42 - 57 dBA
C8	Waimea Valley	45 - 50 dBA	42 - 50 dBA	49 - 56 dBA
C11	Punalau/Pohaku Loa Area	55 - 61 dBA	51 - 57 dBA	59 - 63 dBA
C13	Papailoa/Kawailoa Area	55 - 61 dBA[4]	47 - 49 dBA[4]	56 - 60 dBA[4]
C14	Haleiwa – JPL Hwy Property	50 - 56 dBA	45 - 52 dBA	53 - 58 dBA
C15	Dole Plantation	48 - 60 dBA	39 - 58 dBA	49 - 64 dBA

Notes:

1. $L_{eq(day)}$ is an average of the hourly equivalent sound levels during the daytime hours only (between 7:00 am and 10:00 pm) within a 24-hour measurement period. The range represents the quietest and noisiest day measured within the 14 day measurement period.
2. $L_{eq(night)}$ is an average of the hourly equivalent sound levels during the nighttime hours only (between 10:00 pm and 7:00 am) within a 24-hour measurement period.. The range represents the quietest and noisiest night measured within the 14 day measurement period.
3. The L_{dn} represents the lowest and highest calculated average day-night level from the 14 day measurement period.
4. Peaks caused by meter malfunctions were removed from the from the $L_{eq(day)}$, $L_{eq(night)}$, and L_{dn} calculations.

4.2.1 Pu'u O Mahuka Heiau (C3)

Pupukea Ranch was chosen for one of the sound level meter locations due to its proximity to the Pu'u O Mahuka Heiau. The sound level meter was set up approximately 1000 feet south-east of the Heiau near the edge of the ridge overlooking Waimea Valley (GPS Coordinates: 21°38'19.15"N, 158° 3'21.23"W). A graphical representation of the results from the long-term noise measurements at this location are shown in Figure 4. Noise sources at this site include wind, birds, rain and thunder, frequent military aircraft flyovers, tsunami sirens, ATVs, horses, and sounds from the Waimea Valley parking lot below.

4.2.2 Pupukea - Maulukua Rd Property (C4)

The sound level meter was set up on private property at the edge of the ridge overlooking Waimea Valley and had a direct line-of-sight to the proposed project site on the opposite ridge (GPS Coordinates: 21°38'13.43"N, 158° 2'9.64"W). A graphical representation of the results from the long-term noise measurements at this location are shown in Figure 5. Noise sources at this site include wind, birds, rain and thunder, landscaping equipment, and occasional aircraft flyovers.

4.2.3 Waimea Valley (C8)

The sound level meter was set up on the southern edge of the valley near the back of the botanical gardens area (GPS Coordinates: 21°37'48.13"N, 158° 2'52.58"W). A graphical representation of the results from the long-term noise measurements at this location are shown in Figure 6. Noise sources at this site include wind, birds, landscaping equipment, pedestrians, and occasional aircraft flyovers.

4.2.4 Punalau/Pohaku Loa Area - Ashley Road Residence (C11)

It was necessary to assess noise levels in an area between the residential neighborhoods of Punalau and Papailoa. Therefore, the sound level meter was located at a private residence adjacent to Ashley Road, approximately 300 feet east of Kamehameha Highway (GPS Coordinates: 21°37'20.70"N, 158° 4'48.25"W). A graphical representation of the results from the long-term noise measurements at this location are shown in Figure 7. The ambient noise levels are dynamic and depend significantly on the vehicular traffic patterns of Kamehameha Highway. Noise sources at this site include vehicular traffic, frequent military aircraft flyovers, chickens, landscaping equipment, wind, and birds.

4.2.5 Papailoa/Kawailoa Area - Alluvion Ranch (C13)

In order to assess sound levels in the agricultural neighborhoods mauka of Kamehameha Highway, a sound level meter was located near Kawailoa Ranch (GPS Coordinates: 21°36'49.60"N, 158° 5'7.19"W). A graphical representation of the results from the long-term noise measurements at this location are shown in Figure 8. There were many instances of equipment malfunctions, as indicated in the figure and the affected data points were removed from the L_{eq}(day), L_{eq}(night), and L_{dn} calculations. Noise sources at this site include agricultural and/or landscaping equipment, wind, birds, and occasional aircraft flyovers.

4.2.6 Haleiwa - Joseph P. Leong Highway Residence (C14)

It was also necessary to assess noise levels near Haleiwa town, which is zoned for residential, commercial and agricultural uses. The sound level meter was located at the north end of Haleiwa on an agricultural lot approximately 300 feet east of Joseph P. Leong Highway (GPS Coordinates: 21°35'51.06"N, 158° 5'54.95"W). A graphical representation of the results from the long-term noise measurements at this location are shown in Figure 9. The ambient noise levels are dynamic and depend significantly on the vehicular traffic patterns of Joseph P. Leong Highway. Noise sources at this site include vehicular traffic, frequent military aircraft flyovers, agricultural and/or landscaping equipment, wind, and birds.

4.2.7 Dole Plantation (C15)

The sound level meter was located at Dole Plantation near the plantation garden, approximately 950 feet east of Kamehameha Highway (GPS Coordinates: 21°31'34.57"N, 158° 2'9.52"W). A graphical representation of the results from the long-term noise measurements at this location are shown in Figure 10. Noise sources at this site include vehicular traffic, rain and thunder, tsunami sirens, noise from the train tour, agricultural and/or landscaping equipment, wind, and birds.

4.3 Project Site Measurement Locations and Results

Ambient noise measurements were also conducted on the proposed Kawailoa Wind Farm project site. Six sound level meters were set up at various locations within the project area, as shown in Figure 3. The results from these long-term noise measurements are graphically presented in Figure 12 through 16, which show the measured equivalent sound level, L_{eq}, in A-weighted decibels (dBA) and the measured wind speed as a function of the measurement date and time. The results are summarized in Table 3 below.

Table 3. Project Site Noise Measurement Results

ID	GPS Coordinates	Daily Avg. Sound Level $L_{eq\ (Day)}$ [1]	Daily Avg. Sound Level $L_{eq\ (Night)}$ [2]	Daily Avg. Day-Night Level L_{dn} [3]
L1	N21° 37.355', W158° 04.422'	58 - 64 dBA	55 - 63 dBA	62 - 69 dBA
L2	N21° 37.693', W158° 03.836'	47 - 50 dBA[4]	35 - 45 dBA[4]	46 - 53 dBA[4]
L3	N21° 37.426', W158° 03.422'	43 - 49 dBA[4]	27 - 55 dBA[4]	43 - 60 dBA[4]
L4	N21° 37.510', W158° 02.619'	41 - 52 dBA	36 - 57 dBA	48 - 63 dBA
L5	N21° 36.999', W158° 01.841'	44 - 48 dBA[4]	43 - 44 dBA[4]	49 - 50 dBA[4]
L6	N21° 35.476', W158° 02.312'	41 - 50 dBA	24 - 48 dBA	43 - 53 dBA

Notes:

1. $L_{eq(day)}$ is an average of the hourly equivalent sound levels during the daytime hours only (between 7:00 am and 10:00 pm) within a 24-hour measurement period. The range represents the quietest and noisiest day measured within the 14 day measurement period.
2. $L_{eq(night)}$ is an average of the hourly equivalent sound levels during the nighttime hours only (between 10:00 pm and 7:00 am) within a 24-hour measurement period.. The range represents the quietest and noisiest night measured within the 14 day measurement period.
3. The L_{dn} represents the lowest and highest calculated average day-night level from the 14 day measurement period.
4. Peaks caused by meter malfunctions or due to birds or other unknown noise sources were removed from the $L_{eq(day)}$, $L_{eq(night)}$, and L_{dn} calculations.

The proposed Kawailoa Wind Farm site is located on undeveloped land that was previously utilized for the cultivation of sugarcane. As shown in Figure 11 through 16, ambient noise levels on the project site are dynamic and depend significantly on environmental noise sources. The measurements are fairly consistent for all measurement locations (except Location L1), which indicates a uniform ambient noise environment throughout the project site. Noise sources on the project site include wind, birds, rain, and frequent military aircraft flyovers. At Location L3, there were several occurrences of bird sounds near the microphone. These events and other unknown noise sources caused sound levels to spike. At Locations L2 and L5, there were instances of equipment malfunctions. While these anomalies are indicated in the figure, the affected data points were removed from the L_{eq}(day), L_{eq}(night), and L_{dn} calculations. Peaks due to various events such as military aircraft flyovers and rain are also indicated in the figures.

4.4 Wind Speed Measurement Results

4.4.1 Atmospheric Conditions at Hub Height and Ground Height

In an attempt to address atmospheric conditions at various times of the day, wind speed data was collected from the two First Wind meteorological (MET) stations corresponding to Location L5 on the project site. Figure 17 shows the hourly averaged wind speed measured over a two week period at the MET station at a height of approximately 200 ft (59.5) for Location L5. The figure also shows the wind speed at Location L5 measured during the same time period at ground level (5 ft).

As shown in the figure, the wind data from the MET station fluctuates significantly over time. But on average, the wind speed only varies from 8 mph to 12 mph indicating that wind speed at a high altitude is not dependent on time of day. However, a general pattern in the data indicates that wind speed at ground level is highest during the daylight hours and tends to be minimal at night. This phenomenon occurs during periods of stable nighttime atmospheric conditions, when calm ground level winds become decoupled from winds at a higher altitude. Under this "worst case" condition, wind turbine noise could be perceived as louder and more perceptible if wind speeds at hub height are sufficient to drive the turbine but the lack of wind closer to the ground causes low ambient sound levels that are not effective at masking other noise sources.

4.4.2 Windscreen Induced Self Noise

During unmonitored environmental noise measurements, there is a possibility that the measured ambient noise is actually due to self induced wind noise generated by flow around and through the windscreen. The contamination of ambient noise by the self induced wind noise depends on the porosity of the windscreen and the wind speed itself. Self induced noise levels of 35 to 40 dBA generally occur at wind speeds of 12 mph or greater. Based on the measurements at the various community and project site measurement locations, wind speeds at ground level were insufficient to create self-induced noise.

5.0 SOUND PROPAGATION MODEL

5.1 Model Overview

To evaluate the sound impact of each wind turbine in each direction, the DataKustik CadnaA (version 4.0) software program [Reference 3] was used to create a sound propagation model. The software program uses the calculation procedures of International Standard ISO 9613-2 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* [Reference 4]. The model is a three dimensional representation of the propagation of wind turbine sound throughout the project site and the surrounding areas. It includes the effect of ground cover and terrain and also considers environmental parameters, such as temperature, humidity, and wind direction.

The Kawailoa Wind Farm sound propagation model was developed using the wind turbine coordinates, sound power data, and a site plan provided by First Wind and CH2M Hill. The following paragraphs describe the input parameters used to develop the sound propagation model relative to the Kawailoa Wind Farm.

5.2 Wind Turbine Sound Data

The proposed wind turbines are Siemens SWT-2.3-101 turbines which have 332 ft (101 m) diameter three-blade rotors and a hub height of 326 ft (99.5 m). The current standard for measuring and reporting the sound power of wind turbines is the International Standard IEC 61400-11:2006 *Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques* [Reference 5]. The sound power levels were presented with reference to IEC 61400 requirements based on a hub height of 262 ft (80 m) and a roughness length of 0.16 ft (0.05 m). The data used in the sound propagation model is based on 18 mph (8 m/s) wind speed referenced to a height of 33 ft (10 m) above ground level.

5.3 Project Site Topography

The elevation of the Kawailoa Wind Farm project site ranges from 200 feet above sea level (ASL) at the makai (western) edge to 1,280 feet ASL. Furthermore, the site encompasses a range of topographical conditions from relatively flat and moderately sloping agricultural lands to steep gullies and intermittent streams. As such, the irregular terrain may play a significant role in the attenuation of sound where the line-of-sight from receptor to the wind turbines is broken. Digital geometric data of topographic contours (at 40 ft intervals) were imported into the software. Topographic maps of the island of Oahu were available on the City and County of Honolulu Department of Planning and Permitting Land Information System website [Reference 6].

5.4 Meteorological Conditions

Over large distances, meteorological conditions (i.e., wind, temperature, and humidity) play a large role in the attenuation of sound. Standard practice for calculating sound attenuation at long ranges is to restrict attenuation to atmospheric conditions that are favorable for sound propagation, consistent with the methodology described in ISO 9613-2. Therefore, although physically impossible, every receiver was assumed to be simultaneously downwind of the source in the presence of a well developed temperature inversion. The model also assumes an average temperature of 68° Fahrenheit and relative humidity of 70%, based on software settings that are closest to the average climate on the north shore of Oahu.

The software program does provide the means to model other meteorological conditions including predominant wind speeds and directions. However, the methodology described above is not only standard practice, but also a conservative approach to predicting wind turbine sound. This means that the actual sound levels due to wind turbine sound propagation should be equal to or less than the predicted levels.

5.5 Ground Attenuation Coefficient

The ground attenuation coefficient is another condition used in the sound propagation model that can influence the predicted sound levels. A ground attenuation coefficient of 1.0 indicates that the ground is porous or acoustically very absorptive (e.g., ground covered by grass, trees or other vegetation). A coefficient of 0.0 indicates that the ground is hard or acoustically reflective (e.g., water, pavement, or other low porosity ground surfaces). The project site and surrounding terrain is currently heavily vegetated by various grass species and trees. Therefore, the model assumes a ground attenuation coefficient of 1.0 to represent the absorptive nature of the existing and future ground cover or the project area. For the developed and residential areas (such as Pupukea, Haleiwa, and the Kamehameha Highway corridor), a conservative ground absorption coefficient of 0.0 was used to represent the paved and other reflective surfaces.

5.6 Receiver Height

Wind turbine sound levels have been calculated at the receiver locations at 13 ft (4 m) above ground. This height represents a worst case scenario of a listener on a second story balcony or in a second story bedroom with an open window. This also provides a safety factor when considering shadowing due to terrain features, in case there are slight inaccuracies in the topographical data used in the model. Typically, measurements would most often be made at 5 ft (1.5 m) above ground if testing for compliance with the Community Noise Control Rule. However, the regulation does allow measurements to be made higher on the vertical plane of the property line, or within the complainant's property. In almost all cases, predicted sound levels at 5 ft would be equal to or slightly less than at 13 ft.

5.7 Predicted Wind Turbine Sound Levels

The results of the sound propagation model have been presented in both tabular and graphical formats. Again, various conservative assumptions have been made in developing the model to ensure that actual project noise does not exceed the predicted levels. Table 4 summarizes the predicted wind turbine sound levels at the measurement locations described in Sections 4.2 and 4.3 above. Figures 18 and 19 are graphical representations of the predicted sound level contours due to the wind turbines in the vicinity of the project site and in the North Shore region, respectively. The sound contour lines range from 30 dBA to 60 dBA

Table 4. Predicted Wind Turbine Sound Levels at Various Locations

ID	Name	Distance[1]	Predicted Sound Level[2]	DOH Nighttime Sound Limit[3]
L1-L3	W Site Boundary	1300 - 5000 ft	30 – 43 dBA	70 dBA
L4-L6	**N, E, S Site Boundary**	**200 - 900 ft**	**52 – 55 dBA**	**45 dBA[4]**
C3	Pu'u O Mahuka Heiau	4,100 ft	30 dBA	45 dBA
C4	Pupukea	5,300 ft	30 dBA	45 dBA
C8	Waimea Valley	750 ft	42 dBA	45 dBA
C11	Punalau/Pohaku Loa	7,320 ft	< 30 dBA	45 dBA
C13	Papailoa/Kawailoa	9,390 ft	< 30 dBA	45 dBA
C14	Haleiwa	> 10,000 ft	< 30 dBA	45 dBA
C15	Dole Plantation	> 10,000 ft	< 30 dBA	50 dBA

Notes:
1. Approximate distance from indicated location to closest wind turbine.
2. The predicted sound levels are based on the conditions indicated in Sections 5.2 – 5.6.
3. The nighttime sound limits are based on the zoning of the indicated location and the corresponding HDOH maximum permissible limits, as discussed in Section 3.1.
4. The predicted wind turbine sound levels will exceed the DOH nighttime sound limit at the northern, eastern, and southern boundaries of the project site which are zoned for preservation land. This impact is discussed in more detail in Section 7.1.

6.0 COMMUNITY RESPONSE TO PROJECT

6.1 Community Response Guidelines

The average ability of an individual to perceive changes in noise levels is well documented and has been summarized in Table 5 [Reference 7, 8]. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

Table 5. Average Ability to Perceive Changes in Noise Level

Sound Level Change (dB)	Human Perception of Sound
0	Imperceptible
3	Just barely perceptible
6	Clearly noticeable
10	Two times (or 1/2) as loud
20	Four times (or 1/4) as loud

A commonly applied criterion for estimating a community's response to changes in noise level is the 'community response scale' proposed by the International Standards Organization (ISO) of the United Nations [Reference 9]. The scale shown in Table 6 relates changes in noise level to the degree of community response and allows for direct estimation of the probable response of a community to a predicted change in noise level.

Table 6. Community Response to Increases in Noise Levels

Sound Level Change (dB)	Category	Response Description
0	None	No observed reaction
5	Little	Sporadic Complaints
10	Medium	Widespread Complaints
15	Strong	Threats of Community Action
20	Very Strong	Vigorous Community Action

Human perception to changes in noise level is subjective by its very nature. All people do not respond to noises in the same manner or with the same threshold for tolerance. Tables 5 and 6 above summarize the human perception and response to noise level changes for most people (the general public). These tables are based on a summary of results and research by many different organizations, and they are commonly referenced when determining the perceived annoyances due to changes in sound levels. The values stated in Tables 5 and 6 should not be considered regulatory requirements because they are not associated with a specific governing document for this project. However, these tables are very useful in assessing the human perception to changes in sound levels and they are considered to be supplemental information to the governing State of Hawaii Community Noise Control Rule, which does not discuss community response to changes in noise levels.

A change in sound level of 6 dB or more is commonly used as a threshold for determining the when an adverse reaction from the community can be expected. Based on the information provided in Tables 5 and 6, a 6 dB change in sound level will be easily noticeable and generate complaints from most communities. Many studies support the 6 dB change as a common threshold. Examples of this threshold being applied as a guideline can be found in the 2008 Noise Impact Assessment Report completed for the St. Lawrence Wind Farm Project [Reference 10], and the New York State Department of Environmental Conservation (NYSDEC) program policy (Section V B(7)c) [Reference 11]. Therefore, this 6 dB change in noise level was used as the threshold for determining adverse community response for the Kawailoa Wind Farm project. For clarification, this criteria is based on the change in noise level and is supplemental to the criteria regarding the overall noise level limits regulated by the Hawaii Department of Health.

6.2 Predicted Community Response to Wind Turbine Sound

As described above, a change in noise level of 6 dB or more is the threshold for predicting adverse community response regarding the cumulative change in sound level due to the wind turbines. The cumulative change includes both the wind turbine noise and the existing ambient noise and can be determined by logarithmically combining the existing ambient sound (based on the measurement results) with the predicted wind turbine sound, as shown in Table 7 below.

Table 7: Predicted Change in Sound Level and Community Response

ID	Name	Predicted Sound Level[1]	Measured Min. Average $L_{eq(Night)}$[2]	Combined Sound Level[3]	Δ due to Wind Turbines[4]	Response Category[5]
C3	Heiau	30 dBA	36 dBA	37 dBA	+ 1 dB	Little to None
C4	Pupukea	30 dBA	35 dBA	36 dBA	+ 1 dB	Little to None
C8	Waimea Valley	42 dBA	42 dBA	45 dBA	+ 3 dB	Little to None
C11	Punalau	<30 dBA	51 dBA	51 dBA	+ 0 dB	None
C13	Kawailoa	<30 dBA	47 dBA	47 dBA	+ 0 dB	None
C14	Haleiwa	<30 dBA	45 dBA	45 dBA	+ 0 dB	None
C15	Dole Plantation	<30 dBA	39 dBA	39 dBA	+ 0 dB	None

Notes:

1. Sound levels were predicted from the sound propagation model described Section 5.7 and do not include ambient sound.
2. $L_{eq(night)}$ is an average of the hourly equivalent sound levels during the nighttime hours only (between 10:00 pm and 7:00 am) within a 24-hour measurement period. The minimum represents the quietest night measured within the 7 day measurement period and is a conservative noise descriptor to which the predicted turbine noise can be compared.
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 addition of the Kawailoa Wind Farm project.
5. The response category is based on the information provided in Table 6.

The largest increase is expected to be 3 dB at Waimea Valley (C8). This increase is well below the 6 dB threshold and is likely to generate little to no noise complaints. Furthermore, the residential areas surrounding are expected to experience a cumulative increase of less than 1 dB. Therefore, a negative response to wind turbine noise from the communities surrounding the project site due is not expected.

The same cumulative threshold concept can be applied to the noise contour map, where homes outside of the 40 dBA sound contour will experience an increase in sound level that is less than the 6 dB threshold. In other words, homes located outside of this noise contour line are not expected to have an adverse response to the wind turbines. This estimate is a conservative approach that is based on the quietest area surrounding the project site, which was measured to be 35 dBA. The reason this approach is conservative is because other areas experience higher ambient sound levels that would more effectively mask wind turbine sounds. Even taking this conservative approach, there are no residences located within the 40 dBA sound contour line. Please refer to the blue contour line shown in Figures 18 and 19.

7.0 POTENTIAL SOUND IMPACTS

A sound impact may occur if the sound levels generated by the project exceed applicable standards and regulations. However, the sound level alone cannot determine if a sound impact occurs. The "sound receiver" or typical listener must also be considered, along with the land use, to determine the compatibility of the sound and sound receiver. Even if the sound level complies with all standards and regulations, the sound generated by the project may still be audible at the sound receiver. However, most regulations regarding sound levels are written with the intent to limit excessive sound levels for which the general public may be adversely affected.

7.1 Construction Noise

The areas adjacent to the proposed Kawailoa Wind farm are primarily zoned for agricultural and preservation uses. The Hawaii Community Noise Control Rules state that the primary land use designation shall be used to determine the applicable zoning district class. Maximum permissible noise levels are specified by the State for daytime and nighttime hours, but ambient noise levels are also taken into account. Construction noise levels are expected to exceed the daytime limits and a permit must be obtained from the State DOH to allow the operation of construction equipment.

The Kawailoa Wind Farm project boundaries are not easily accessible due to the terrain in the area. Furthermore, much of the project area is not considered noise sensitive and does not represent typical listener locations. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in Figure 9. The mitigation measures discussed in Section 7.1 may not be necessary due to the remote locations of the wind turbines.

7.2 Compliance with State of Hawaii Community Noise Control Rule

7.2.1 Preservation Zone

Sound from the wind turbines must meet the nighttime HDOH maximum permissible noise limit for zoning district Class A at the northern, eastern, and southern boundaries where the project site is adjacent to preservation land. The results of the sound propagation model show that project noise will not comply with the 45 dBA nighttime noise limit at this adjacent land zoned for preservation. Although the property line locations are not easily accessible or commonly occupied locations, the Hawaii Department of Health should be contacted to determine if a noise variance is needed for this adjacent land.

7.2.2 Agriculture Zone

Sound from the wind turbines must meet the nighttime HDOH maximum permissible noise limit for zoning district Class C at the western boundary where the project site is adjacent to land zoned as agriculture. The results of the sound propagation model show that project noise will comply with the 70 dBA nighttime noise limit.

7.2.3 Residential/Commercial Zones

The results of the sound propagation model show that project noise will not exceed the 45 dBA nighttime noise limit at the residences closest to the project site. In addition, project noise will not exceed the 55 dBA nighttime noise limit at commercial properties closest to the project site. Since the project noise complies with the HDOH Community Noise Rule, a noise impact is not expected at the nearby residences and businesses.

Furthermore, most residential communities along the North Shore are located at a sufficient distance from the Kawailoa Wind Farm project site that wind turbine sounds are predicted to be lower than the existing ambient noise environment. Wind turbine noise will not be audible at these residences. Even at the closest noise receptors (i.e., Waimea Valley), sounds from the turbines are expected to increase the ambient noise environment by less than 3 dB, which is not considered a significant increase. During the daytime hours, wind turbine sound at Waimea Valley will be fully masked by environmental noises such as birds and wind blowing through the landscape. During periods of stable atmospheric conditions, sounds from the wind turbines may just barely be perceptible at night.

7.3 Compliance with EPA Noise Guidelines

The EPA has an existing design goal of $L_{dn} \leq 65$ dBA and a future design goal $L_{dn} \leq 55$ dBA for exterior noise levels. It is important to note that the EPA noise guidelines are design goals and not enforceable regulations. However, these guidelines and design goals are useful tools for assessing the noise environment.

The results from the long-term ambient noise measurements conducted in the community surrounding the project site show calculated day-night noise levels, L_{dn}, that range from 42 to 64 dBA. After completion of the project, ambient noise levels are not expected to increase when the wind turbines are in operation.

8.0 MITIGATION OF NOISE IMPACTS

8.1 Construction Noise

In cases where construction noise exceeds, or is expected to exceed the State's maximum permissible property line noise levels [Reference 1], a permit must be obtained from the HDOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit sound levels in excess of the "maximum permissible" levels.

In order for the HDOH to issue a construction noise permit, the Contractor must submit a noise permit application to the HDOH, which describes the construction activities for the project. Prior to issuing the noise permit, the HDOH may require action by the Contractor to incorporate noise mitigation into the construction plan. The HDOH may also require the Contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The Contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, the HDOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities [Reference 1] are:

"No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."

“No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 a.m. and after 6:00 p.m. on Saturday."

“No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

The use of hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, and chain saws are restricted to 9:00 a.m. to 5:30 p.m., Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers [Reference 1].

The construction of the proposed turbines may include blasting and on-site rock crushers. Although these types of construction activities are not individually delineated in the noise permit documentation, they would fall under the restricted construction hours of 9:00 a.m. to 5:30 p.m., Monday through Friday.

The HDOH noise permit does not limit the sound level generated at the construction site, but rather the times at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the DOH permit are followed.

8.2 Wind Turbine Noise at Project Boundaries

The predicted wind turbine sound levels will not comply with the HDOH maximum permissible nighttime noise limit at the project site boundaries adjacent to preservation land. Because there are no inhabitants in these areas, it is unlikely that there would be noise complaints near the boundaries of the project site. However, to comply with the Community Noise Rule, any requirements for a noise variance should be confirmed with the Department of Health.

8.3 Wind Turbine Noise in the Community

The predicted wind turbine sound levels complies with the HDOH maximum permissible noise limits in the communities surrounding the proposed Kawailoa Wind Farm project site. Therefore, a noise impact due to wind turbine noise is not expected and mitigation should not be required.

REFERENCES

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APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as “unwanted” sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 µPa, which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If P = 20 µPa, then SPL = 0 dB
If P = 200 µPa, then SPL = 20 dB
If P = 2000 µPa, then SPL = 40 dB

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[1] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the

[1] D.W. Robinson and R.S. Dadson, “A Re-Determination of the Equal-Loudness Relations for Pure Tones,” *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

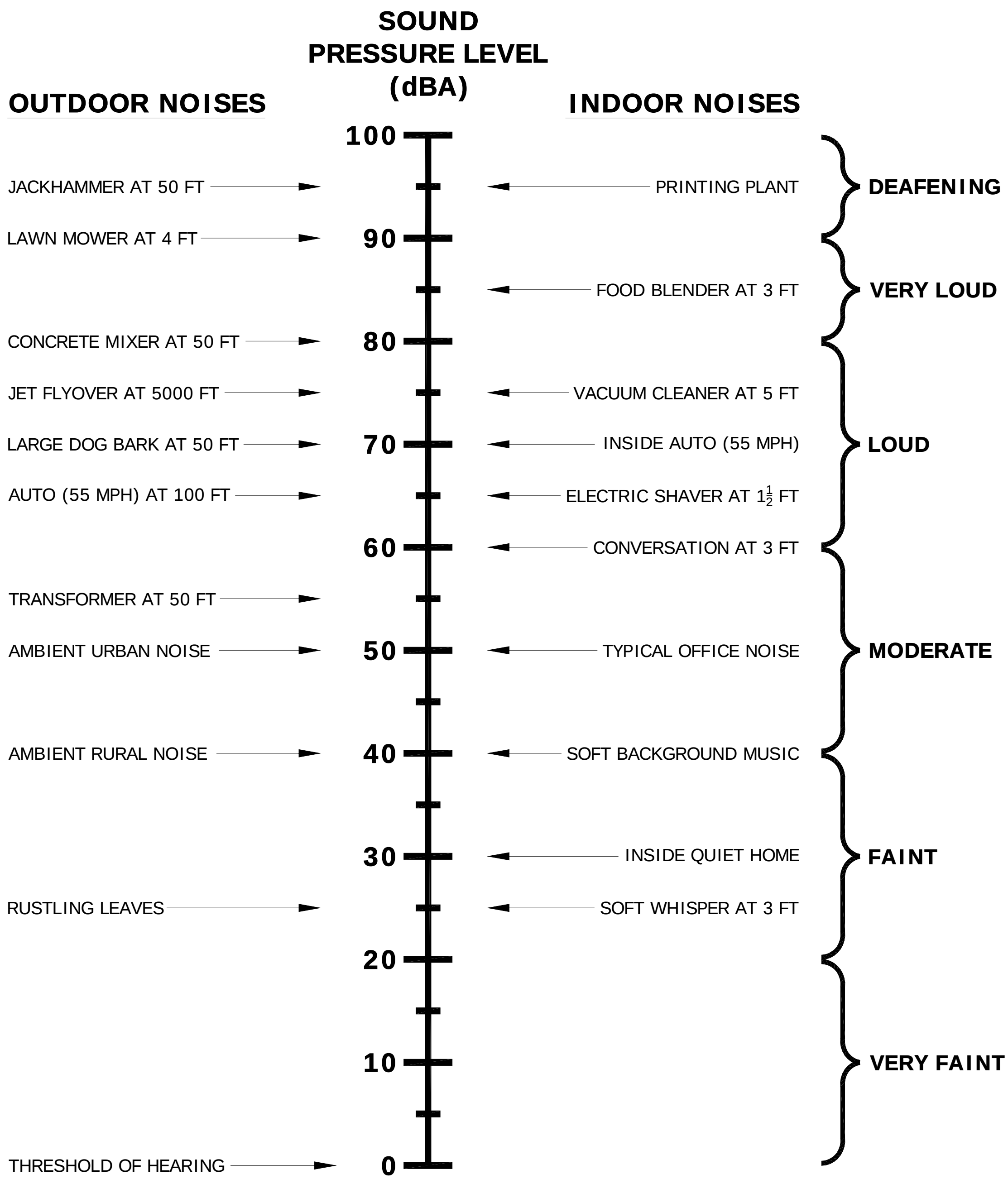


Figure A-1. Common Outdoor/Indoor Sound Levels

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

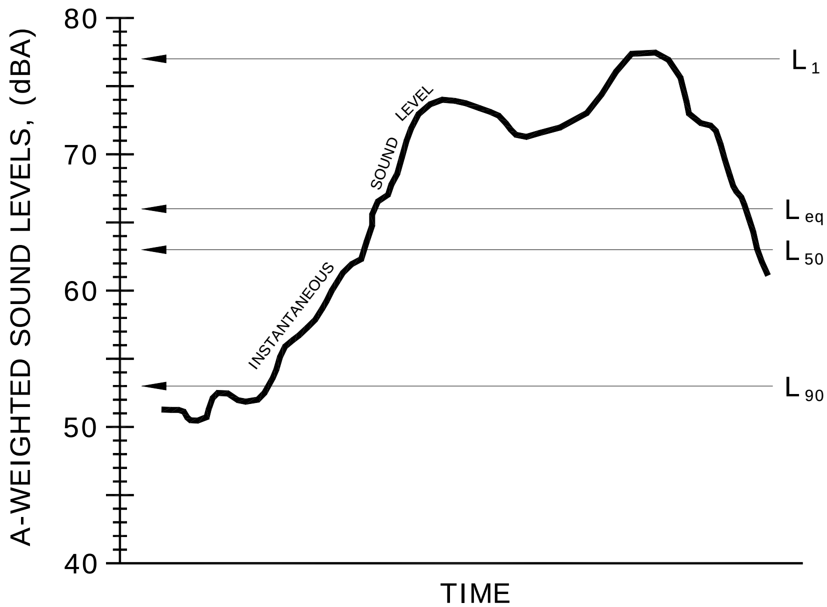


Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

Statistical Sound Level

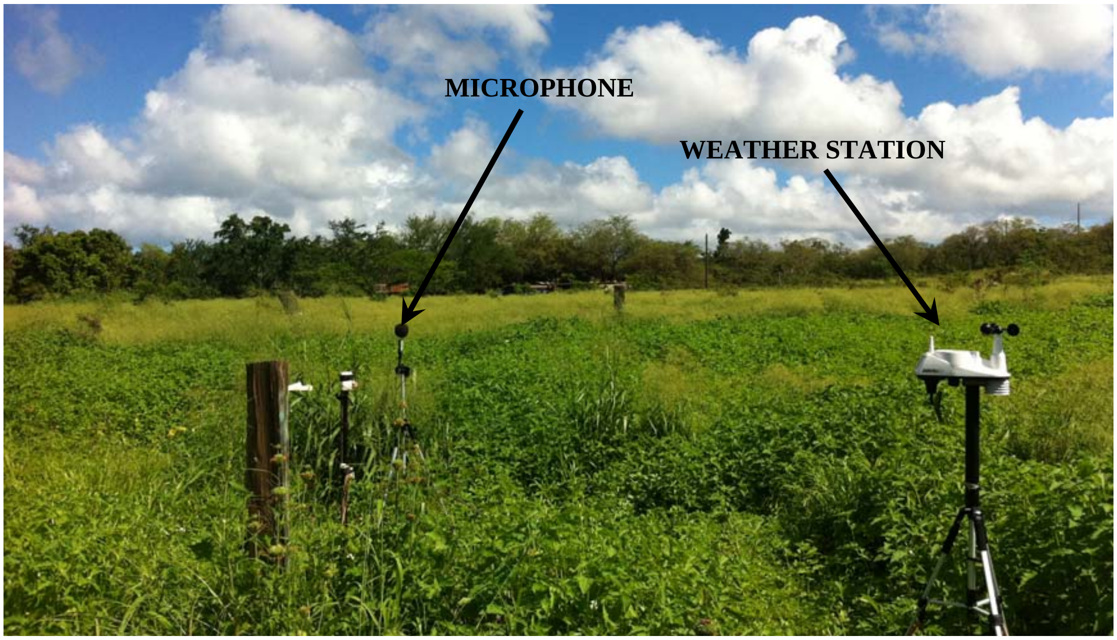
The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

Day-Night Equivalent Sound Level

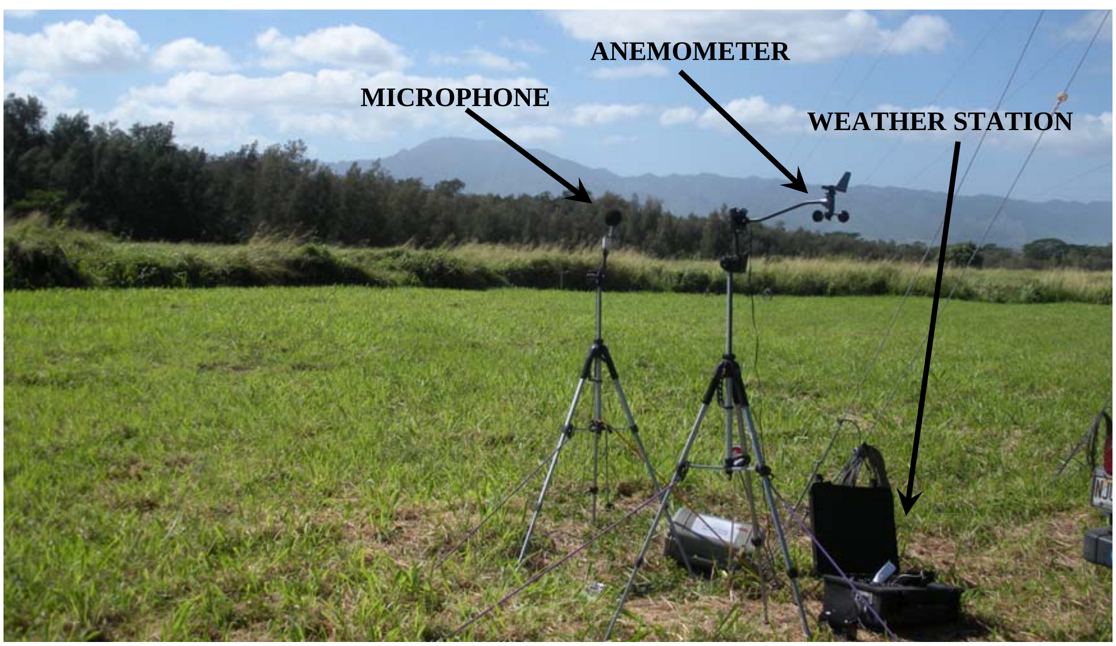
The Day-Night Equivalent Sound Level, L_{dn}, is the Equivalent Sound Level, L_{eq}, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

APPENDIX B

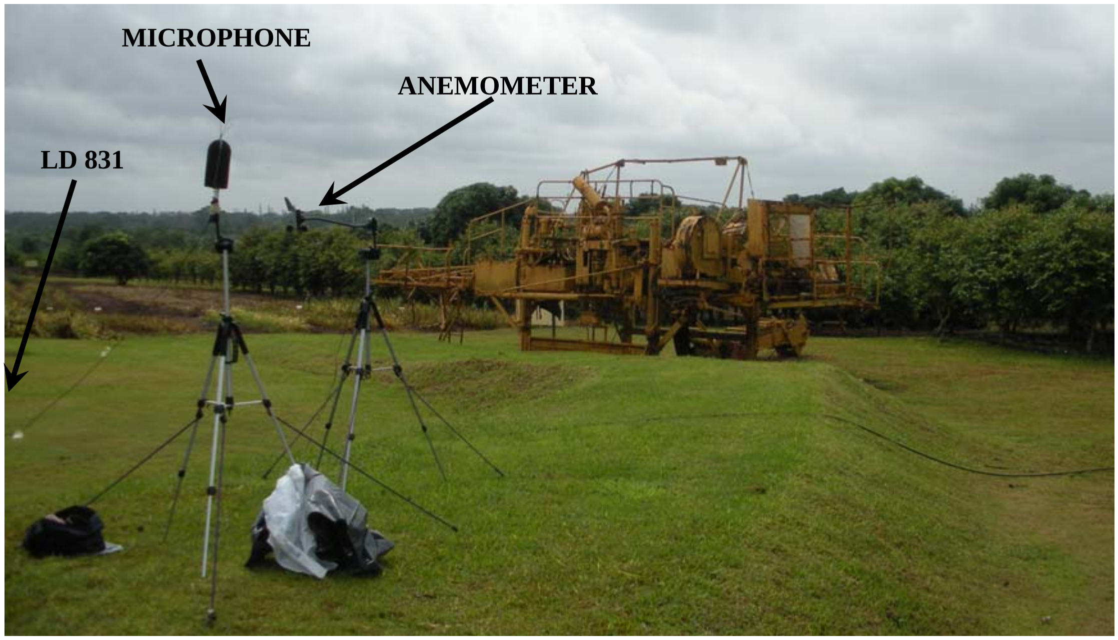
Photographs at Project Site



Equipment Setup A:
Larson Davis 820 Sound Level Meter with Davis Vantage Vue Weather Station

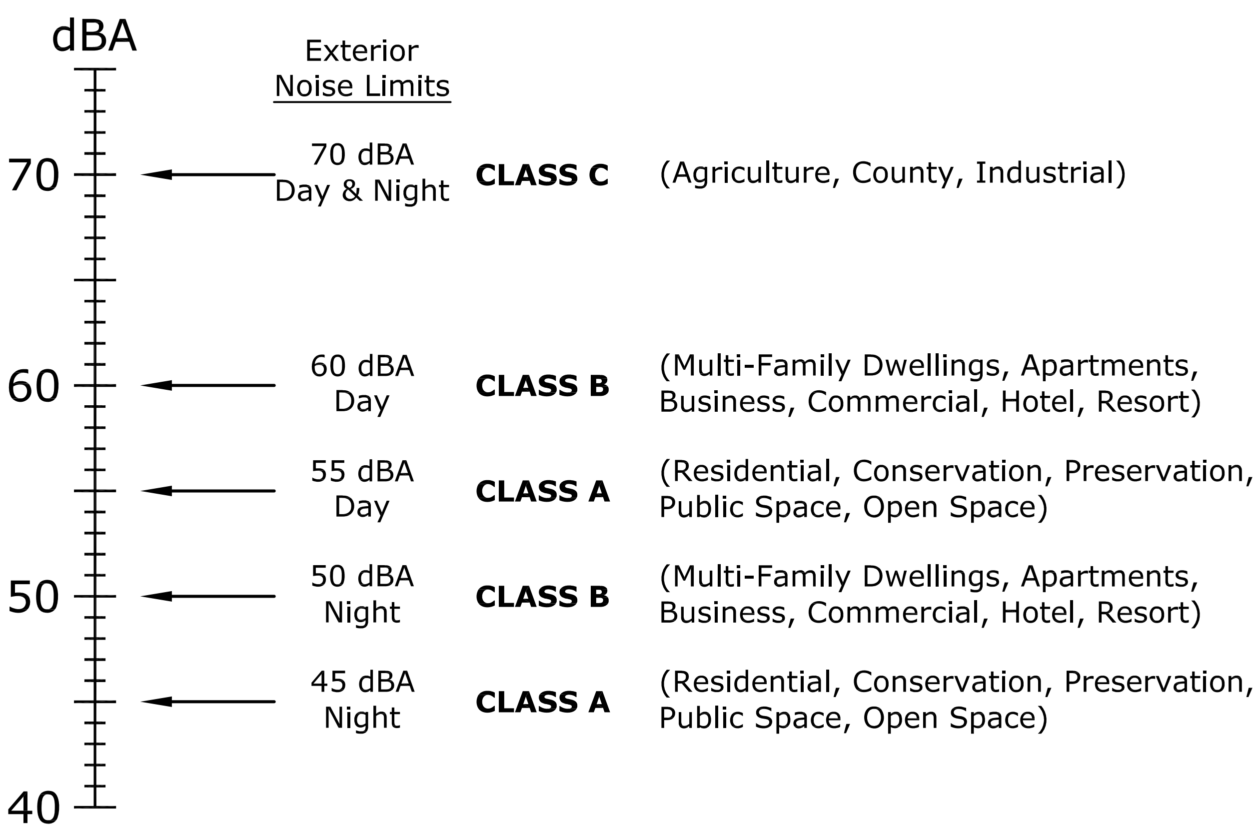


Equipment Setup B:
Larson Davis 820 Sound Level Meter with Davis WeatherLink Weather Station



Equipment Setup C:
Larson Davis 831 Sound Level Meter with Weather Module

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



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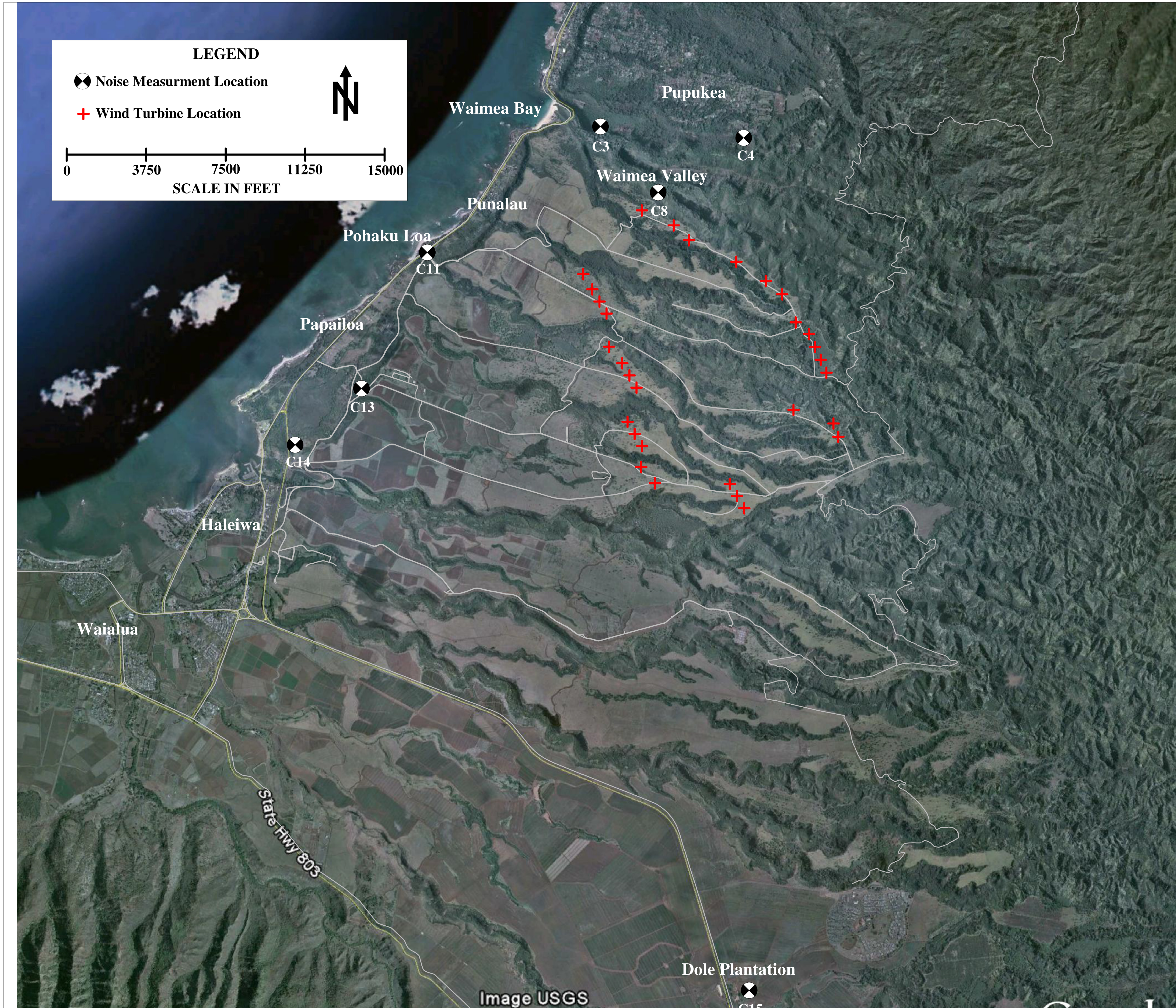
Hawaii Maximum Permissible Sound Levels for Various Zoning Districts

Kawailoa Wind Farm Project

Not to Scale

Figure No 1

Date	Project No.	Drawn By
April 2011	09-39A	TRB



Kawailoa Ridge Wind Farm

Haleiwa, Oahu, Hawaii

February 2011

Figure 2

Community
Long Term Measurement Locations

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Kawailoa Wind Farm Project

Haleiwa, Oahu, Hawaii

April 2011

Figure 3

Project Site
Long Term Measurement Locations

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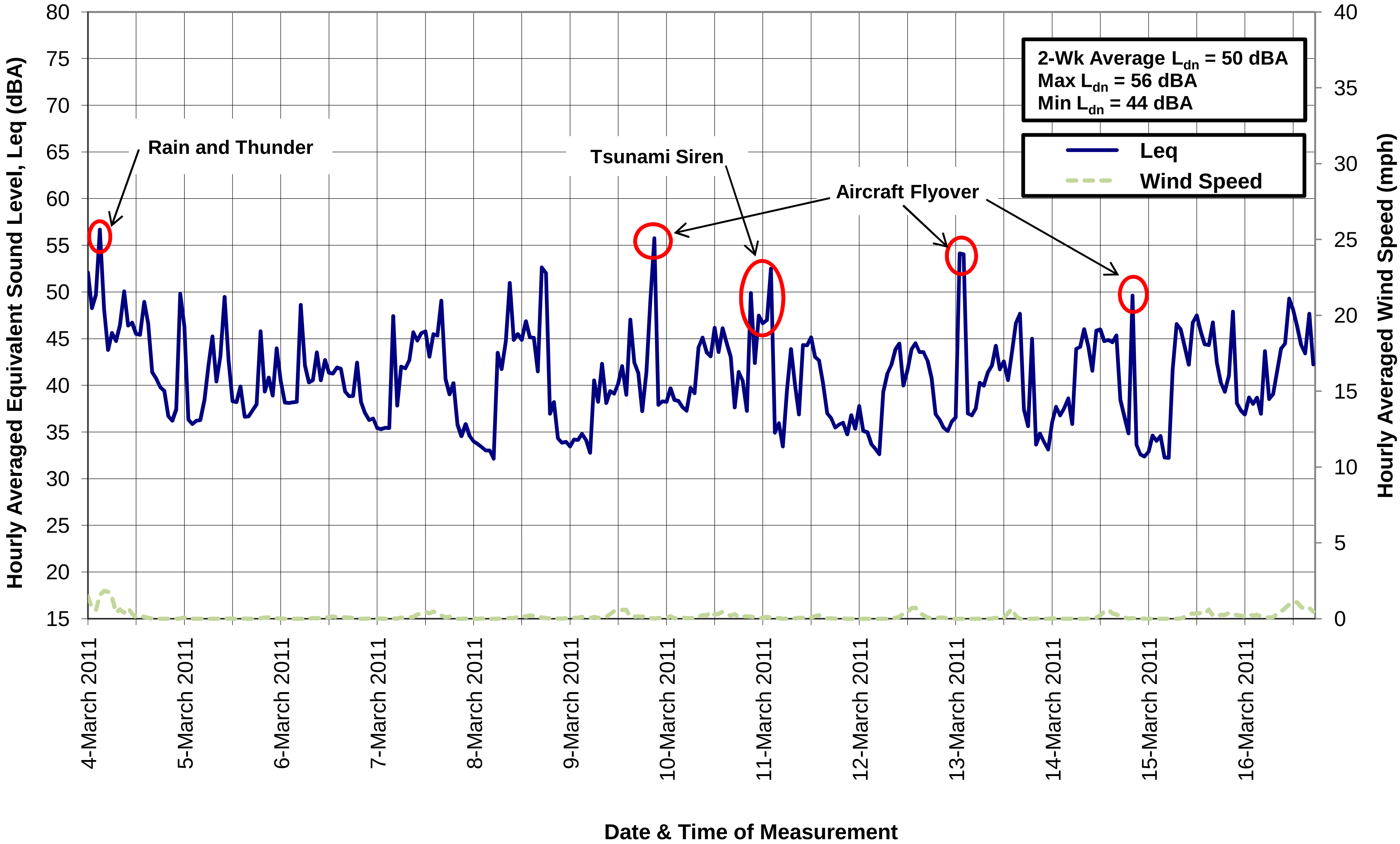

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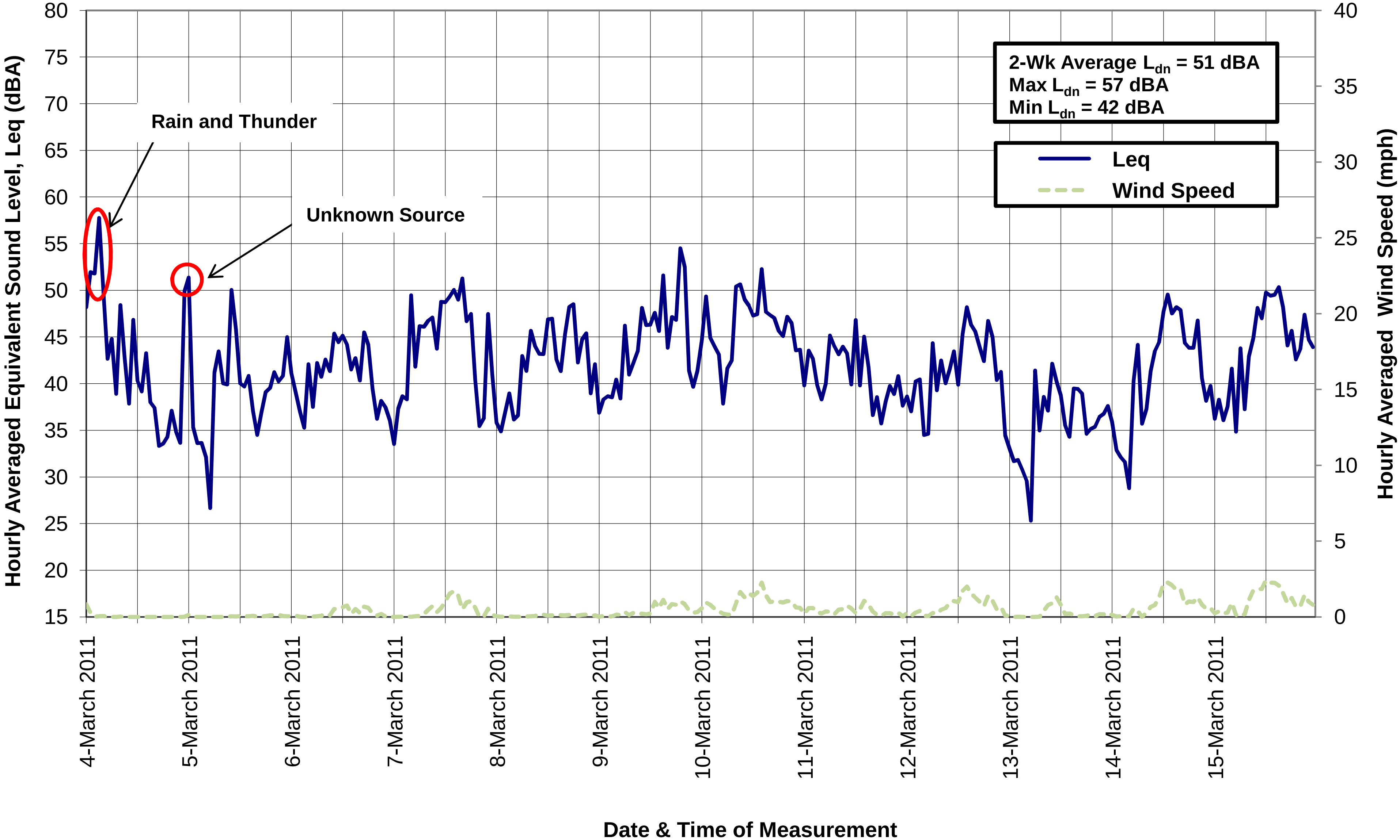
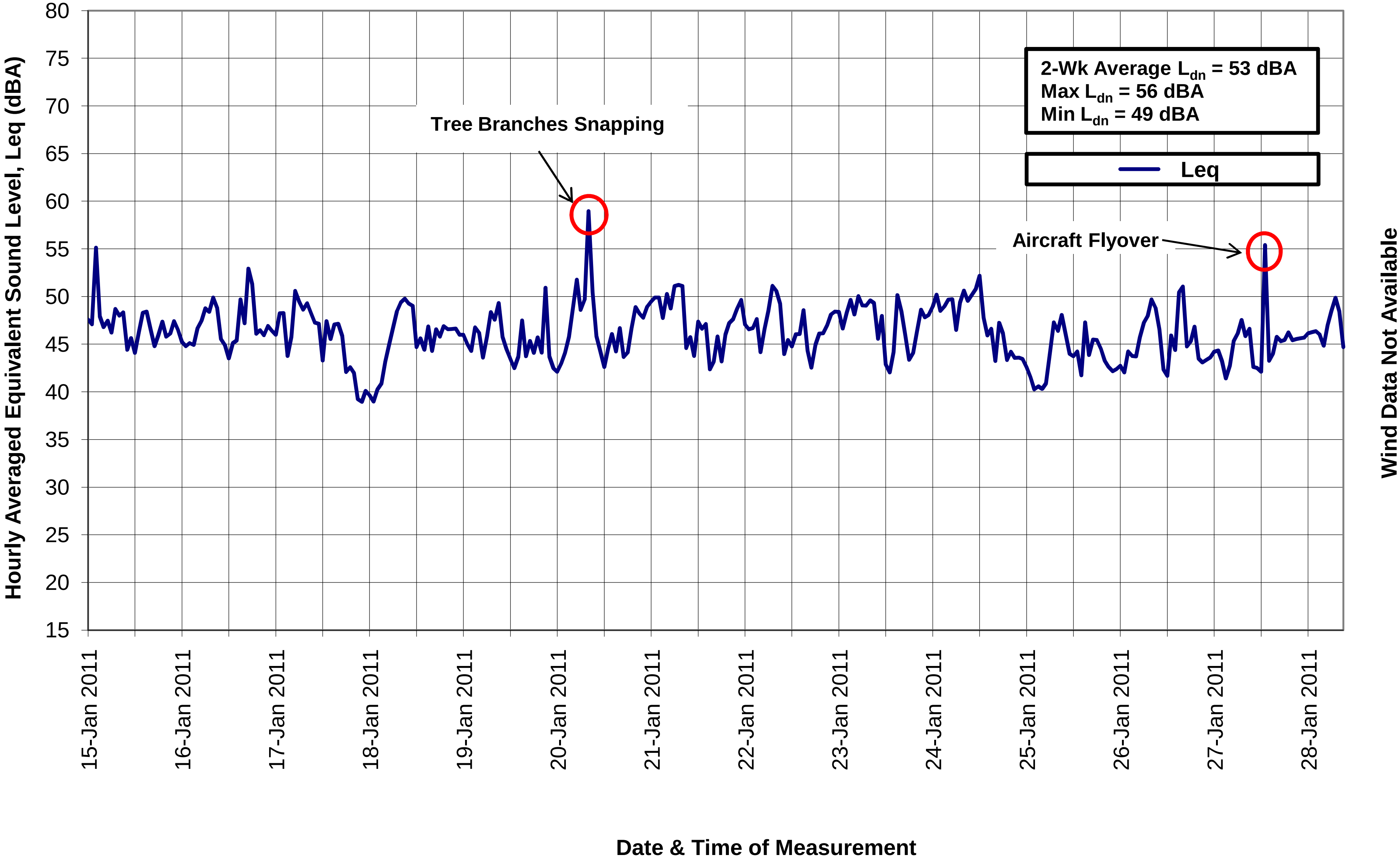
Community Noise Measurement Results - Pu'u O Mahuka Heiau (C3)

Date	Project No.	Drawn By	Figure No
March 2011	09-39A	APD	4



D. L. ADAMS ASSOCIATES, LTD. 970 N. KALAHEO AVE, A-311 KAILUA, HAWAII 96734 808/254-3318 FAX 808/254-5295	**Community Noise Measurement Results - Pupukea (C4)**			Figure No 5
	March 2011	09-39A	APD	
	Date	Project No.	Drawn By	



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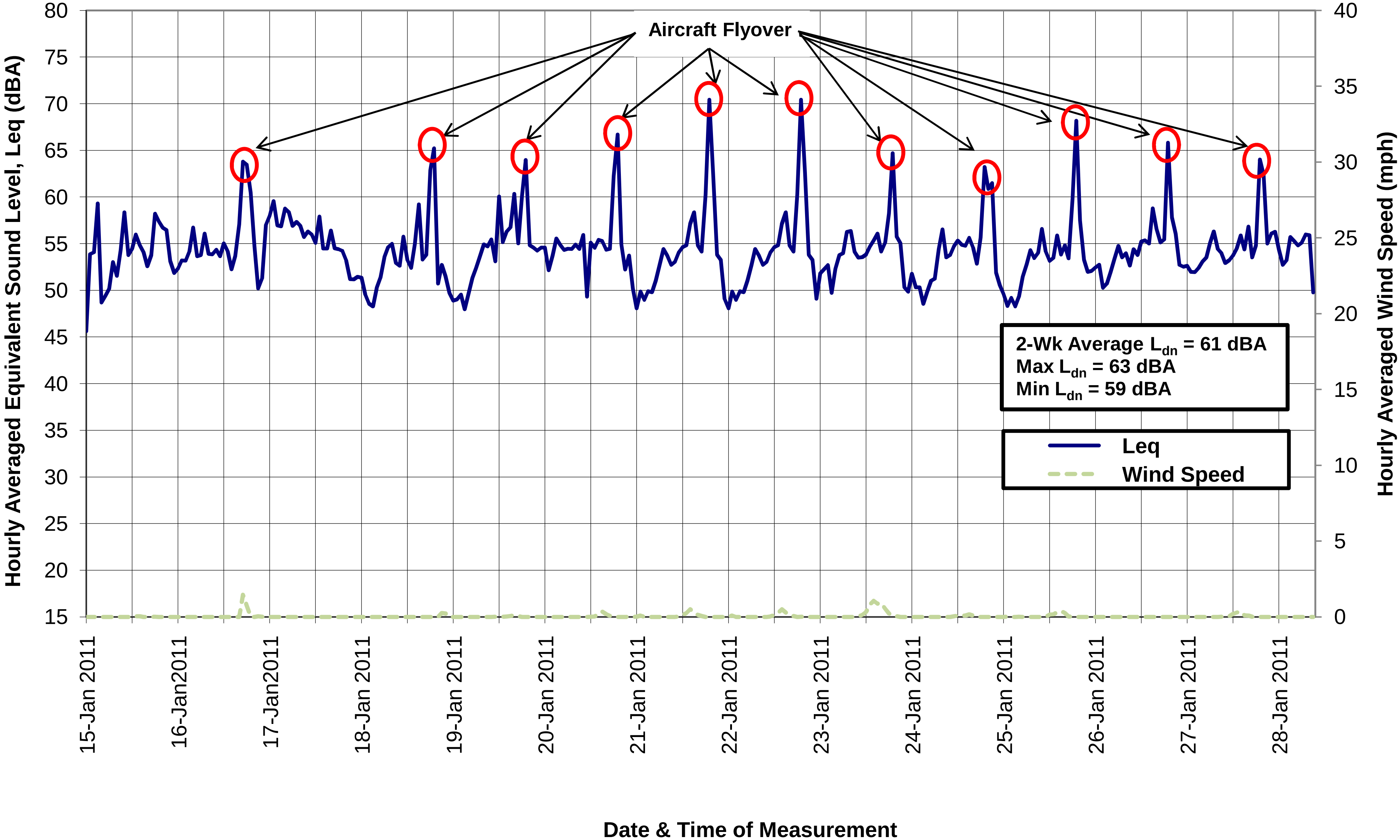
Community Noise Measurement Results - Waimea Valley (C8)

March 2011	09-39A	APD	Figure No 6
Date	Project No.	Drawn By	



Community Noise Measurement Results - Punalau/Pohaku Loa Area (C11)

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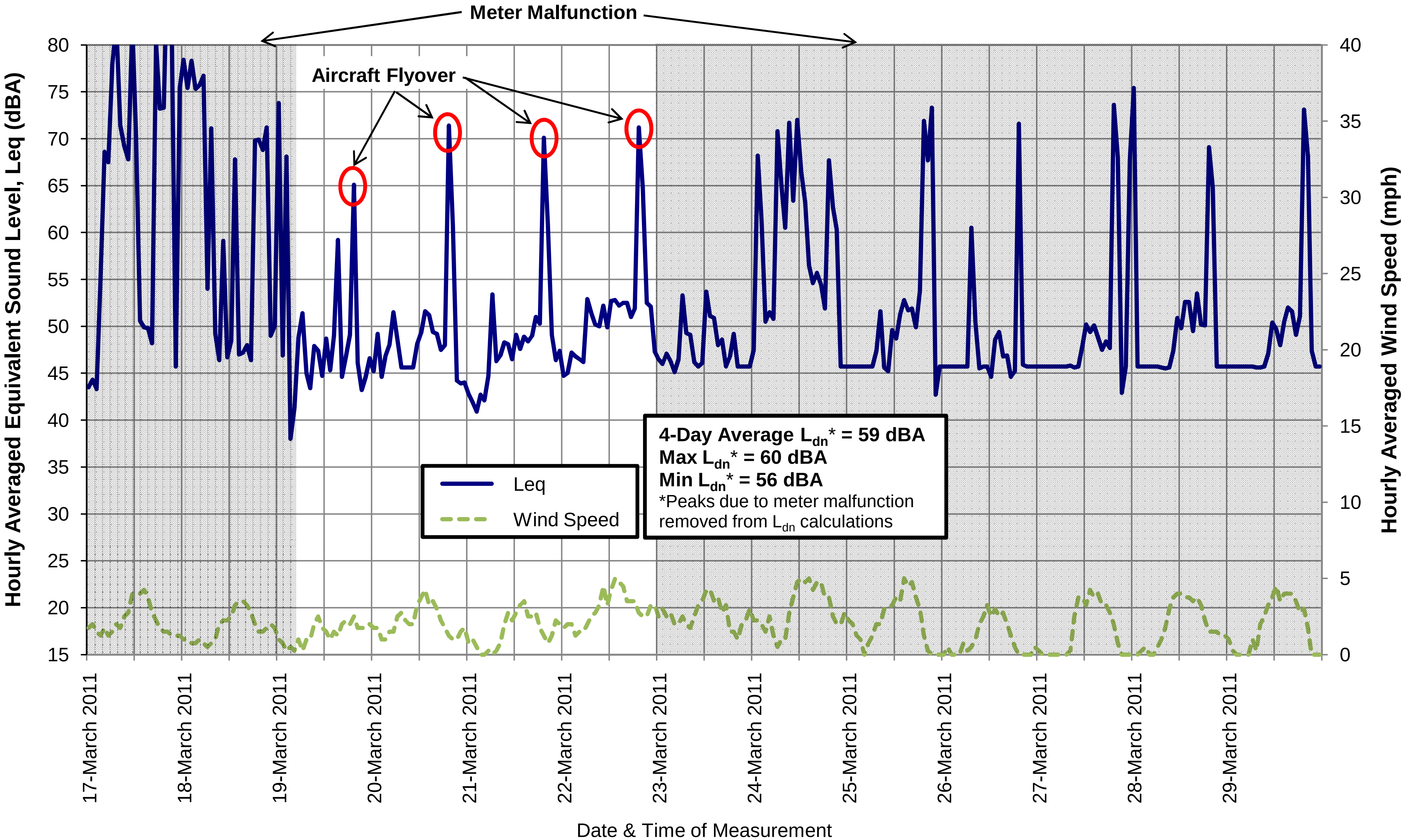
Date	Project No.	Drawn By	Figure No
March 2011	09-39A	APD	7



Community Noise Measurement Results - Papailoa/Kawailoa Area (C13)

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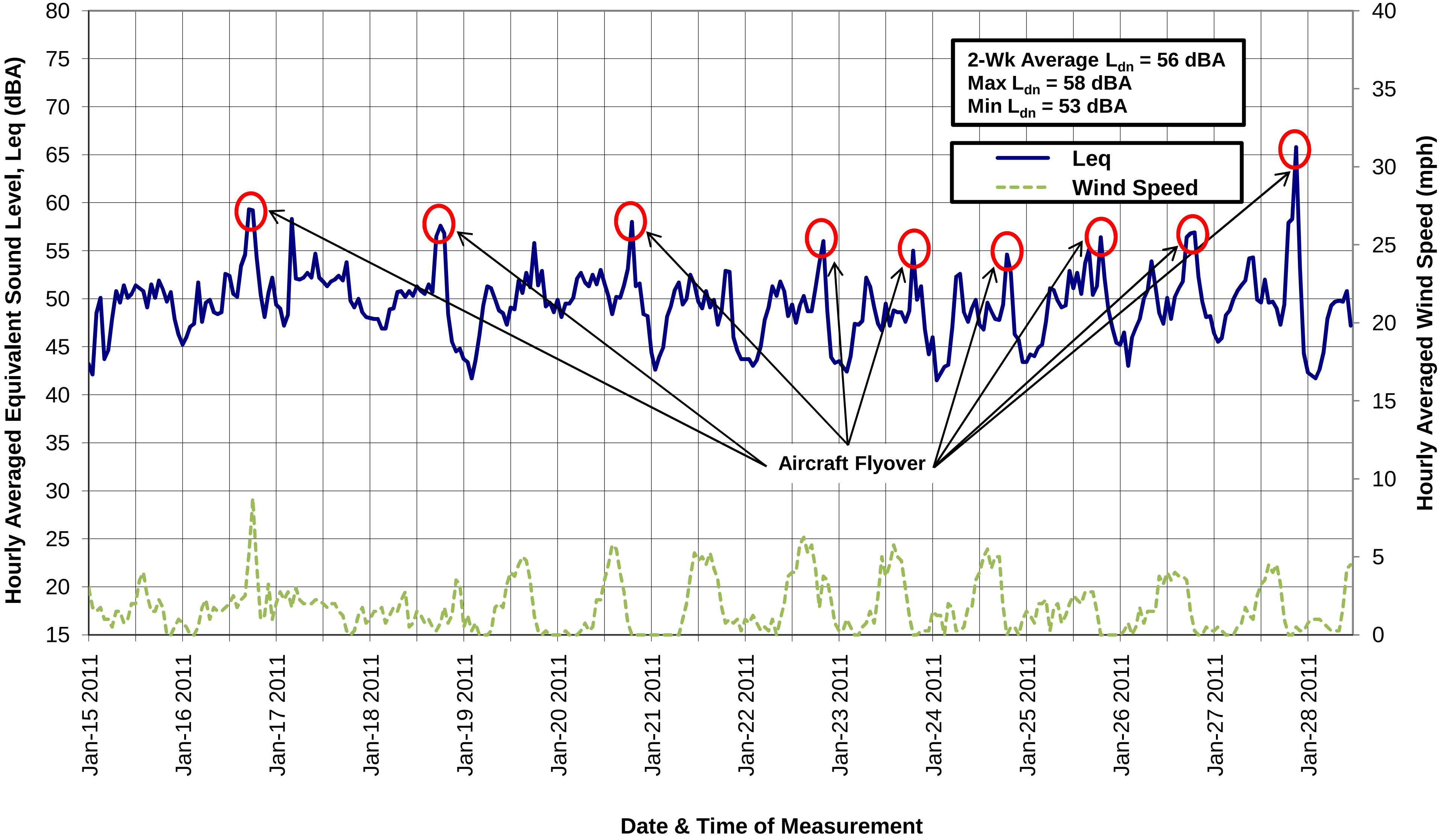
March 2011	09-39A	APD	Figure No 8
Date	Project No.	Drawn By	



Community Noise Measurement Results - Haleiwa (C14)

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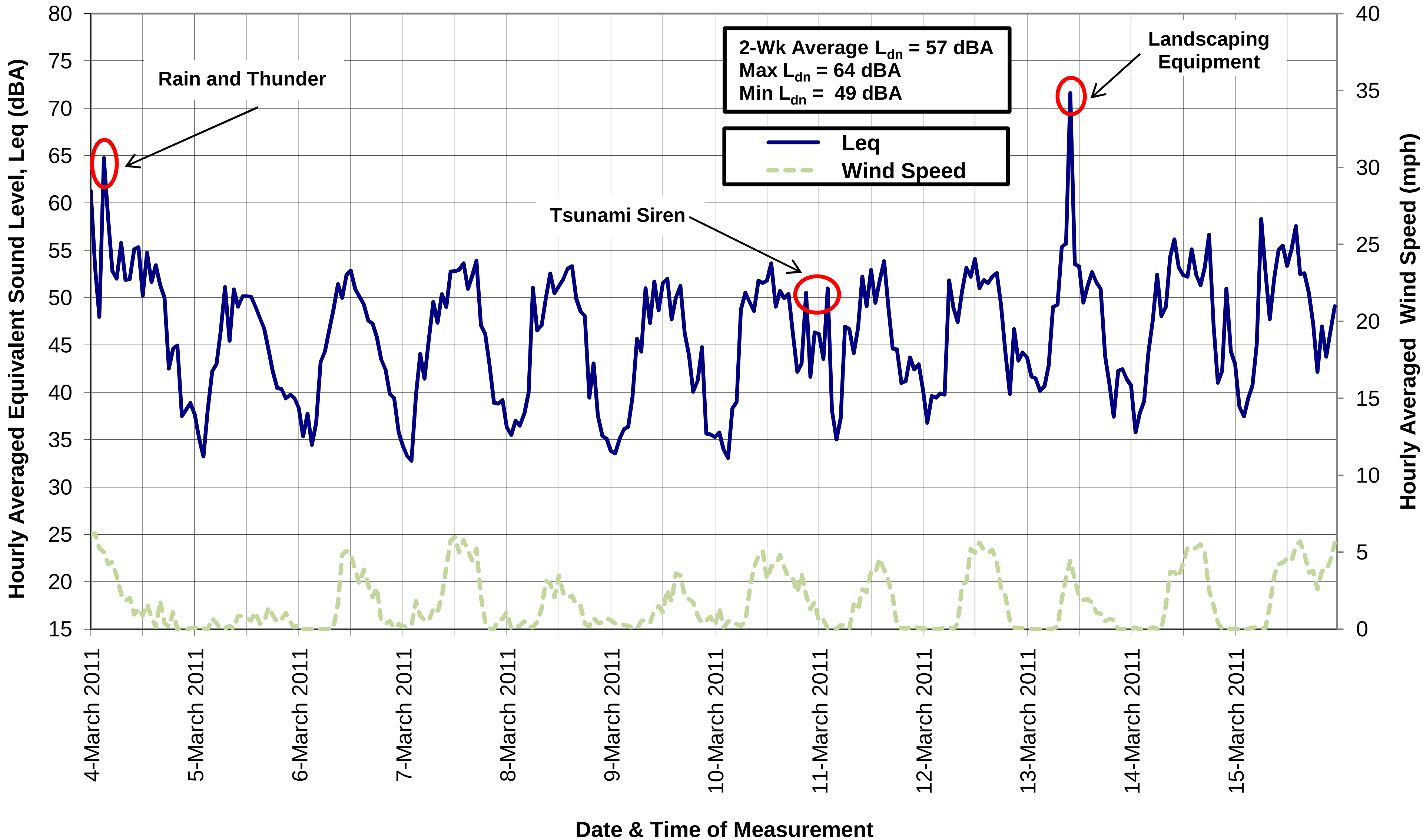
March 2011	09-39A	APD
Date	Project No.	Drawn By

Figure No

9



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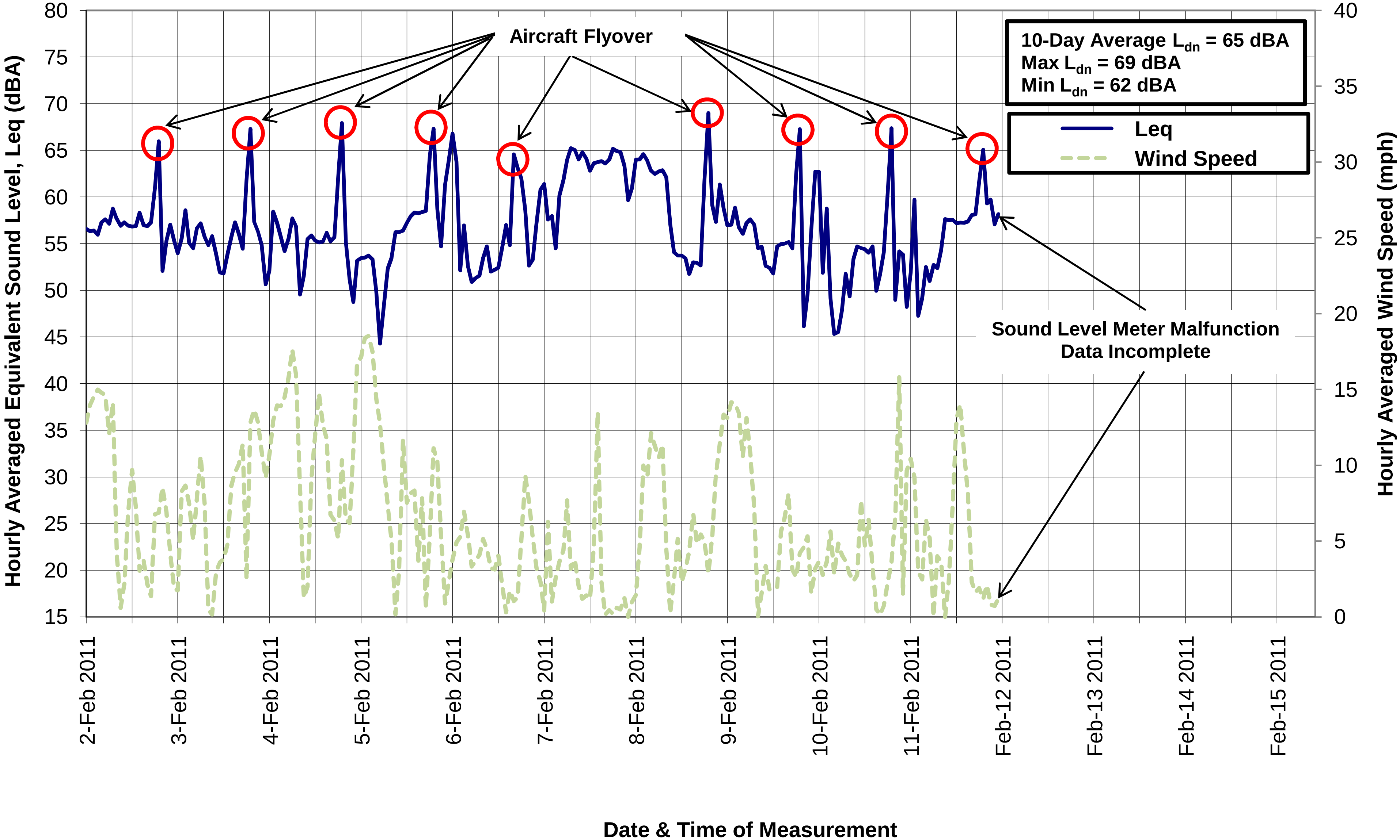
Community Noise Measurement Results - Dole Plantation (C15)

Date	Project No.	Drawn By	Figure No
March 2011	09-39A	APD	10



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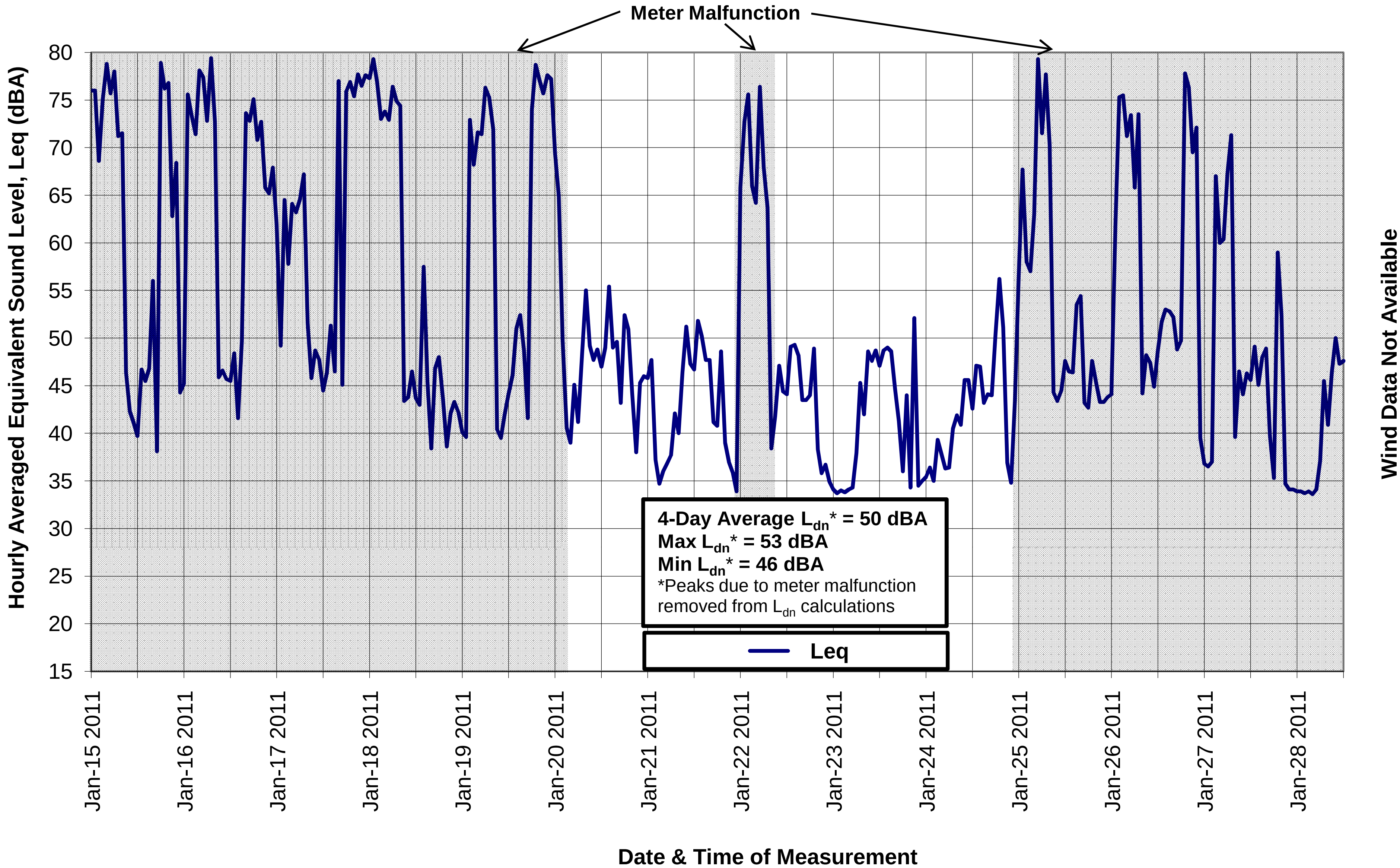
Project Site Noise Measurement Results - L1

March 2011	09-39A	APD	Figure No 11
Date	Project No.	Drawn By	



Project Site Noise Measurement Results - L2

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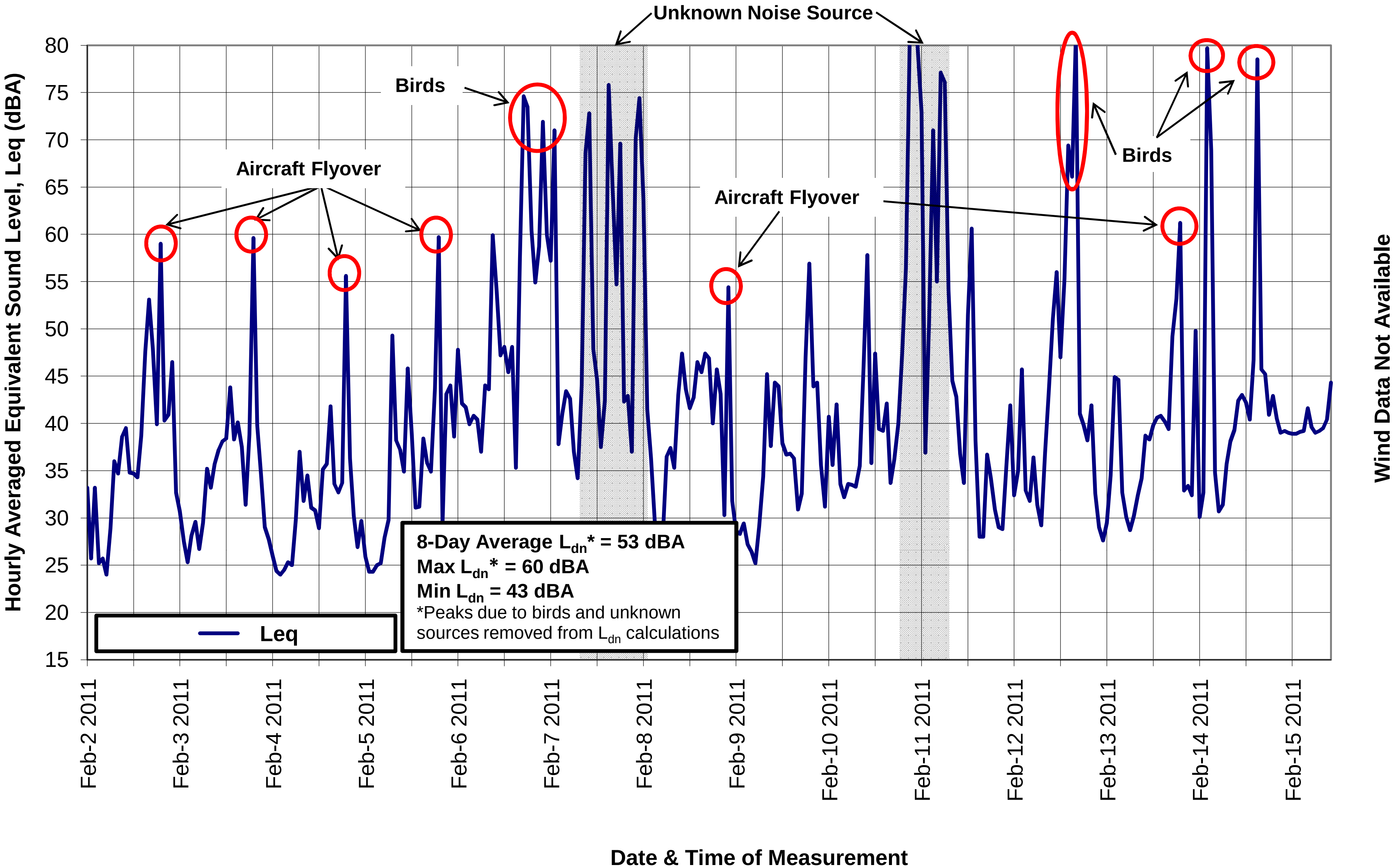
Date	Project No.	Drawn By	Figure No
March 2011	09-39A	APD	12



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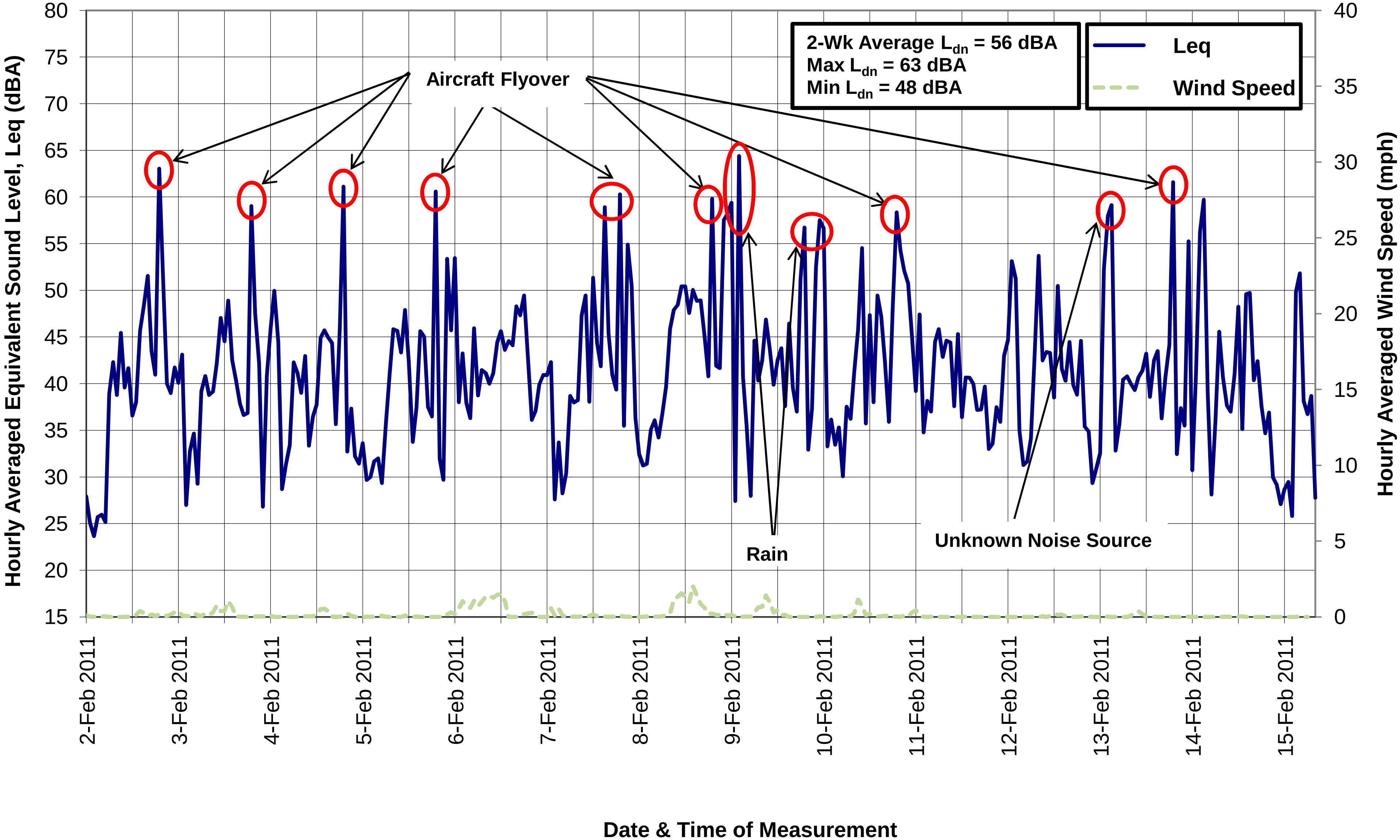
Project Site Noise Measurement Results - L3

Date	Project No.	Drawn By	Figure No
March 2011	09-39A	APD	13



Project Site Noise Measurement Results - L4

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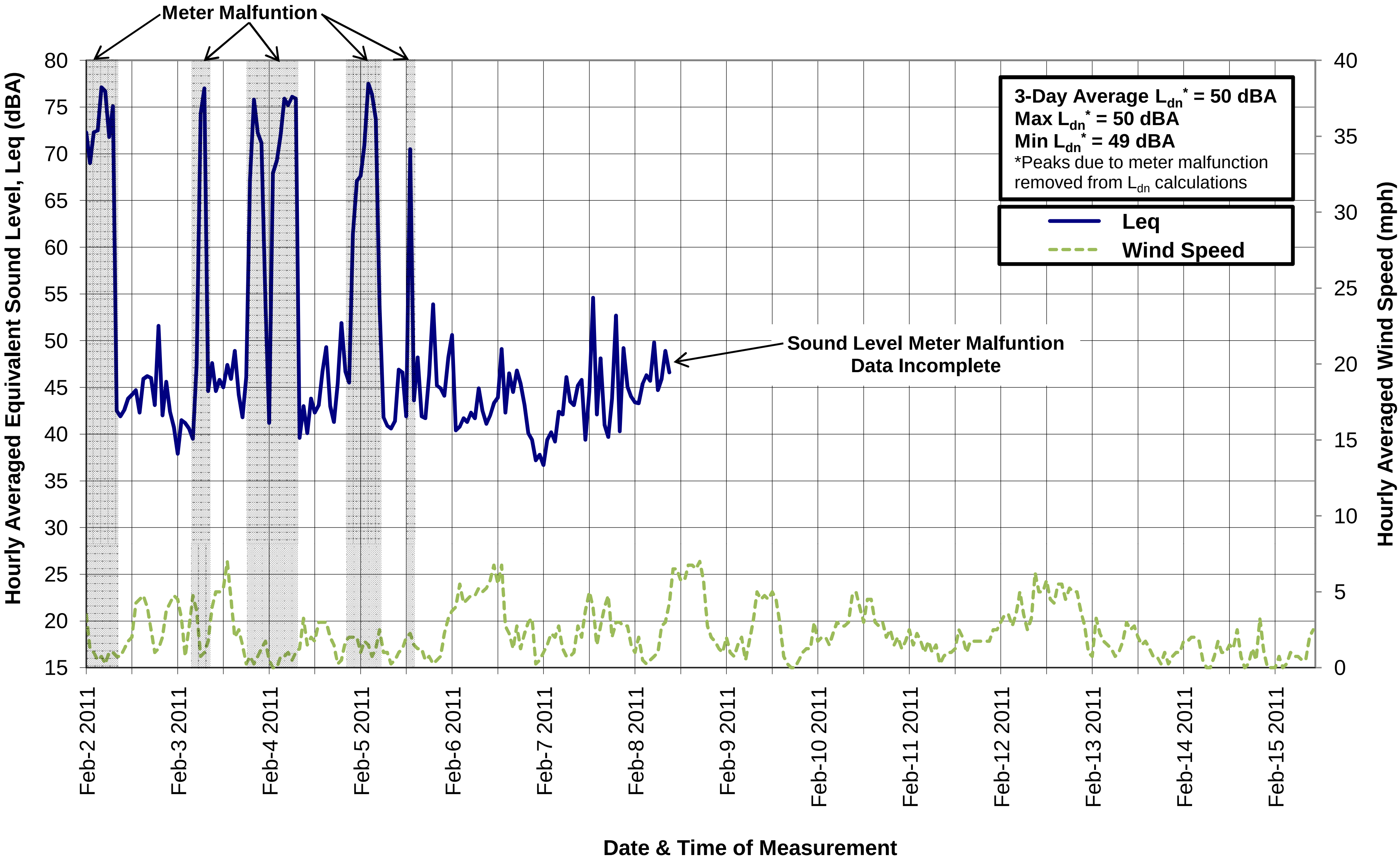
Date	Project No.	Drawn By	Figure No
March 2011	09-39A	APD	14



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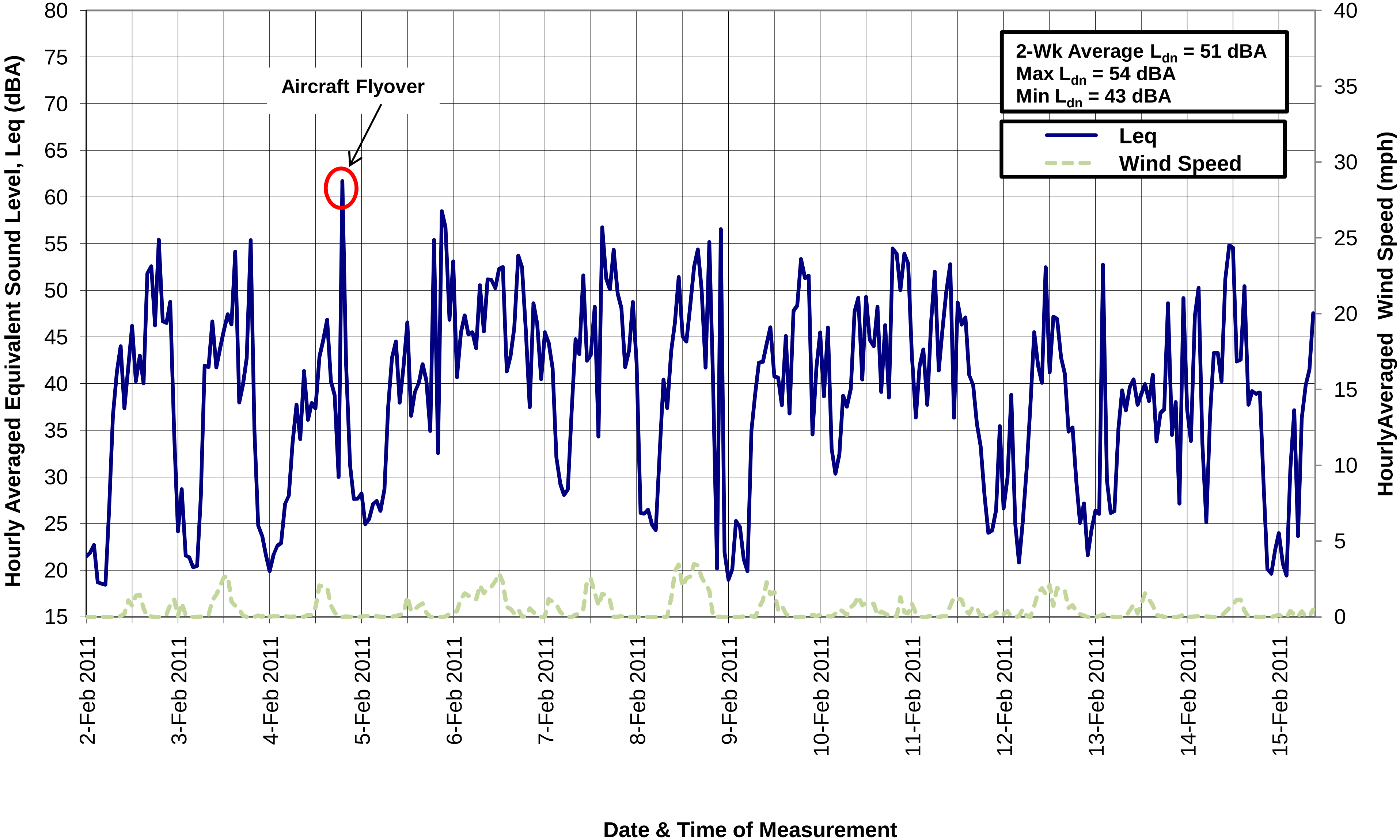
Project Site Noise Measurement Results - L5

March 2011	09-39A	APD	Figure No 15
Date	Project No.	Drawn By	



Project Site Noise Measurement Results - L6

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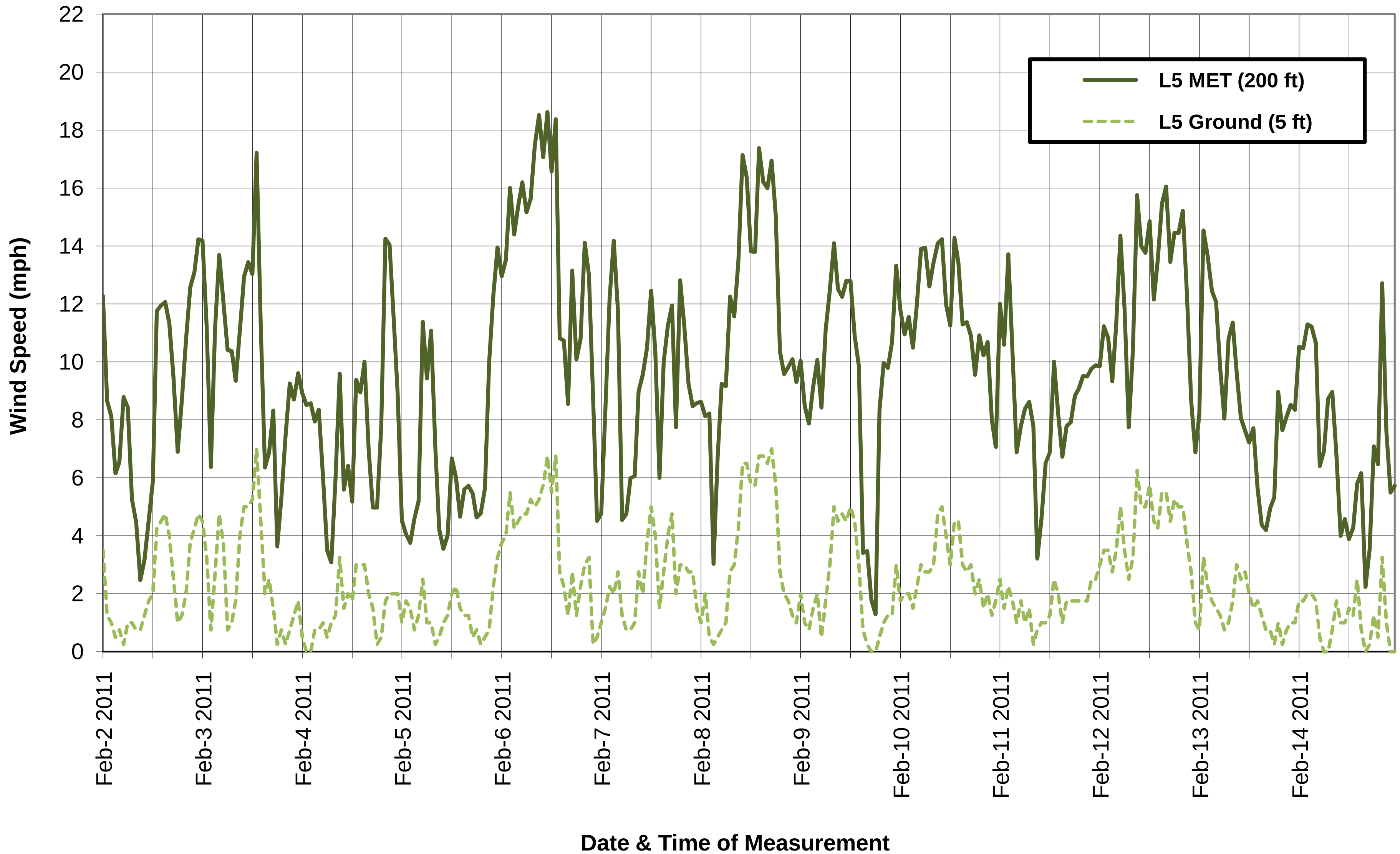
March 2011	09-39A	APD	Figure No 16
Date	Project No.	Drawn By	



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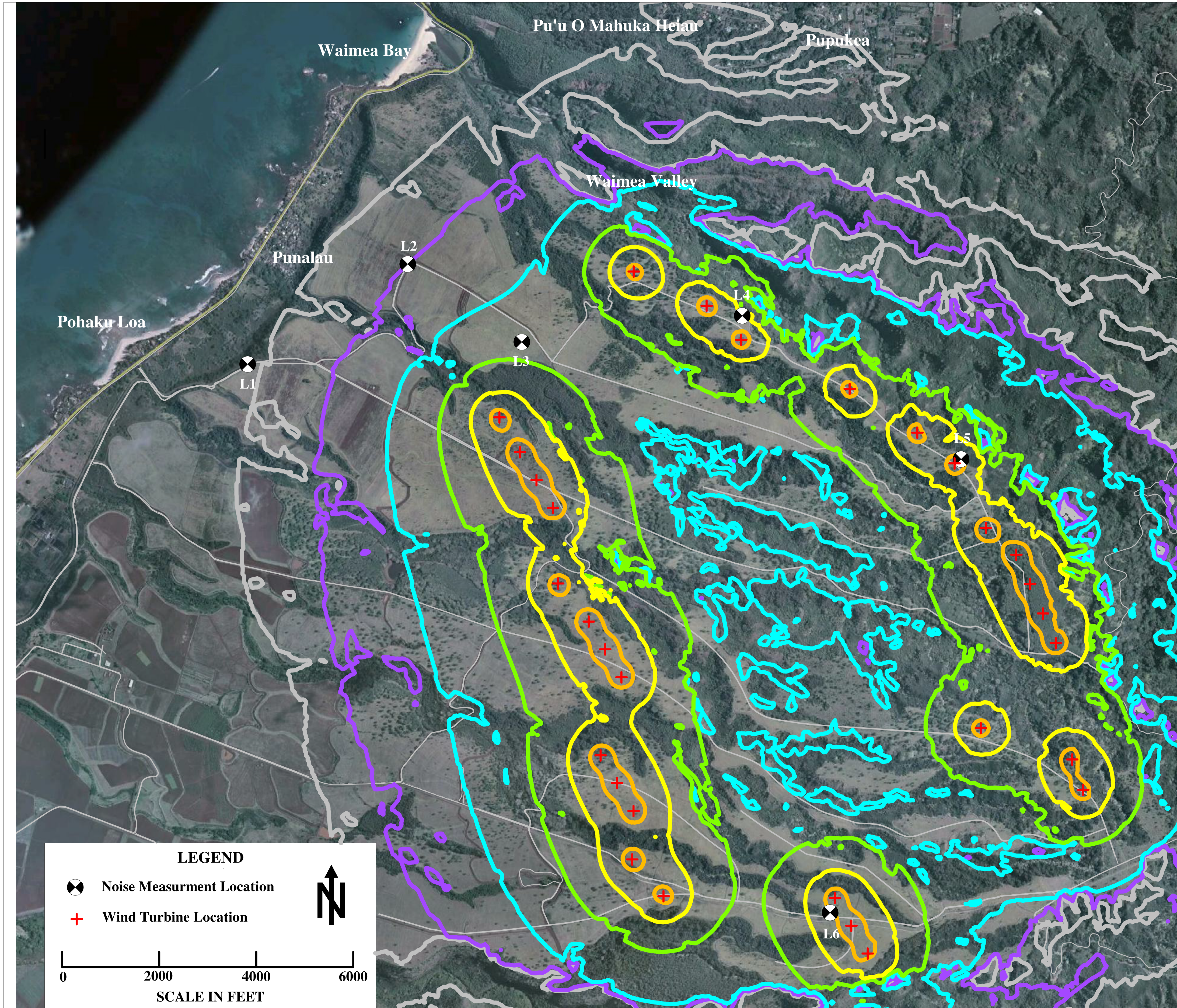
Project Site Wind Speed Results - L5

Date	Project No.	Drawn By	Figure No
March 2011	09-39A	DFD	17



Kawailoa Wind Farm Project

Haleiwa, Oahu, Hawaii

April 2011

Figure 18

Projected Sound Level Contours due to Wind Turbine Noise in Project Vicinity

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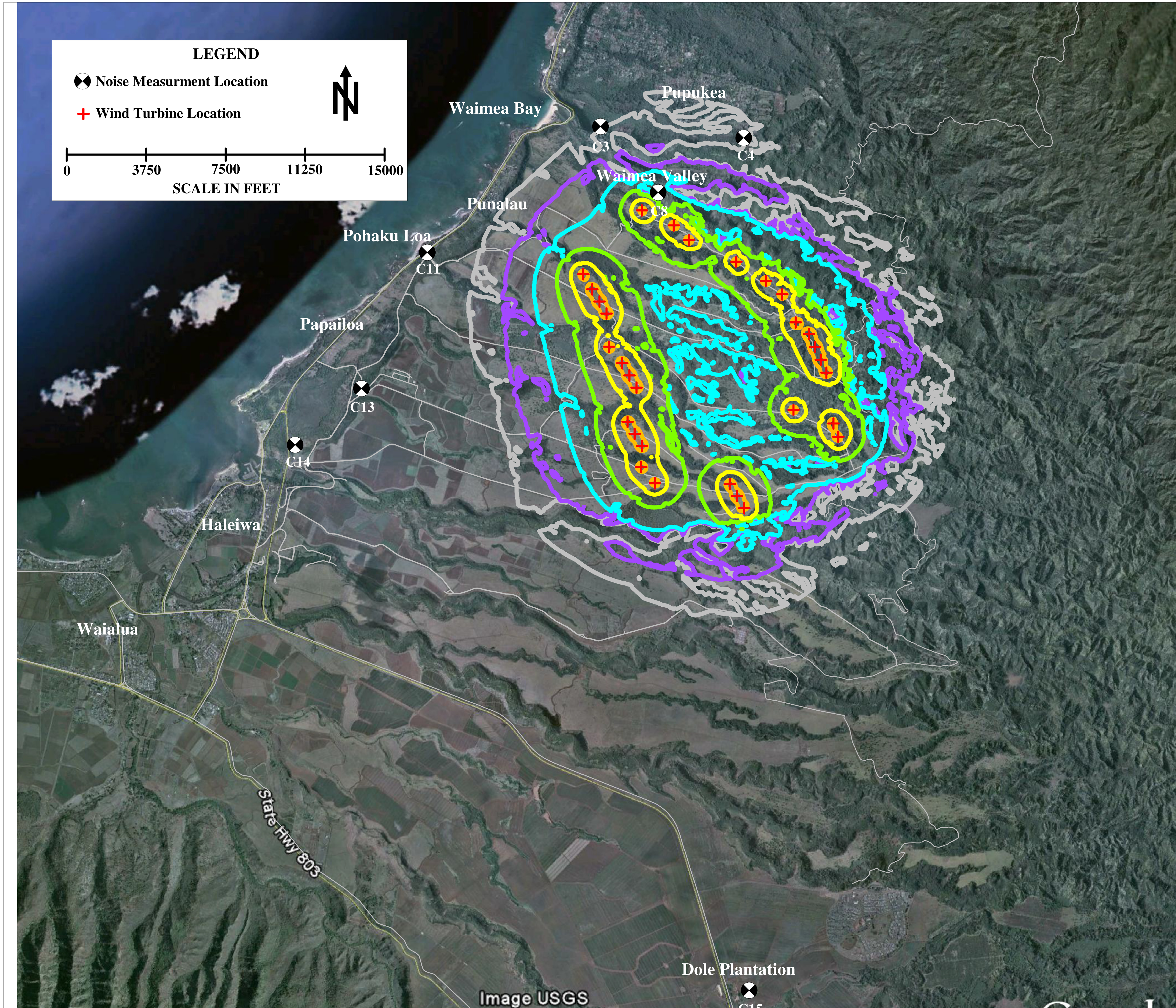
= 60 dBA



Kawailoa Wind Farm Project

Haleiwa, Oahu, Hawaii

April 2011

Figure 19

Projected Sound Level Contours due to Wind Turbine Noise in North Shore Region

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